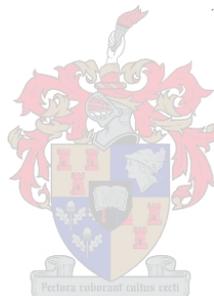


Determinants of the South African residential real estate growth cycle

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**Thesis presented in fulfilment of the requirements for the degree of
Master of Business Management at Stellenbosch University**



Prof Jonathan Bloom

December 2007

Determinants of the South African residential real estate growth

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature:

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ABSTRACT

As from the beginning of 2000 house prices have seen four consecutive years of sustained price increases for the first time since 1984. These price increases enhanced activity in and redirected investment focus to the residential property market. It appears that the boom in house prices was preceded and supported by a number of economic variables, such as growth in disposable income, greater affordability, low inflation and low interest rates.

Based on the above, the primary objective of this study is to identify through regression analysis the leading indicators of the house price growth cycle. The results indicate that one-quarter lagged growth in house prices, one-quarter lagged interest rate growth, one-quarter lagged growth in the rand/dollar exchange rate and growth in the one-quarter lagged construction cost could be used to predict the growth in house prices.

The analysis is extended to include a regression analysis of the upswing and downswing phases of the house price growth cycle, which is intended to identify potential leading indicators of an upswing and downswing in the property cycle.

The results for the upswing phase indicate that one-quarter lagged growth in house prices, one-quarter lagged interest rates, one-quarter lagged growth in household consumption, one-quarter lagged growth in JSE ALSI and one-quarter lagged growth in the rand/dollar exchange rate may be used to predict the growth during the upswing phase of house prices. The results for the downswing phase indicate that one-quarter lagged growth in house prices, one-quarter lagged growth in interest rates, one-quarter lagged growth in household saving and one-quarter lagged growth in construction cost could be used to predict the growth of house prices during the downswing phase.

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No indicator series could consistently predict the direction of growth in house prices. To test which economic variables appear most frequently as indicators of growth in house prices a second regression analysis is performed for the cycle and the upswing and the downswing phases using a longer predictive period. The initial regression analysis is based on data from 1974 to 2000 and the second regression analysis is performed on data from 1974 to 1995 and tested on data from 1996 to 2004.

A comparison between the relevant regression analyses performed on the complete house price growth cycle found that only one-quarter lagged growth in house prices is a common variable for the prediction of growth in the complete house price cycle. The regression analysis performed on data from 1974 to 1995 for the upswing phase produced three models. The regressions have four variables in common; one-quarter lagged growth in house prices, one-quarter lagged growth in building plans passed, one-quarter lagged household savings and one-quarter lagged consumption.

The regression is repeated on the downswing phase and a comparison of the results of the regression analysis from 1974 to 2000 and the regression analysis from 1974 to 1995 showed that one-quarter lagged growth in house prices, one-quarter lagged growth in interest rates and one-quarter lagged growth in construction costs consistently predicted changes in the growth of house prices during the downswing phase. Only one-quarter lagged growth in house prices are consistently identified as a growth indicator for the complete cycle, upswing phase and downswing phase.

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OPSOMMING

Sedert 2000 het huispryse die eerste keer ná 1984 vier jaar se volgehoue prystoenames ervaar. Hierdie prystoenames het aktiwiteite in die residensiële eiendomsmark laat toeneem en beleggingsaandag op hierdie mark gerig. Dit kom voor dat die sterk oplewing in huispryse voorafgegaan en ondersteun is deur 'n aantal ekonomiese veranderlikes soos toename in bestebare inkome, toenemende bekostigbaarheid, lae inflasie en lae rentekoerse.

Gebaseer op die voorgaande, is die primêre doelwit van hierdie studie om by wyse van regressie-analise die leidende aanwysers in die huisprystoenamesiklus te identifiseer. Die resultate dui aan dat een kwartaal vertraagde toename in huispryse, een kwartaal vertraagde toename in rentekoerse, een kwartaal vertraagde toename in die rand/dollar wisselkoers en 'n toename in een kwartaal vertraagde boukoste gebruik kan word om die verhoging in huispryse te voorspel.

Die analise is uitgebrei om 'n regressie-analise in te sluit van die opswaai- en afswaafases van die huisprystoenamesiklus, wat daarop gemik is om potensiële leidende aanwysers van 'n op- en afswaai in die eiendomsiklus te identifiseer..

Die resultate vir die opswaafase toon aan dat een kwartaal vertraagde toename in huispryse, een kwartaal vertraagde toename in rentekoerse, een kwartaal vertraagde toename in huishoudingsverbruik, een kwartaal vertraagde toename in die JSE se Alle Aandele Indeks en een kwartaal vertraagde toename in die rand/dollar wisselkoers kan gebruik word om die toename in die opswaafase van huispryse te voorspel. Die resultate vir die afswaafase dui aan dat een kwartaal vertraagde toename in huispryse, een kwartaal vertraagde

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toename in rentekoerse, een kwartaal vertraagde toename in huishoudingsbesparings en een kwartaal vertraagde toename in boukoste aangewend kan word om die toename in huispryse tydens die afswaifase te voorspel.

Geen aanwyserreekse kon konsekwent die rigting van die toe- of afname in huispryse voorspel nie. Om te toets watter ekonomiese veranderlikes die meeste voorkom as aanywers van 'n groei in huispryse, is 'n tweede regressie-analise uitgevoer tov die siklus in die op- en afswaifases tydens 'n langer voorspellingstydperk. Die aanvanklike regressie-analise is gebaseer op gegewens tussen 1974 en 2000 en die tweede regressie-analise is uitgevoer op gegewens van 1974 tot 1995 en getoets op gegewens tussen 1996 en 2004.

'n Vergelyking tussen die betrokke regressie-analises uitgevoer op die volledige huisprystoenamesiklus het bevind dat slegs een kwartaal vertraagde toename in huispryse 'n gemeenskaplike veranderlike is in die voorspelling van 'n toename in die volledige huispryssiklus. Die regressie-analise uitgevoer op gegewens van 1974 tot 1995 vir die opswaifase het drie modelle opgelewer. Die regressies het vier veranderlikes in gemeen met mekaar: een kwartaal vertraagde toename in huispryse, een kwartaal vertraagde toename in bouplanne goedgekeur, een kwartaal vertraagde toename in huishoudingsbesparings en een kwartaal vertraagde toename in verbruik.

Die regressie is herhaal op die afswaifase en 'n vergelyking tussen die resultate van die regressie-analise van 1974 tot 2000 en die regressie-analise van 1974 tot 1995 het aangetoon dat een kwartaal vertraagde toename in huispryse, een kwartaal vertraagde toename in rentekoerse en een kwartaal vertraagde toename in boukoste konsekwent veranderinge voorspel het vir die groei van huispryse gedurende die afswaifase. Slegs een kwartaal

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vertraagde toename in huispryse is deurgaans geïdentifiseer as 'n groei-aanwyser in die volledige siklus, asook ten opsigte van op- en afswaafases.

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CHAPTER 1

INTRODUCTION: BACKGROUND, OBJECTIVES AND OVERVIEW

1.1 Background to the Study

Since the beginning of 2000 residential real estate in South Africa has, for the first time since 1984, seen four consecutive years of sustained price increases. These price increases inspired home-owners to buy new houses and investors to enter into or enlarge their stake in the market. The residential property market recorded 17 percent annual nominal growth and 11 percent annual real growth in house prices from 2000 to 2004 (Du Toit, 2004c). Average real house prices have increased from R240 000 in the fourth quarter of 1999 to R488 000 in the first quarter of 2004, which is slightly above the historical high of R472 100 reached in 1984 (Du Toit, 2004a). Internationally numerous countries, such as the United States (US), United Kingdom (UK) and Australia, also experienced strong growth phases in their residential property markets. In a 2004 survey, The Economist ranked South Africa, with an annual growth rate in house prices of 25, 5 percent, second only to Hong Kong (Economist: 2004).

South African real estate has last seen such pronounced growth in residential prices in the early 1980s when house prices increased for four consecutive years. Unfortunately, those years were followed by plummeting house prices from 1984 to 1986, referred to as a bust (Loos, 2004a). Investors in the residential property market often refer to this bust when discussing doubts about the sustainability of the current real estate boom. The crash in the market was, however, preceded by major changes in the economy, for example: mortgage rates that rose from 11 percent in the fourth quarter of 1981 to 21,5 percent in the second quarter of 1985, real growth in GDP decreased from 6,6

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percent in 1980 to a negative 1,8 percent in 1983. The political uncertainty that reigned at that time also played a role. These circumstances and changes were contributory factors to the bust, if not its cause (Loos, 2004a).

The current house price boom were preceded and supported by a number of factors or economic variables, such as personal tax relief, strong growth in disposable income, a decline in the ratio of household debt to disposable income, greater affordability of housing, the improved political situation, growth in the gross domestic product (GDP), relatively low inflation and interest rates, a strong domestic demand for housing and strong foreign demand for residential properties (Du Toit, 2004b and Loos, 2004a).

The above mentioned factors are seen as key drivers of the property market and research indicates that the drivers tend to follow a regular pattern (Trass, 2004:18). The pattern is reflected in the property market and is called a property or real estate cycle. The real estate market fluctuates according to a real estate cycle, but the cycle does not lend itself to easy prediction. It is possible to determine in which phase of the cycle the market finds itself at any given time, but to forecast the timing of movement between phases in the cycle presents a dilemma (Trass 2004,17-19). The variables that influence a property cycle may be divided into macro and micro variables. Macro variables are applicable to the complete cycle, whereas micro variables are only applicable to real estate cycles for provinces, cities, towns or suburbs (Trass, 2004:36-37). This research focuses on the macro property cycle and all reference to cycles should be construed as macro property cycles. The real estate cycle could be assessed through the use of economic variables or performance measures.

The rent cycle, construction cycle, vacancy cycle and numerous other property related cycles are seen as economic variable indicators of the property cycle. These cycles, as well as the macro property cycle, are each in turn influenced by certain indicators, such as rental rates, construction prices,

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inflation and real income. These are only some of the determinants that act as indicators of the property cycle. These indicators serve as early warning signs of changes in the real estate cycle and consequently in the state of the real estate market. Changes in the real estate cycle accordingly determine the long-term direction of property prices and have historically been a significant alert of successes and failures of the property market.

The interaction of different determinants of the real estate cycle during different phases of the cycle is quantified by using performance measures. Examples of performance measures are house prices to income levels or to changes in sales volumes. Performance measures are thus indicators of the phases of the property cycle and are consequently reflected in house prices. At different points in the cycle various determinants interact, which offer an indication of the state of the market and real estate prices. The prominent role of performance measures, along with the macro property cycle and its determinants, can thus not be underestimated.

Internationally research into the identification and assessment of performance measures of property is seen as one of the top five research priorities. In a recent survey that identified twelve general property research topics, performance measures ranked first in the US, third in Australia and fifth in the UK. Research into the existence and predictability of property cycles, regarding specific property research topics, ranked third in the UK and fourth in the US. Property cycles and forecasting were indeed indicated as some of the areas of the United Kingdom property market that are under-researched (Newell, McAllister, Worzala, 2004).

It is important to acknowledge that the real estate market is not a uniform sector within the economy. Investment performance and market behaviour differ fundamentally across real estate classes and each class needs

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to be considered separately. For example: residential real estate appears to react more to downturns in cycles than commercial real estate (Dokko, Edelstein, Lacayo and Lee, 1999). Extensive research in the commercial, industrial and office real estate classes has been performed to develop an approach to predict real estate prices. Interest in the residential class has, however, lagged, leaving a gap in the research performed on price prediction in this property class.

1.2 Objectives of the Study

1.2.1 Primary Objectives

- To develop a model of the real estate cycle using performance measures and movements in house prices that allows for the prediction of residential real estate values.
- To develop a model of the upswing and downswing phases of the real estate cycle that allows for the prediction of the different phases in the cycle.
- To identify performance measures and variables that could act as leading indicators for the different phases of the property cycle.

1.2.2 Secondary Objectives

- To analyse the business cycle, the real estate cycle and the residential real estate cycle.
- To define the classical and growth cycles of the house price cycle and to identify the determinants of the growth cycles.

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- To test the model using empirical house price data.

1.3 Hypotheses

A combination of macro determinants and performance measures assist in the prediction of growth in house prices.

Different macro determinants and performance measures of the real estate cycle are active during the upturn and downturn of the cycle.

1.4 Scope of the Study

This research is based on synthesising relevant literature and residential real estate market statistics to develop a model that could be used to predict growth in residential real estate values. The literature focuses on real estate cycles, the macro determinants of house prices and growth in house prices. Statistics on economic variables and performance measures of the residential market and cycle are analysed and grouped into leading, coinciding and lagging indicator classes. An empirical study of the South African residential real estate growth cycle is performed and a predictive growth model is developed through best subset regression analysis. The predictive growth model is also applied to assess the upswing and downswing phases of the cycle.

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1.5 Research Methodology

1.5.1 Analysis of Secondary Literature

The secondary literature that forms the basis of this study consists of local and international journal articles, literature on real estate and personal interviews. The literature focuses on the real estate cycle, macro determinants of the growth real estate cycle and its influence on the growth in house prices. Literature on performance measures and their role as indicators of phases in the real estate cycle is also analysed.

1.5.2 Primary Research

The primary research of this study covers four phases. Phase one defines the business cycle and the real estate cycle and explores the interaction between the cycles. The phases of the business cycle and the real estate cycle are identified and the indicators of the phases are separated into leading and lagging classes for each of the phases. These leading and lagging indicators of the cycles are analysed as well as the dynamics of the indicators during the different phases of the property cycle. Furthermore, the research on the real estate cycle is expanded to the construction cycle and the residential real estate cycle. Finally the South African residential real estate cycle is divided into classic and growth cycles and the cycles are analysed.

During phase two the macro determinants of house prices are analysed. The macro determinants are classified as supply and demand indicators and the effect of the indicators on house price growth is discussed. This is combined with a study of the relevant performance measures applicable to residential real estate and their relevance for predicting house prices. The performance measures are classified as absolute measures and relative

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measures. At the end of phase two the Granger causality test is performed on all the indicators and performance measures with relation to house price growth.

Phase three consists of combining phase one and two to develop a model for prediction of the growth in residential real estate values. The development commences with the gathering of available and applicable data where after a least squares regression analysis is performed on the year-to-year growth of the data. Thereafter a best subset regression analysis is conducted and the best model is discussed and analysed. During phase four the same process as in phase three is repeated, but is limited to the upswing and downswing phase of the house price growth cycle.

1.6 Important Terminology

The **business cycle** is fluctuations in the aggregate economic activity of nations that consists of expansions, recessions, contractions and revivals.

The **classical cycles** are cycles that ignore miscellaneous random fluctuations and seasonal fluctuations, but group secular trends and cyclical fluctuations together.

The **growth cycles** are cyclical fluctuations in the rate of growth of economic activity relative to long term growth.

Lags are a phenomena in which an action or event appearing now has an effect that surfaces later in time.

Property boom is an extended and sustainable period of growth in real estate prices.

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Property bubble is a sharp and unsustainable rise in real estate prices that attracts speculators and buyers intent on short-term profits.

Property bust/crash is a liquidity crisis brought on by sudden shocks to the market.

The **property cycle** is an irregular, but recurrent and predictable succession of causes and effects that the property market experiences with resultant impacts on the creation and destruction of property wealth.

1.7 Constraining Factors

- Residential real estate cycles for the domestic market have not been extensively studied in available literature.
- Residential real estate price determinants are not covered exclusively in the available literature.
- The relevant literature is mostly aimed at international settings and is thus based on foreign economies and may not necessarily be relevant to the South African situation.
- The South African economy is very volatile and does not lend itself to easy prediction.
- Not all the necessary data to develop the models are available.

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1.8 Structure of the Study

This study consists of six interrelated chapters. Chapter 1 provides an overview of the study. Topics covered in Chapter 1 are the background to the study, a primary and secondary literature review, the purpose of the study, hypotheses, research methodology and constraining factors. This chapter also provides a broad overview of the following chapters.

Chapter 2 is devoted to an analysis of the business as well as the real estate cycle. The business cycle is defined and discussed through synthesising relevant cycle research. Each phase of the cycle is evaluated separately. The important indicators of the business cycle and its phases are identified and their relevance as possible leading indicators is analysed. The discussion of the real estate cycle follows the same structure as that of the business cycle, but it forms a more in-depth study. The residential real estate cycle is identified and placed into the context of the market real estate cycle. The real estate cycle in South African context forms part of the primary discussion and is briefly compared to international real estate cycles. A comparison between the real estate cycle and business cycle along with a case for ignoring cycles concludes this chapter.

Chapter 3 provides an introduction to determinants of residential real estate prices. It is followed by an analysis of significant macro demand and supply determinants. These determinants include population growth, income, interest rates and construction cost. Thereafter the micro determinants of house prices are examined. Micro determinants include the number of bedrooms, number of bathrooms, age in years and square meters of the house. In the latter section of the chapter the different measures of market performance are investigated. Fluctuations in the underlying demand and supply determinants of real estate prices are easy to observe, but indicators of the

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timing of these fluctuations are not readily available. This section identifies performance measures that serve as leading indicators for movements along the real estate cycle.

Chapter 4 combines the research of Chapters 2 and 3 in the development of a model to predict residential real estate prices. This chapter includes an empirical study in which the model is tested. It is followed by a summary of the research and findings of the study.

Chapter 5 expands the empirical study of Chapter 4 through the development of a model to predict the upswing and downswing phases of the house price cycle. The chapter starts with an assessment of the upswing and downswing model, where after Best Subset regression analysis is used to build the model. It is followed by testing the continuous relationship between the variables and the summary of the findings of the study.

Chapter 6 contains the conclusion of the thesis and consists of a summary of the findings, conclusions to the research and recommendations for future research.

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CHAPTER 2 THE REAL ESTATE CYCLE IN CONTEXT

2.1 Introduction

Cycles are a phenomenon that appears frequently in nature, society and the economic environment. The weather follows a seasonal cycle, political systems change according to a cycle and the business environment moves cyclically. Cycles are important for everyday life and thus the need arises to map, understand and predict cycles. Economic and real estate literature suggests that economic factors, cash flow variables and real estate performance are cyclical, but in contrast the forecasting power of cycles is limited (Pyhrr, Roulac and Born, 1999).

This chapter is subdivided into four parts. Part one is the introduction to the chapter. Part two is a basis discussion of the business cycle and cycle terminology. It highlights the different phases of the business cycle and provides an indication of the major influences on the cycle. Part two concludes with a discussion of leading, lagging and coincident indicators of the business cycle.

Part three focuses on the real estate market in an economic context. It commences with an analysis of the real estate cycle and its phases. That is followed by the construction cycle of the residential real estate market whereafter the residential real estate cycle is considered. The residential real estate cycle in South Africa from 1974 to 2004 is used as an illustration. Part three concludes with a discussion of the leading, lagging and coincident indicators of the residential real estate cycle. Part four contains the summary of the chapter.

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2.2 Business Cycle

The business cycle of an economy is an aggregate of important economic factors that combined represents business activity where individual economic factors measure certain aspects of the economic activity (Mills and Wang, 2003). The individual economic factors consist of variables such as inflation, household expenditure, construction cost and expenditure on housing. The business cycle encompasses all cycles contributing to business activity including all property cycles. This requires an assessment of the business cycle before directing attention to real estate cycles and in particular, the residential real estate cycle.

2.2.1 Definition of Business Cycle

Through the ages economic activity has fluctuated recurrently, if not periodically. These fluctuations have been a permanent feature as far as records go, but those activities that may be discerned as 'business cycles' could only traced back to modern industrialism that developed at the time of the Napoleonic Wars in the late 1700s to early 1800s (Cloete, 1990:10 and Estey, 1956:37).

Business cycles were first documented in South Africa between 1888 and 1891. No previous records of cycles were found mainly because the economy of the period had an agricultural orientation (Sherman and Kolk, 1996:32). Burns and Mitchell (1946), early leaders in business cycle research, define the business cycle as follows:

"Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in

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many economic activities, followed by similarly general recessions, (or) contractions (in absolute terms), and revivals which merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic; in duration, business cycles vary from more than one year to ten or twelve years."

In classical theory, fluctuations in economic activity were grouped together under the explanation of business cycles. In reality, business cycles account for only a part of the cyclical characteristics of an economy. It is difficult to discern with certainty the exact level of influence the business cycle has on the fluctuations, even though researchers are tempted to say that the business cycle accounts for the largest part of the fluctuations (Cloete, 1990:15). The cyclical characteristics of the economy may be divided into the following categories: secular trends, seasonal fluctuations, cyclical fluctuations and miscellaneous random fluctuations (Case and Fair, 1999:511 and Estey, 1956:3-4). Figure 2.1 provides a graphical illustration of the four fluctuations.

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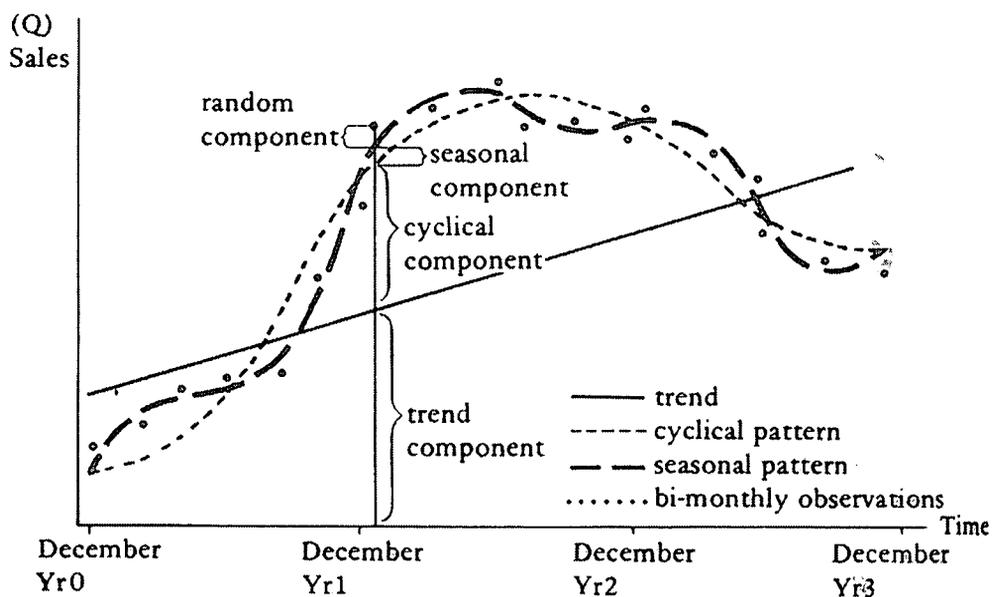


Figure 2.1: Cyclical representation of the components of a business cycle

Source: Reekie and Crook (1975:92)

Further grouping of the characteristics into two classes could reduce the categories to non-recurring and recurring changes. Trends and miscellaneous fluctuations are seen as non-recurring and non-rhythmic changes, while cyclical and seasonal fluctuations are recurring fluctuations. Miscellaneous random fluctuations are irregular, uncyclical and unpredictable and are regarded as 'accidental' fluctuations. They are thought to cause the departure from the expected course of the business cycle (Estey, 1956:6-7). Seasonal fluctuations are connected with the physical seasons and take place within one calendar year. Because seasonal fluctuations are predictable and thus compensated for, their fluctuating effects are minimised.

Cyclical fluctuations and secular trends are the two fluctuations important to business cycle analysis. Cyclical fluctuations are commonly known as the business cycle and are described by A.J. Estey (1956) as "wavelike fluctuations of business activity characterized by recurring phases of expansion and contraction in periods of longer than a year" (Case and Fair, 1999:510-

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511). This correlates with the previous definition of the business cycle by Burns and Mitchell (1946). Secular trends are continuous movement of business activity in one direction for a period that is long in relation to the business cycle. More recently trends have been identified and labelled as long cycles (Brown, 1984).

Secular trends and cyclical fluctuations are frequently discussed in business cycle theory and the theories are divided into two sections: 'classical cycle' analysis and 'growth cycle' analysis. Classical cycles are cycles (or theories) that ignore miscellaneous random fluctuations and seasonal fluctuations, but group together secular trends and cyclical fluctuations. Pagan (1997b, 20) describes classical cycles as "... hills and valleys in a plot of the *levels* of the series..." which represents the level of economic activity. Growth cycles are cyclical fluctuations in the rate of growth of economic activity relative to long term growth (Boehm and Summers, 1999). Authors appear not to have reached a uniform conclusion on whether or not growth cycles or classical cycles should be used for analysis and prediction (Cloete, 1990:15 and Trass, 2004:37). Figure 2.2 illustrates the difference between the classical and growth cycle for (residential) South African properties.

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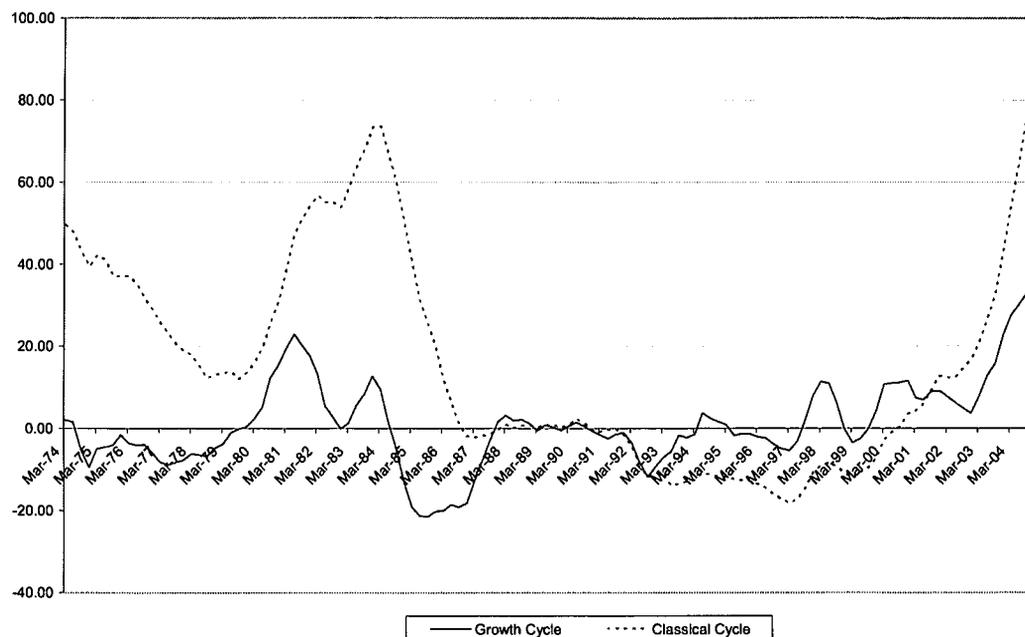


Figure 2.2: A comparison between the classical and growth cycle of South African house prices where the growth cycle is year-on-year quarterly growth and the classical cycle is quarterly with 2000 as the basis year

Source: Prepared from data supplied by Absa

The classical cycle analysis explains recessions that see negative economic growth, but the economy has at times suffered major slowdowns while still experiencing positive growth (Zarnowitz and Ozyilidirim, 2002). Classical cycle recessions are usually preceded by growth cycle slowdowns (Boehm and Summers, 1999). There are theoretical and empirical advantages in using both the cycles for prediction. An analysis of growth phases in an economy used for prediction and other purposes require that trends be separated from the general business cycle in order to focus on the growth cycle (Krystalogianni, Matysiak and Tsolacos, 2004 and Zarnowitz and Ozyilidirim, 2002).

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2.2.2 Phases of the Business Cycle

A perfect economy exists in a constant state of equilibrium, which is when the supply of goods and services equals demand. However, perfect economic conditions are not a realistic assumption and thus economic activity in a country constantly adjusts to compensate for disequilibria. The supply and demand adjustments are the basis of the business cycle: if demand is higher than supply, production of goods or services rises, increasing GDP until supply equals demand. Similarly, if demand is lower than supply, production would decrease. The above two basic economic principles form the upswing and downswing phase of the business cycle. The upswing and downswing phases could further be divided into four phases. Figure 2.3 illustrates the business cycle and its difference phases.

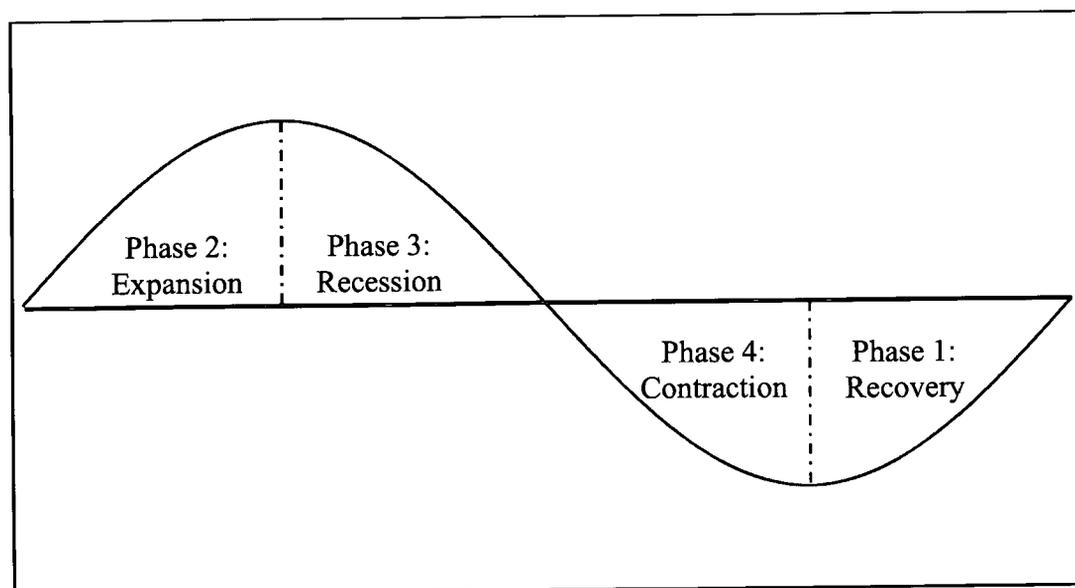


Figure 2.3: An illustration of the business cycle

Source: Adapted from Peter Dag & Associates

A complete business cycle, as seen in Figure 2.3, is characterised by four distinct growth phases: recovery (phase 1), expansion (phase 2),

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recession (phase 3) and contraction (phase 4) (Cloete, 1990:11-12 & Estey, 1956:84). Each of the phases represents periods of dissimilar economic activity, but there remains a logical course of events permeating them. The peak and trough of the cycle represents the transition phases between the upswing and downswing of the cycle. The transitions are distinguished by a slowdown in economic activity at the top of the upswing phase and an increase in economic activity at the bottom of the downswing phase. The length of the cycle is measured from trough to trough and may vary between one and twelve years (Cloete, 1990:11-12).

A cycle usually commences through one of various changes in the aggregate economy. This initiating factor is called a 'starter' and could be ascribed to anything from a government decision to increase the budget deficit or a surplus in the current account of the balance of payments (Cloete, 1990: 11, Estey, 1956:85). Regardless of the origin or nature of the starter, business cycles tend to display the same characteristics (Estey, 1956:86). The business cycle in South Africa, characterised as a small and open economy, tends to be governed by the current account, more specifically the level of exports and imports (Cloete, 1990:24). In the 2004 fiscal year the deficit on the current account was 3, 2 percent of GDP, which amounts to R 44, 4 billion (South African Reserve Bank, 2005:23). The balance between imports and exports influences the income and expenditure of the country and normally initiates the changes between the cycle phases.

2.2.2.1 Recovery

At the start of the recovery phase an endogenous initiating factor, such as exports surpassing imports, or an exogenous factor like new technological development, causes demand for goods and services to increase (Estey, 1956:86). The initial increase is usually restricted to certain sectors of the

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economy, such as industrials. The interdependence between the sectors causes the increase in one sector to spill over to other sectors and this initiates a cumulative expansion. At the trough of the cycle supply of goods and services equals demand and inventories are low. The increase in demand gives way to a rapid increase in supply (Estey, 1956:87). This first causes the amount of hours worked to increase, then the number of workers employed and finally the salaries and wages (Achinstein, 1950:242). The lag of salaries and wages coupled with the sudden increase in demand cause prices of goods and services to increase without an increase in cost (Estey, 1956:87). Soon the firms are producing at full capacity necessitating capital expenditure (e.g. machinery and other pieces of capital equipment, houses and other construction).

Additional income is injected into the economy by an increase in production that follows a rise in demand. This has a cumulative recovery effect causing income, expenditure and private consumption to rise. Domestic demand exceeds domestic supply causing exports to decrease and imports to increase. A further accelerant of imports is the rise in capital expenditure made by firms to equal the demand for production. To fund the additional capital expenditure demand for credit arises. During the first phase of the upswing wages and salaries lag the business cycle, thus while prices are increasing the cost of production is still low causing a sudden increase in profits and pushing the cycle fully into the expansion phase (Estey, 1956:87).

2.2.2.2 Expansion

The strength of the economy, the rise in imports and decrease in exports strengthen the exchange rate. Fixed investment lags the business cycle and during the expansion phase firms reach full production capacity while demand for goods and services are still rising. Firms find it necessary to

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increase their production capacity and only now enter into contracts for new industrial and commercial construction. The shortage in supply persists because it takes time to execute orders for new machinery and for construction to be completed. This causes an increase in prices of goods and services. Salaries and wages join the upswing of the cycle, increasing the cost of production and reducing profits (Cloete, 1990:26). The high demand for credit to finance fixed investment and expenditure causes a decline in net bank reserves and an increase of the short-term interest rate. The current account develops a deficit, or a smaller surplus, caused by the continuous inflow of capital goods (Cloete, 1990:27). The pace of economic activity decreases toward the peak of the cycle. Increases (changes) in taxation and interest rates lag the cycle, causing income to increase sharply for the duration of the expansion phase, but to decrease sharply in contraction.

2.2.2.3 Recession Phase

The high level of prices causes the demand for goods and services to decline during the recession phase. High inventory levels persist during this phase, but the fall-off in consumption expenditure and high interest rates causes new inventory investment to decrease. Fixed investment expenditure is still rising since the completion of new machinery, and the construction of industrial and commercial buildings at the height of the expansion phase are still continuing. The current account experiences a mounting deficit that results in a weakening of the exchange rate and an increase in the price of imported goods and services. The rise in the cost of production cannot be matched by a rise in prices and accordingly profits start to fall (Cloete, 1990:28). The rising short-term interest rates and the increase in taxation cause total income to fall sharply.

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2.2.2.4 Contraction Phase

Completion of new production facilities causes an oversupply of production capacity during the contraction phase. This phase could be divided into two concurrent/successive segments: segment one is a continuation of the contraction, but segment two is the preparation for recovery. In segment one the excess production capacity, coupled with low profits, cause unemployment to rise and salaries and wages to decrease (Cloete, 1990:28). Total consumption expenditure and inventory investment diminish and a cumulative contraction of income, expenditure and employment ensues (Cloete, 1990:29). The increased short-term interest rates lead to increased mortgage delinquency, foreclosures and financial distress (Dokko, Edelstein, Lacayo and Lee, 1999).

In segment two short-term interest rates commence a downward trend. This phase is characterised by low interest rates that cause an increase in demand for home loans, coupled with an increase in the number of houses purchased and the number of residential construction contracts (Achinstein, 1950:236 and Cloete, 1990:24). The increase in the number of housing units increases the demand for consumer durables (Cloete, 1990:24). Low employment forces workers to accept reductions in salaries and wages and prices of raw materials are substantially reduced. A favourable cost-price relationship develops, making recovery possible. Imports continue to fall, but the weak economy and exchange rate cause exports to increase (Cloete, 1990:29). This movement continues until a surplus on the current account is reached during the trough of the cycle. The increase in exports causes demand for goods and services to increase and production to rise, starting the new business cycle. The typical events in the economy that occur during each of the four phases are summarised in Table 2.1.

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Table 2.1: Typical events in the economy that occur during the different phases of the cycle

Recovery	Expansion
Imports increase	Current account shows deficit
Total income and expenditure recovers	Total income and expenditure increases
Inventory investment are made	Inventory levels increase
Increase in production	Further increase in production
Unemployment decreases	Further decrease in unemployment
Constant salaries and wages	Salaries and wages increase
Sharp rise in profits	Profits level out
Rising volume of bank credit	Demand for credit rises sharply
Demand for housing increases	Construction of commercial and industrial buildings starts
High but declining short-term interest rates	Rising short-term interest rates
High but declining inflation	Rising inflation
Expanding economy	Strong economic growth
Weak commodities	Rising commodities
Contraction	Recession
Large deficit on current account	Exports start to rise
Total income and expenditure levels out	Total income and expenditure decreases
Inventory levels still increase	Excess inventory, no new investment
Cutback in production	Low production
Unemployment increase	High unemployment
High salaries and wages	Decrease in salaries and wages
Profits decline	Low profits
Construction slows down	No new construction
Further rise in short-term interest rates	Slight decline in short-term interest rates
Accelerating inflation rate	Slowdown in inflation rate
Economic growth decreases	Very low economic growth
Little or no progress in commodities	Commodities continue to decline

* Items in italics have a direct or indirect effect on the real estate cycle

Source: Achinstein, 1950; Cloete, 1990, Estey, 1956; Ruby, 2005 and Tvede, 1997

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The business cycle develops through a combination of the specific cycles of the economy, for example, the production cycle, real estate cycle and income cycle. The aggregate business cycle is called a reference cycle (Sherman and Kolk, 1996:44). Unless stated otherwise, the business cycles refer to the reference cycle. Analysis of specific cycles is necessary since they return data on leading, coincident and lagging indicators of the business cycle.

2.2.3 Leading, Coinciding and Lagging Indicators

There are a variety of methods available to analyse and predict the business cycle, of which economic indicator analysis appears to be the oldest and most popular. Burns and Mitchell laid the basis of this analysis in 1946 with their seminal work *Measuring Business Cycles*. Indicator analysis is applicable to both classical and growth cycles (Boehm and Summers, 1999). Economic indicators are divided into leading, lagging and coincident categories. The coincident series usually reach their peak at the reference peak of the cycle, and their trough at the reference trough of the cycle. A leading series reach their peak and trough before the reference, while the lagging series reach theirs after the reference cycle. A suitable indicator is classified by Boehm and Summers (1999) as follows:

- it is a significant economic variable,
- it is statistically adequate,
- it is not subject to significant revisions,
- it reveals a consistent relationship over time with business cycle peaks and troughs,
- it conforms to the general cyclical movements between peaks and troughs,
- it is not dominated by irregular, erratic and non-cyclical influences and
- it is promptly and readily available, preferably monthly, but at least quarterly.

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Indicators contain a variety of economic information that is synthesised into a composite leading, coincident and lagging index. The coincident index may be used as a substitute for GDP as a measure of the business cycle (Boehm and Summer, 1999). The leading and coincident indices serve as early warning signs of turning points in the business cycle, for example: one of the first signs indicating that the expansion phase of the business cycle is coming to an end is a slowdown in the growth rate of the leading index. If the growth rate falls below the trend rate, but remains positive, it represents generally a growth slowdown (recession), but a negative growth rate would indicate a classical recession (Boehm and Summer, 1999). The leading indicator of classical cycle recovery is a rise of the growth rate above zero, while for growth cycle recovery it occurs when the growth rate exceeds the trend rate. Although lagging indicators do not add to prediction practices, they are useful for understanding how the business cycle functions.

No single indicator series could consistently predict the direction of a business cycle accurately, and consequently it is necessary to track a variety of different series (Sherman and Kolk, 1996:382). The timing and strength of the relationship of the indicators with the aggregate economy changes over time, which further complicates forecasting. The indicator series, therefore, constantly change to reflect current relationships. In addition to single indicators, composite time series or indices may be used for forecasting. A composite time series is the weighted average of several indicators and the inclusion of several indicators reduces the likelihood that any concomitant movement is insignificant or random (Reekie and Crook, 1987:100). Composite leading, coincident and lagging indices are commonly compiled and reported in the media.

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2.3 An Analysis of the Real Estate Cycle

Real estate cycle theory first appeared in literature in the land economics work of Homer Hoyt (1933). His work represents the foundation of real estate cycle research and is still regularly quoted in the real estate literature. The real estate cycle is volatile and complex, but persistent in its effect on property in both developed and developing economies. The South African (SA) economy is small and has a volatile history. To produce consistent economic models for SA are difficult, since not merely the fundamental economic workings influence the state of the SA economy. For example: short-term interest rates should only increase when the economy is overheating during the upswing phase of the business cycle, but the South African Reserve Bank (SARB) has artificially increased the interest rate three times during the last twenty years to compensate for exogenous factors (Kahn and Farrell, 2002).

2.3.1 Components of the Aggregate Real Estate Cycle

The term 'real estate cycle' is used to describe a variety of cycles, including the supply of property, demand for space, vacancy, construction and rental cycles. It is also used to refer to non-residential and residential cycles alike. In reality 'real estate cycle' refers to the aggregate cycle obtained from combining all the relevant cycles and it is measured by means of real property prices (Trass, 2004:46). Different measures of real property prices exist, such as aggregate value, median value and property indices. The most accurate indicator of activity in the real estate market is property indices (Trass, 2004:46). An example of such an index in South Africa is the Absa House Price Index. The Royal Institution of Chartered Surveyors (1994) defines the aggregate real estate cycle as follows:

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“Property cycles are recurrent but irregular fluctuations in the rate of all-property return, which are also apparent in many other indicators of property activity, but with varying leads and lags against the all-property cycle”.

The aggregate cycle represents the total real estate market activity and the basic cycle is depicted as a sine wave, as illustrated in Figure 2.4 (Pyhrr, Roulac and Born, 1999). The cycle is portrayed as symmetrical, whereas in reality it is normally skewed, with the time between the trough and peak being significantly longer than the time-lapse between the peak and subsequent trough (Trass, 2004:28). The upswing of the cycle lasts longer than the downswing. This could be ascribed to the influence of the trend component of the classical cycle on the growth cycle. Cyclical fluctuations in the property market are caused by secular trends, seasonal fluctuations, cyclical fluctuations and miscellaneous random fluctuations. Miscellaneous random cyclical fluctuations may distort the perceived length and direction of the real estate cycle. For example: a major terrorist attack (such as 11 September 2001) could well halt the activity in the property market for weeks or even months (Trass, 2004:39).

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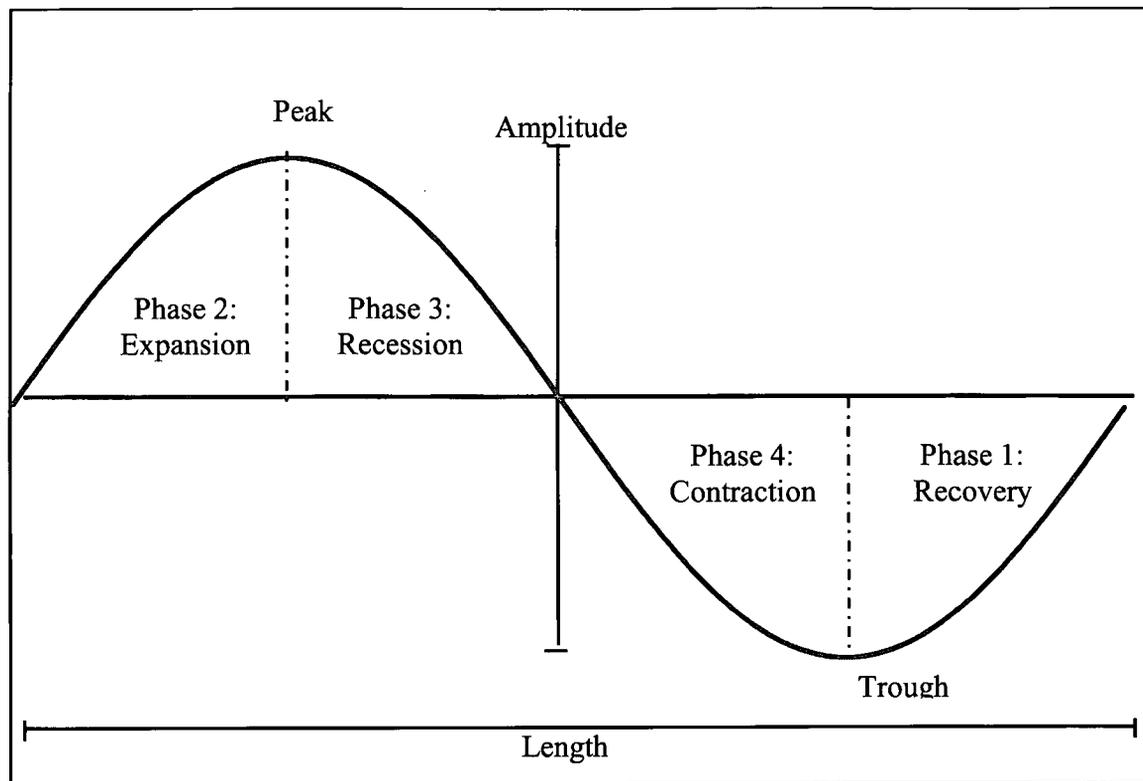


Figure 2.4: Sin wave plot of the real estate cycle and its basic characteristics

Adapted from source: Born, Phyr and Roulac (1999)

Both the short and long cycle, the growth and the classical cycles, govern real estate markets. The classical cycle could last for seven to eighteen years (ruled by the Wenzlick 181/3 year construction cycle) and may be used to predict the direction of property values (Kaiser, 1997 and Trass, 2004:28 and 61). The classical cycle could last for any length of time, from 30 to 100 years (Kaiser, 1997). The longevity of each cycle depends on the magnitude and the state of the key drivers of the cycle. The length of the cycle in smaller economic countries appears to be shorter because of the increased volatility of their economies (Trass, 2004:28). Historically the classical property cycle in South Africa has had a duration of 17 years (Rode, 2003). An important aspect of growth cycle research and forecasting is the removal of trend components from the cycle data and concentrating on the growth cycle (Brown, 1984).

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In business cycle theory it is accepted that secular forces influence the cycle, while cyclical forces influence the trend. It is difficult to determine and eliminate trends from cycle data and faulty trend estimates could well result in significant errors (Zarnowitz and Ozyildirim, 2002). Traditionally the NBER smoothed business cycle data by removing the seasonal component and then adjusting the data for irregular movements by using a set of smoothing formulas. Trends are removed through numerous methods, for example the phase average trend (PAT), using growth rates directly and using year-on-year growth rates (Zarnowitz and Ozyildirim, 2002).

For the purpose of this study, seasonally adjusted data are provided by the SARB and detrended by removing inflation and using the time-series as year-on-year growth rates.

The property cycle is influenced by supply and demand in the same manner as the business cycle. The peaks and troughs of the cycle are identifiable as the areas where the growth in supply equals the growth in demand. Oversupply in the market results in decreasing values and is represented by the downswing in the aggregate property cycle, whereas high demand with inadequate supply results in higher prices and the upswing of the cycle. Property cycles are an international phenomenon, whether in the USA, UK or South Africa, and they furthermore display the same basic features (Trass, 2004:20).

The aggregate cycle is compiled from a multitude of interrelated base cycles, most noticeably the construction, supply, demand, rental rate and vacancy rate cycles. The base cycles have a continuous influence on the aggregate cycle, but the extent, timing and magnitude of their influence differ between the four phases of the cycle. For example, interest rates have a larger

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effect on house price growth at the end of an upswing than at the end of a downswing.

2.3.2 Phases of the Aggregate Real Estate Cycle

The growth of the real estate cycle is divided into four phases according to the relationship of the major influences on each other. The phases are named recession, recovery, expansion and contraction/hypersupply and are illustrated in Figure 2.5 (Pyhrr, Roulac and Born, 1999, Mueller and Pevnev, 1997 and Mueller, 1999:134). Most of the literature agrees that the property cycle consists of four phases, but more recent publications divide the cycle into only three phases: recovery, boom and slump (Trass, 2004:19). The three phases approach is not yet widely recognised and, therefore, it was decided to consider the cycles with the familiar four phases. The classical cycle is dotted with the peaks and troughs of the growth cycle and has a long-term upward slope, which implies that in real terms the current trough of the growth cycle would not be as low as the previous trough (Trass 2004:134).

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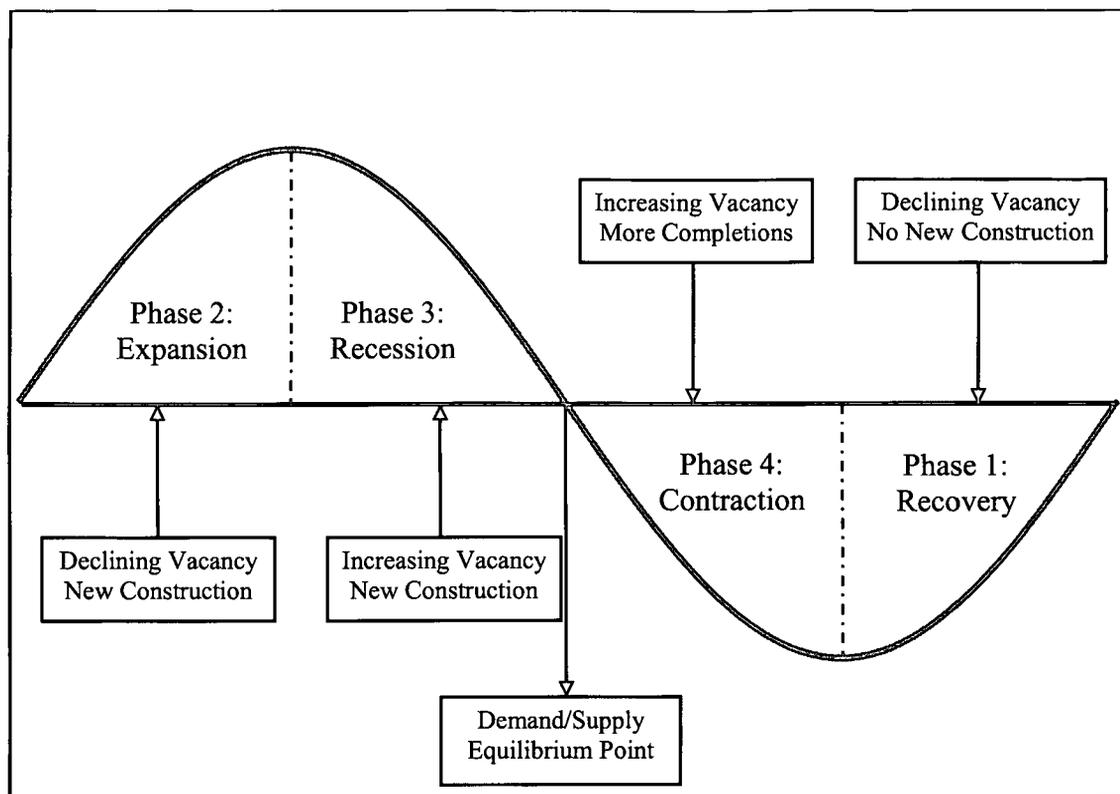


Figure 2.5: Phases of the real estate cycle

Source: Adapted from Mueller (2002)

The aggregate property cycle is driven by a combination of changes in key drivers, which include vacancy rates, supply (construction), demand (absorption) and rental levels (Pyhrr, Roulac and Born, 1999). To distinguish between the different phases and thus the state of the property market, an understanding of the key drivers and their position in the property cycle is required (Mueller, 2002). Real estate cycles are influenced both by endogenous and exogenous factors. The endogenous factors are market imperfections in the form of time lags: the price-mechanism lag, the decision lag and the construction lag. Exogenous influences occur in the form of demand shocks that are caused by, for example, inflation and interest rates (Rottke and Wernecke, 2002).

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2.3.2.1 Recovery Phase

At the trough of the cycle the market is in a state of oversupply, vacancies are at their peak and there is no excess construction (Mueller, 2002). The endogenous and exogenous factors (called starters) cause an increase in demand for space at the start of the recovery phase of the aggregate real estate cycle. The demand causes an absorption of vacancies, but the oversupply in the market keeps rental levels constant (Leland Consulting Group, s.a.). Significant increases in rentals and absorption are needed before new construction commences and thus construction shows minimal activity levels at that stage (Leland Consulting Group, s.a. and Hoyt, 1947). Increases in supply are mainly governed by the expectations of developers on the future state of economic factors, such as GDP (Wheaton, 1999).

Towards the end of the recovery phase the decrease in vacancies causes a slow increase in rents. Rental rates increase at a faster pace than property values, which cause an increase in the return on investment of real estate (Dokko, Edelstein, Lacayo and Lee, 1999 and Trass, 2004:87). The higher rental levels have a positive impact on the value of property, even though the capitalisation rate remains stable at a high level (Leland Consulting Group, s.a.). The increase, albeit low, in property values makes it easier to qualify for financing and with a market flooded by foreclosed properties and eager sellers the volume of sales increases. Low investor confidence in the state of the market prevents sales from increasing exponentially (Trass, 2004:87).

2.3.2.2 Expansion Phase

During the expansion phase the demand for space is very strong and exceeds the growth rate of supply (Leland Consulting Group, s.a.). Vacancy rates decline further and, coupled with the construction lag, exert a positive

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influence on rental levels (Leland Consulting Group, s.a.). The rapid rise in rents makes it profitable to construct new structures, thus investor interest is high and a continuous stream of new properties are introduced onto the market (Leland Consulting Group, s.a. and Hoyt: 1947). The increasing income through rents and decreasing capitalisation rates cause property values to increase (Leland Consulting Group, s.a.).

2.3.2.3 Hypersupply Phase

At the peak of the cycle vacancies are absorbed and the growth in demand is equal to growth in supply. After equilibrium demand grows slower than supply and indicates the beginning of the hypersupply phase (Leland Consulting Group, s.a.). There is no excessive oversupply in this phase, but new supply completions increase the vacancy rate and cause a lower growth rate in rentals (Leland Consulting Group, s.a.). Construction levels are very high, and the high values make property less affordable. Property finance remains readily available, since financial institutions are capitalising on the boom (Trass, 2004:100). Stable incomes and slowly increasing capitalisation rates cause property values to fall towards the end of the contraction phase (Leland Consulting Group, s.a.). At the end of the phase market participants realise that the market has turned and new construction slows down or halts completely.

2.3.2.4 Recession Phase

During the recession no new construction is started and demand for space is still declining (Leland Consulting Group, s.a.). The degree of the recession is determined by the extent of the difference between supply growth and demand growth in the market (Mueller, 2002). Large oversupply and low or negative demand growth increases the bid-ask gap and causes low liquidity in

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the market (Dokko, Edelstein, Lacayo and Lee, 1999). Landlords lower rents to stay competitive and soon they only cover their operating costs. Lower rental income collections, perceived higher risk and depressed future property resale price expectations place downward pressure on market values, frequently depressing them below replacement cost (Leland Consulting Group, s.a. and Dokko, Edelstein, Lacayo and Lee, 1999). Vacancy rates increase until they reach their peak at the trough of the aggregate real estate cycle (Leland Consulting Group, s.a.). The cycle reaches its bottom as new construction and completions cease, or when demand growth turns up and begins to increase at a higher rate than supply growth. At this stage the trough demand starts to absorb the excess supply.

The aggregate real estate cycle represents the complete real estate sector, making no distinction between the industrial, commercial or residential sectors. In reality each of these sectors reacts differently to the above factors and thus the cycles for each property type are not coincident (Pritchett, 1984). Real estate activity varies greatly in the same urban region between different types of property (Hoyt, 1947). Different property types do not react in a similar fashion to influences of the real estate and the business cycle. This causes the different property types to display differences in their relationship and timing towards the business cycle and each other (Leland Consulting Group, s.a.). For example, the residential cycle may peak before the business cycle, whereas the industrial cycle could well peak after the business cycle. Residential price movements are subject to their own influences and this subject merits a separate discussion. To understand the residential cycle it is necessary to discuss the construction cycle first.

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2.3.3 The Construction Cycle

An initial analysis of the construction cycle in relation to the business cycle is important for understanding the fluctuations that occur in the residential cycle, since house prices are determined in the long run by construction cost (Hendershott, 1987). The total construction cycle can be divided into a long and a short cycle (Guttentag, 1961). The average length of the long construction cycle is 18 $\frac{1}{3}$ years (Hoyt, 1933). The long cycle in South Africa extends over an average of 17 years (Rode, 2003). The short cycle in construction averages 3 $\frac{1}{2}$ years (Jaffee and Rosen, 1979). It is important to discern between the long and short cycle in construction, since they differ in their basic causes (Guttentag, 1961). Long cycles are mainly influenced by demand for housing caused by a change in the rate of population growth (Achinstein, 1950:423 and Guttentag, 1961). Changes in the supply of credit and interest rates are only a secondary influence on long cycles, whereas it is seen as the major influence on short cycles (Guttentag, 1961).

Construction substantially affects the business cycle, because of the importance of the construction industry in respect to the large volumes of materials and the high number of labour required (Estey, 1956:16). South African statistics show that the upswing phases of the economy that coincide with the upswing of the long construction cycles are strong and extended. Similarly a downswing in the cycle, which coincides with the downswing of the long construction cycle, tends to be severe and prolonged (Cloete, 1990:14-15). Locally, one-half of total annual new fixed investment in the economy is new investment in building and construction (Cloete, 1990:27-28). The reasons for a longer construction cycle are stipulated below (Cloete, 1990:14-15):

- It takes time to construct new houses and other buildings in response to an increase in demand.

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- Contractors leave the building industry during a recession and it takes time to reorganise the industry.
- A secondary investment interest in the real estate sector prolongs the upswing phase.
- The demand for residential property (and to a lesser extent non-residential property) grows at a relatively constant rate each year that is in line with population growth.
- High rentals and high prices during the upswing cause an oversupply of properties.

Short cycles correlate with the previously discussed minor business cycle and thus further discussion of the construction cycle will refer only to short cycles. The total construction cycle consists of interrelated cycles that are represented by residential, commercial, industrial, private and public construction. Each construction sector is influenced by its own economic and political determinants. For example: the residential construction cycle is related to net household formation and changes in debt financing, whereas private non-residential construction is influenced by factors determining business fixed investment. Furthermore, there is an unstable relationship between the total construction cycle and its sub-sectors, and a correlation between residential and non-residential construction is very rare (Grebler and Burns, 1982).

The residential construction cycle has been the subject of numerous scholarly investigations as it appears to move counter-cyclically to gross national product (GNP) and thus to the business cycle (Grebler and Burns, 1982). Residential construction is dependent on external financing and is, therefore, sensitive to changes in short-term interest rates, experiencing an inverse relationship towards it (Achinstein, 1950, Grebler and Burns, 1982; and Guttentag, 1961). During the contraction and recovery phase of the business cycle, interest rates decrease and residential construction increases (Grebler

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and Burns, 1982; and Cloete, 1990). Residential construction cycles have been leading the business cycle since the earliest documentation in this respect was published in the USA, with the exception of the years during the World Wars (Guttentag, 1961). Green (1997) analysed residential data from 1959 to 1992 and found that residential investment leads the US in and out of recessions. It also implies that residential investment is a cause of GDP growth (Green, 1997). Studies performed on data originating in the US have shown that residential construction recovers four months before the business cycle and that it leads a recession by almost a year (Achinstein, 1950 and Grebler and Burns, 1982).

2.3.4 The Residential Real Estate Cycle

The residential cycle in real estate includes the fluctuations in real prices of single-family properties, apartments, owner-occupied and non-owner-occupied housing and can be measured by, for example, the Absa House Price Index. Fluctuations in house prices can be defined as either (1) an acceleration/deceleration of rates of increase over those recorded in previous years or (2) a sustained increase in house prices higher than the rise in the consumer price index (CPI) (Grebler and Mittelbach, 1979:11). The fluctuations in the residential cycle are more stable than other sectors of the property market, since the aggregate demand for residential properties grows constantly as population expands (Guttentag, 1961).

The South African economy is small and has a volatile history when compared for instance to the US. The residential cycle tends to lag the business cycle peaks and troughs, which seems to indicate that prices in the residential market adjust more slowly than other equity markets (OECD, 2004:130). According to Rode (2005) the residential real estate cycle in South Africa has always lagged the business cycle, but has emerged as a leading

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cycle during the past ten years. In countries, such as the US, UK and Australia, house prices continue to accelerate past the GDP downturn point, showing countercyclical movements (OECD, 2004:130). Figure 2.6 shows the quarterly, seasonally adjusted growth rate of GDP in 2000 prices provided by the South African Reserve Bank and the quarterly, seasonally adjusted growth rate of residential property prices provided by ABSA.

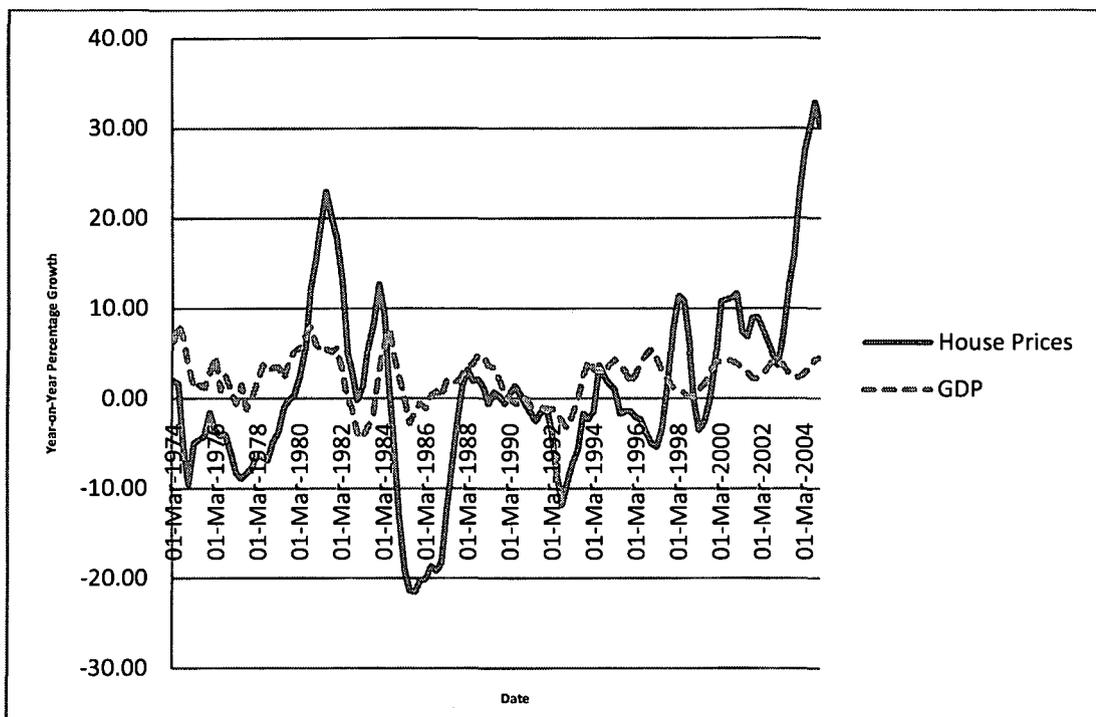


Figure 2.6: Quarterly growth of GDP and house prices

Source: Prepared from data supplied by ABSA and the South African Reserve Bank

The cycle influences the state of the housing market across the whole country in varying degrees and time lags. The same property cycle also exists for any country's residential market that is driven by a free market and is free from significant intervention from government forces (Trass, 2004:19, 21). The residential property cycle follows the same basic pattern as the aggregate real estate cycle, but because its key drivers vary from those of other property classes, they differ in volatility and in their relationship with the business cycle.

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The key driver of residential property cycles, as indicated previously, is an increase in the rate of population growth of the country (Hoyt, 1947 and Trass, 2004:62). An increase in population results in decreasing vacancies, a rise in rental levels and thus increasing prices, since additional properties cannot be supplied rapidly (Trass, 2004:63). Changes in population are also seen as one of the main causes of economic growth (Achinstein, 1950). This basic factor could vary significantly between cities (Hoyt, 1947). Some cities only experience moderate real estate activity when others experience a boom (Hoyt, 1947). The cycle for suburbs within a city may also vary from the city's overall cycle (Trass, 2004:36). Research indicates that lower-priced suburbs and the suburbs farthest away from the central business district (CBD) reflect a more cyclical behaviour than other suburbs (Trass, 2004:37). One reason for this is that investors invest heavily in the suburbs further removed from the CBD, since they have higher possibilities for profits (Trass, 2004:37). Thus while an analysis of the complete residential cycle is relevant, it is important to bear in mind that it represents an averaging of differences (Hoyt, 1947). Each city and town should be evaluated on its own to determine where it is in the current residential real estate cycle.

As mentioned in Section 2.2.1, cycles are subject to four cyclical influences. The seasonal fluctuations are discounted, but residential properties are particularly vulnerable to seasonal influences. Seasonal fluctuations influence cycles through a fixed rhythm of seasons (Estey, 1956:8). The influences could be natural, and for example rental levels may increase at the coast during summer months, or increases could be caused by customs, regulations and the law. Residential construction is seasonal, busy in summer, dull in winter. Current building methods have made construction in the winter possible, so if seasonal fluctuations still persist, this is out of habit rather than necessity (Estey, 1956:9). Seasonal fluctuations in the price of residential

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properties should not affect informed investor decisions since most, if not all, of the available data are seasonally adjusted.

The residential real estate cycle is commonly measured by real house prices, and thus the position of price changes in the aggregate property cycle is significant. An increase in house prices are preceded by an increase in occupancy and rental levels; followed by an increase in construction (Krainer, 2002 and Trass, 2004:22). The residential construction cycle frequently leads the business cycle and this encourages the expectation that house prices should lead GDP, but Trass (2004) found that GDP peaks in the recovery phase and troughs occur during the middle of the slump of the residential real estate cycle. House prices do not reflect immediate activity in the residential property market. A reason for this phenomenon is that it is relatively unusual to see a decline in nominal house prices on a national level (Case, 2002 and Krainer, 2002). While house prices adjust slowly, the volume of housing market transactions is more responsive to a slowing of activity in the economy (Krainer, 2002). Mueller (1999) argues that occupancy rates indicate the interaction between supply and demand and he uses occupancy rates as a measurement to understand the states of the cycle. This raises the question whether or not house prices are the best measure of residential real estate activity.

2.3.4.1 The Residential Cycle in South Africa

In South Africa there are two sources that systematically collate residential property data: Absa Bank and the Deeds Office. Absa Bank has 31 percent of the market share for mortgage loans, which makes it the best provider of real estate data in South Africa (Luüs, 2003). From here on all data used for the house price cycle will be data sourced from Absa.

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The monthly house price index compiled by Absa Bank is based on the average purchase price of houses in respect of which mortgage loan applications were approved by the bank within a certain period of time. The data are also smoothed by using the X11 statistical procedure to exclude outliers and seasonal factors that may distort the data. For the purpose of the House Price Index, the smoothed monthly price data are converted to an index with 2000 as a base year. From the monthly, quarterly and annual data the growth in house prices is calculated. House prices are also calculated in real terms, i.e. after adjusting the prices for inflation, by deflating the nominal house prices by the headline consumer price index (Du Toit, 2005). The classical cycle illustrated in Figure 2.7, is represented by movement in real house prices measured by a monthly house price index.

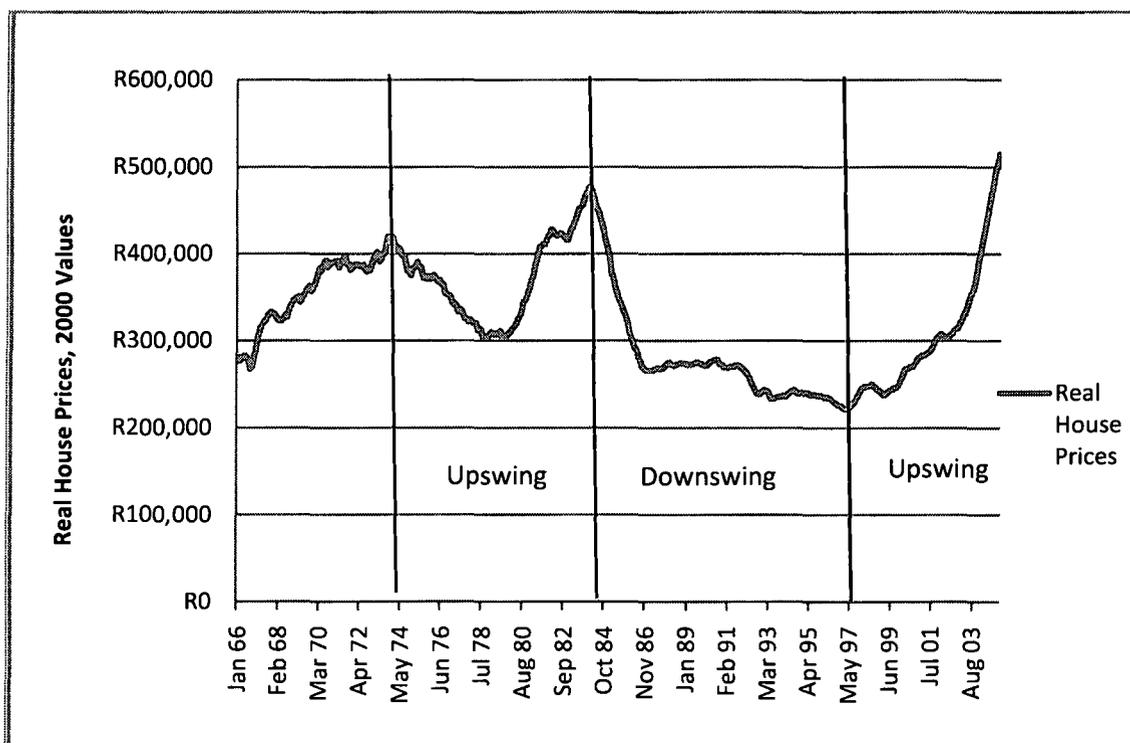


Figure 2.7: The classical residential cycle in South Africa

Source: Data are supplied by Absa

Note: These prices are the smoothed average price of new and existing houses in South Africa

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The most recent complete residential cycle in South Africa as presented in Figure 2.7 (measured from trough to trough) covered 17 years and one month and stretched from 31 July 1979 to 28 February 1997. At the initial point of the cycle average real house prices was R 303 157 and it reached a low of R 221 987 during the second trough. The cycle experienced a short upswing of four years and five months, followed by a prolonged downswing of 13 years and one month, which is atypical of the property cycle. The prolonged downswing of the cycle had a variety of causes. For example the South African economy experienced periods of political instability, multiple interest rate shocks and periods of high inflation. Figure 2.8 illustrates the residential growth cycle of South Africa from 1967 to 2004.

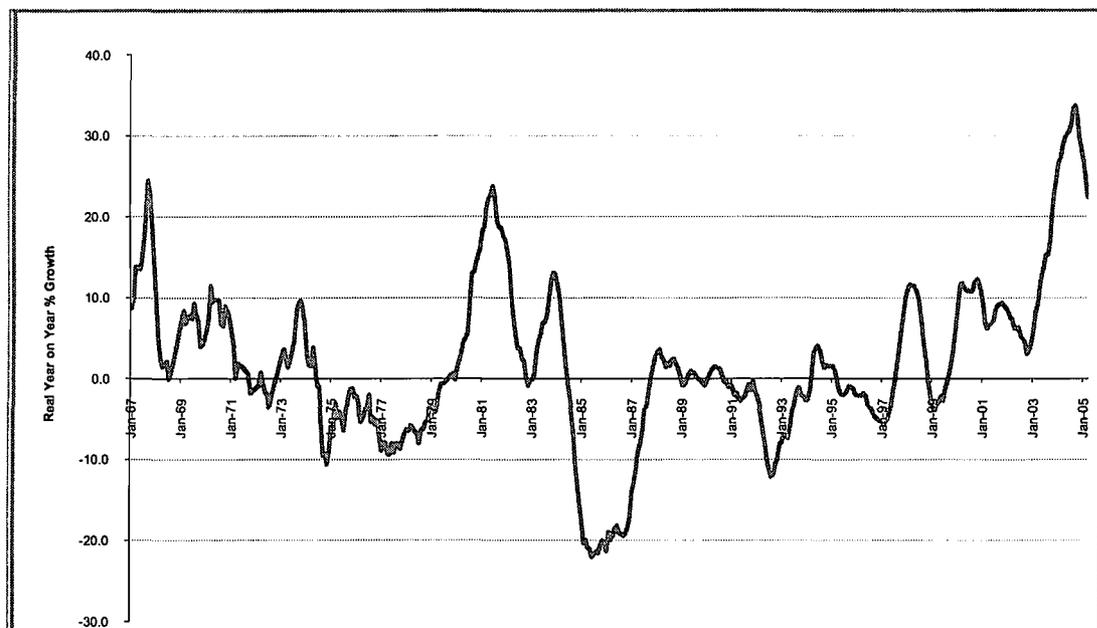


Figure 2.8: The South African residential growth cycle

Source: Data supplied by ABSA

Note: The data are seasonally adjusted

During the classical cycle from 31 July 1979 to 28 February 1997 the real estate market experienced six growth cycles. The growth cycles from 1957 to 2005 are shown in Figure 2.8. The growth is represented by the year-on-

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year growth rate or residential real estate prices in percentage as measured by Absa. The growth in house prices was lower than average from 1988 to 1994, whereafter growth stabilised into longer and mostly positive cycles. Growth cycles could be used for prediction purposes, since a classical cycle recession is usually preceded by a downturn in the growth cycle, but not all downturns become classical recessions (Boehm and Summers, 1999). In South Africa the downturn of the classical cycle in 1984 was preceded by a downturn of the growth cycle in 1983. Currently the growth cycle is entering another downturn, but no evidence has yet emerged of a classical cycle recession. To enhance the predictability of house prices it is necessary to combine cycle analysis with leading indicators.

2.3.5 Key Drivers/Leading Indicators of the Residential Property Cycle

The real estate cycle has a set of instigating factors for each of the different phases. By recognising and analysing these factors and the timing of their entrance and exit to the cycle makes it easier to predict the direction, if not the absolute change, in residential property prices. Leading indicators help to predict the next phase while lagging indicators define the end of a phase. For example, a decrease in the vacancy rate signifies the start of the recovery phase. The important indicators/variables in the development of the residential cycle may be divided into three categories: financial, emotional and demographic. The financial factors refer to the financial viability of real estate and include rental levels, return on investment, income levels, rental affordability, property affordability, finance availability and property values.

Demographic factors influence the level of physical demand for properties and consist of population levels, net migration, employment levels, the number of people per household, vacancy rates of rental property and the scale of property construction. The confidence in real estate as an investment

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class is determined by the emotional factors of the cycle. These factors are: average number of days it takes to sell property, the number of listings of property for sale and sales levels (Trass, 2004:60). The above factors collectively drive the development of the real estate cycle, but individually they could indicate which part of the real estate cycle, as measured by changes in house prices, the market is currently experiencing (Trass, 2004:61). Table 2.2 provides a summary of the financial, demographical and emotional indicators of the property cycle.

Table 2.2: The financial, demographical and emotional indicators of the property cycle

Financial Indicators	Demographical Indicators	Emotional Indicators
Rental Levels	Population Levels	Average number of days it takes to sell a property
Return on Investment	Net Migration	Sales Level
Income Levels	Employment Levels	Gentrification
Rental Affordability	Number of People per Household	
Property Affordability	Vacancy Rates of Rental Properties	
Finance Availability	Construction Levels	
Property Values		

Source: Trass 2004: 60 - 61

The leading indicators for the recovery phase, and thus an increase in the house price index, are property construction levels, vacancy rates, employment levels, return on investment, average rents, GDP and property sales. The leading indicators for the end of the expansion phase, and the decrease in the house price index, are vacancy rates, employment levels, return on investment, average rents, the number of days to sell, GDP and property sales. Lagging indicators for the upswing and downswing are the number of

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people per household and the affordability of property. Population change, property construction, average incomes and property sales volumes are the coincident indicators of the residential real estate cycle (Trass 2004, 63-70).

The analysis of leading, lagging and coincident indicators corresponds with the previous discussion of the real estate cycle, with the exception of GDP and construction. GDP may lead house prices, but it does not lead activity in the residential market. The Conference Board Leading Index (2002) is an example of an index that uses leading indicators to predict the direction of economic growth. Historically the Conference Board Leading Index (2002) shows that activity in private housing leads the peak of the business cycle by 11 months, while it leads the trough by two and a half months (Reilly and Brown, 2003:410). The individual effect of each of the factors and their relationship with house prices in the property growth cycle will be covered in the next chapter.

2.4 Summary

A country's economy consists of a series of interrelated cycles where every cycle represents an economic variable or a group of variables. The aggregate economy is represented by the business cycle, which is usually measured by GDP. The business cycle represents and indicates the level of economic activity in a country.

One of the cycles forming part of the business cycle is the real estate cycle, which collectively represents all activity in the real estate sector. The real estate sector may be divided into cycles for industrial, commercial and residential real estate where every part of the sector could be represented by its own cycle. The impact and timing of the different cycles towards the business cycle and the aggregate real estate cycle differ. The residential real estate

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cycle is an aggregate of real prices of single-family properties, apartments, owner-occupied and non-owner-occupied housing. Literature suggests that the key driver of the residential real estate cycle is an increase in population growth, but the cycle is influenced by numerous economic variables throughout the length of the cycle.

Cycles consist of an upswing and downswing phase, which are separated into four phases: expansion, recession, contraction and recovery. During the analysis of the business, real estate and residential real estate cycle indicators of house price growth for the different phases were identified.

The literature suggests that during the recovery phase of the residential real estate growth cycle unemployment decreases, interest rates decline and inflation is high, but declining. The expansion phase experiences further decreases in unemployment, rising interest rates and high, but declining inflation. During the third phase of the residential real estate growth cycle, called the contraction phase, unemployment increases, construction slows down and there is a further rise in interest rates and inflation. The recession is characterised by high unemployment, no new construction, a decline in interest rates and a slowdown in the inflation rate. These indicators of the real estate cycle form the basis of Chapter 3.

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CHAPTER 3 INDICATOR ANALYSIS FOR HOUSE PRICES

3.1 Introduction

House prices are generally determined by supply and demand for housing goods. Changes in house prices are thus caused by the economic factors that underlie shifts in demand or supply. It thus stands to reason that changes in the relevant economic factors may well help to predict changes in house prices. It is, therefore, relevant to analyse each factor and its relationship with house prices in order to identify leading indicators for the residential market (Tse, Ho and Ganesan, 1999).

The aggregate residential real estate sector comprises two sections: owner-occupied housing and rental housing. The sectors are subject to two different demand instigators: a demand for housing and an investment demand (Tse, Ho and Ganesan, 1999). Investment demand for residential property is the sum of housing demand and demand generated by the need for investments. Housing demand is included in investment demand since owner-occupied housing is both a consumption and an investment good (Hendershott, 1987). Investment demand thus includes owner-occupied housing, rental housing and housing bought for capital appreciation (Tse, Ho and Ganesan, 1999).

The choice to buy, rent or/and invest is determined by prevailing market factors applicable to the residential market participant. It is necessary to analyse each of these factors independently to analyse their effect on the housing market and whether they could be construed as leading indicators of house prices. For most working people in South Africa the largest portion of their wealth is the value of their house. Due to high home-ownership rates, the

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analysis in the chapter will focus on factors that influence the demand for housing (Luüs, 2003).

This chapter is divided into six sections. Section one serves as the introduction, while section two covers the macro demand variables applicable to residential real estate such as population, income, interest rates, inflation and employment. Section three is devoted to supply variables and is limited to construction cost, rental levels and occupancy rates. In section four the absolute and relative performance measures as indicators of the property cycle are discussed. Section five analyses the results of Granger causality tests and section six concludes with the summary of the chapter.

3.2 Macro Demand Indicators

During normal market conditions the demand for housing declines when housing prices increase, and thus housing demand is negatively related to real house prices. Any excess demand for residential properties is capitalised into higher house prices (Tse, Ho and Ganesan, 1999:626 and Peek and Wilcox, 1991:19). Housing demand is influenced by long-term and short-term economic factors. The former factors include growth in household disposable income, permanent features of the tax system and the average level of interest rates (Tsatsaronis and Zhu, 2004). The latter indicators are factors such as valued add tax (VAT), stamp and registration duties and estate taxes. Short-term indicators mainly relate to the liquidity of the housing market (Tsatsaronis and Zhu, 2004). As in chapter two the focus will remain on the macroeconomic indicators, since the state of the general market is discussed.

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3.2.1 Population Growth

In the previous chapter population growth was identified as an important factor of increases in demand for residential property. Population growth is a function of the local fertility rate and net immigration (Bollard, 2003 and Marcin, 1976). It has a direct influence on the demand for property, especially if the demand stems from the home buying age group with a significant income. This growth could be rapid and may cause a sudden increase or decrease in demand for properties (Trass, 2004:63).

Excess demand for housing caused by a sudden increase in population growth can result in an increase in rental levels, which translates into rising property prices (Trass, 2004:63). Higher levels of population growth also raises house prices through expectations that future higher population levels could cause higher prices (Marcin, 1976 and Tse, Ho and Ganesan, 1999). Thus a change in population leads to higher expectations of house prices (Tse, Ho & Ganesan 1999).

It is difficult to measure the impact of population changes on the South African economy, since population data are not available for an extended period of time. The results of only two censuses are available; one for 1996 and one for 2001 compiled by Statistics South Africa (Statistics South Africa, 2001). This provides an indicator of the behaviour of the South African population, but the political environment of the country underwent substantial changes in the preceding years and net migration cannot be used as a reliable indicator for previous years. The only available net migration data, compiled in 2001, relate to the white population, which comprises only about nine percent of the total population of South African (Statistics South Africa, 2001).

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Population also has an important influence on regional house prices. The growth in population is normally caused by urbanisation and employment, but it is also applicable to a micro-economic study.

3.2.2 Short-Term Interest Rate

Changes in the monetary policy, such as an increase in short-term interest rates, have an impact on house prices since most households have to borrow to acquire a property (Tse, Ho and Ganesan, 1999 and Lecat and Mésonnier, 2005). According to Absa senior economist Jacques du Toit, the mortgage debt as a percentage of household disposable income in South Africa was on average just above 40% from 1996 to 2002, making it an important consideration when entering the property market or when moving between properties (Rode, 2003). Thus interest rates have a major effect on property prices, but Trass argues that the effect is indirect (Trass 2004:74). Trass (2004) states that an increase or a decrease in interest rates creates a fear or greed response from inexperienced investors. This emotional reaction, rather than the actual increase or decrease, drives the changes in house prices (Trass, 2004:77-78).

A change in interest rates directly affects the disposable income of households and thus the affordability of properties. Adjustments to short-term interest rates have a stronger impact on house prices in countries with a variable mortgage rate, like South Africa, whereas adjustments to the long-term interest rate are relevant in countries with a fixed mortgage rate (OECD 2004:75; and Tsatsaronis and Zhu, 2004). Over the short term the effect of interest rates is further enhanced by the slow response of housing supply to increases in demand (Tsatsaronis and Zhu, 2004).

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The changes in short-term interest rates affect house prices through two channels: an income channel and a wealth channel (OECD, 2004). The income channel covers the effect of interest payments on a household (OECD, 2004). A lasting decline in real interest rates leaves a household with a smaller down payment, a higher disposable income and stimulates an increase in house prices. A higher disposable income makes it easier for the household to afford a larger/more expensive home, which leads to an acceleration in property transactions as house prices increase (Tse, Ho and Ganesan, 1999 and Lecat and Mésonnier 2005). The reverse is true for an increase in interest rates.

The wealth channel involves a demand link for housing. A decrease in interest rates causes a reduction in the relative cost of housing making investment in the residential market more attractive. An increase in demand, coupled with the short-term limited supply, increases the price of residential properties (OECD, 2004).

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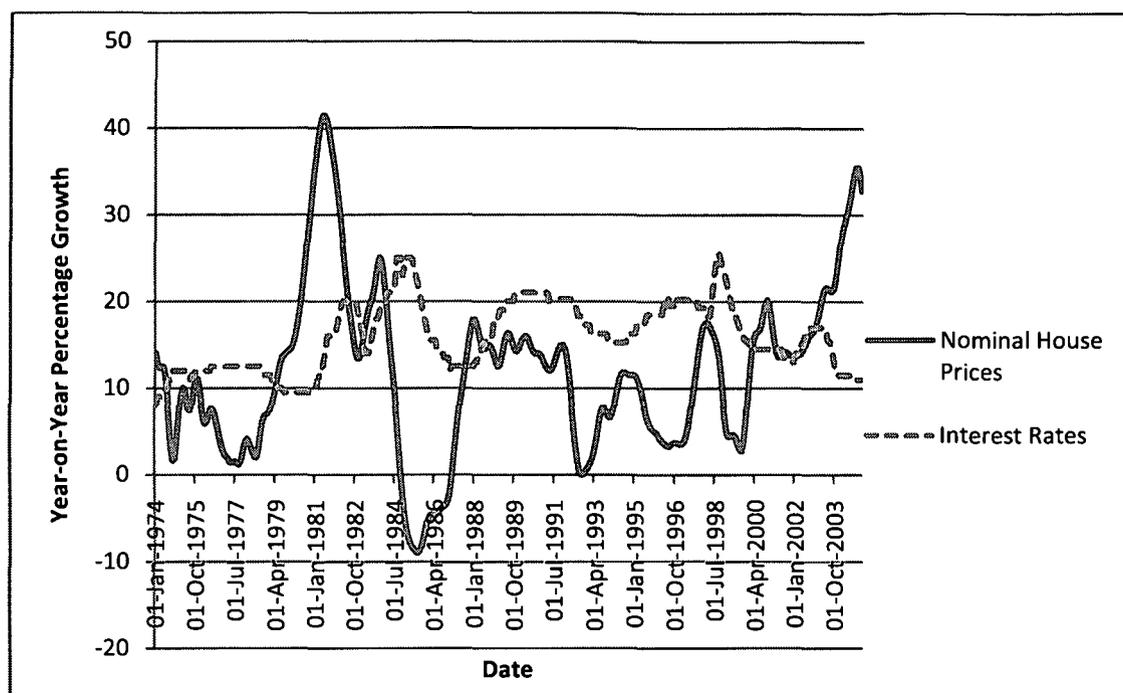


Figure 3.1: Nominal house price growth and interest rates for the period from 1974 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: House prices are represented by the nominal year-on-year percentage change and interest rates are the nominal prime interest rate as determined by the South African Reserve Bank

Figure 3.1 illustrates the relationship between nominal adjustments of the prime interest rate applied by the South African Reserve Bank and the year-to-year changes in nominal house prices. Since a decrease in interest rates has a positive effect on household income and thus on house prices, the relationship between interest rates and house prices is inversely related. This inverse relationship is clear in Figure 3.1 from 1995 onwards. During the period from 1998 to 1999 interest rates sharply increased from 19.25% in February 1998 to 25.50% in September 1998 and the nominal growth of house prices decreased from 17.60% in February 1998 to 2.70% in September 1999.

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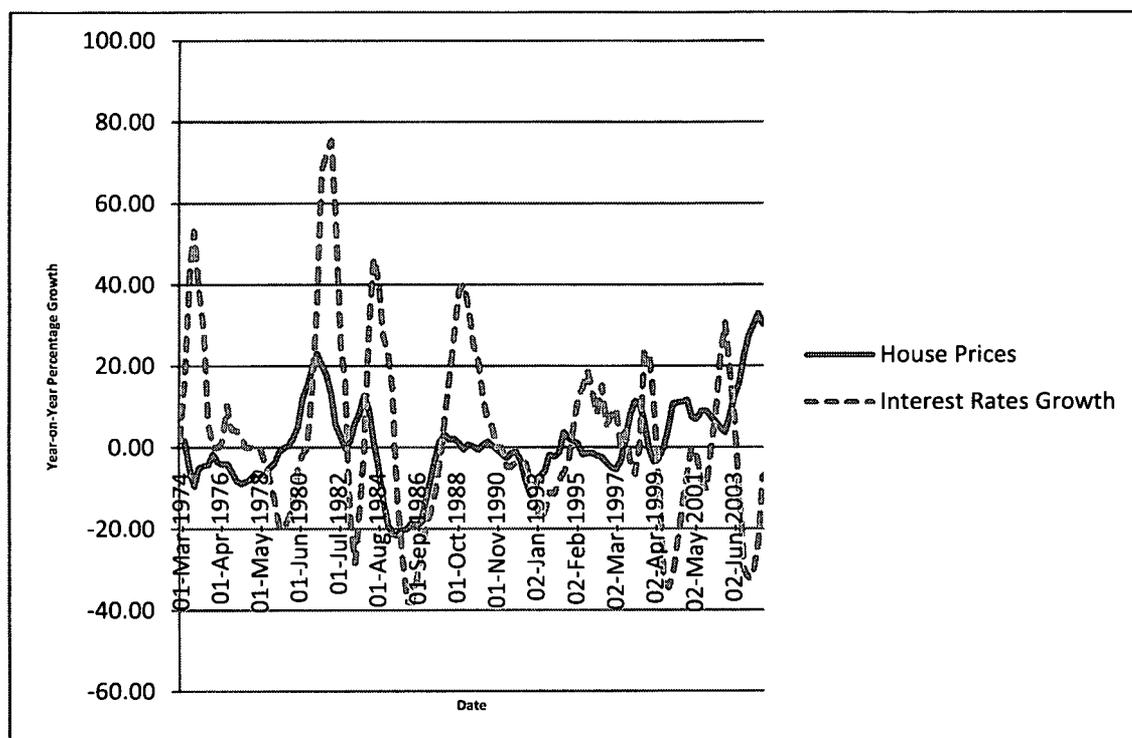


Figure 3.2: The year-on-year growth of quarterly real house prices and quarterly interest rates

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The house price is the real year-on-year percentage change and interest rates are the real prime interest rate

Figure 3.2 shows that during the same period interest rates increased from 13.92% in February 1998 to 17.87% in August 1998 and real house price growth decreased from 9.11% in February 1998 to 8.75% in January 1999. According to the analysis of the residential cycle and business cycle provided in Chapter 2, changes in interest rates that play a role in the changes of house prices should lead changes in house prices.

Rising interest rates exert a different effect on investment buyers and home buyers. It is most likely to reduce the number of investment buyers from the housing market (Tse, Ho and Ganesan, 1999). The magnitude of the effect of interest rates on house prices are determined by such factors as the elasticity

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of housing supply, inflation expectations and housing tax regimes (OECD, 2004).

The literature suggests that interest rates affect changes in house prices, but it is assumed that bank credit is readily available and thus that bank credit does not influence house prices. But credit availability does have some effect on house prices and, therefore, credit availability merits more attention.

3.2.3 Credit Availability

Credit availability refers to the availability of mortgage financing in the economic market. Credit availability plays a key role in the property cycle; the willingness of financiers to provide mortgage credit depends on the current phase the property cycle (Trass, 2004:159). Financiers adjust their lending policies throughout the duration of the property cycle to maintain their risk and exposure at desired levels. Normally mortgage credit would be easily available during a boom phase, making property purchases easier and assisting with an increase in demand that leads to an increase in price. During a slump mortgage credit would be harder to access, with the effect that the demand for properties decreases (Trass, 2004:160-161).

Interest rates and credit availability are inversely related. An increase in credit availability should cause a decrease in interest rates (Ng and Chow, 2004). The previous section indicated that a decrease in interest rates causes an increase in house prices. House prices in return affect both the supply and demand for credit. If house prices rise faster than available credit resources, the size of the mortgage requirement increases, automatically causing new houses to become less affordable. Fluctuations in house prices affect the supply of mortgages, since houses and erven are frequently used as collateral for mortgages (Lecat and Mésonnier, 2005).

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An increase in house prices reduces risk between lenders and borrowers and encourages bankers to lend more (Lecat and Mésonnier 2005). This could be a risky action, since the consequences of undisciplined credit extension financing on a runaway property market could be detrimental, as seen in Thailand during 1997 (Ng and Chow, 2004).

Since credit and property prices are highly correlated, a mass default on mortgages is likely to cause a decrease in property prices. In such an eventuality banks would be unable to obtain the acquired liquidation price on default properties (Ng and Chow, 2004).

The inverse relationship between interest rates and credit availability means that a positive change in interest rates can be used as a proxy for negative change in credit availability (Ng and Chow, 2004). To effectively analyse the effect of credit availability on house prices in a market where credit availability is exogenously separated from the interest rate, a closer investigation may well be required. Ng and Chow (2004) tested the effect of credit availability on the residential property market (both private and public) of Singapore, which provides a unique separation between credit availability and interest rates. Their results suggest that property prices are caused by bank credit, but that the effect is short-lived when compared to determinants such as interest rates and affordability (Ng and Chow, 2004).

3.2.4 Inflation

In order to determine how inflation influences residential real estate, it is necessary to define inflation. According to Koelsch (1981) the most appropriate definition in the real estate context for inflation is that inflation is a rise in the general level of prices (Koelsch, 1981:522). Recent studies found

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that although changes in house prices increased more rapidly than consumer price inflation (CPI), house price variability is correlated with inflation variability. House prices respond positively to both expected and unexpected inflation (Anari, 2002). The supply of housing is fixed in the short term, leaving demand to affect residential real estate prices, which may cause the price changes to lead or lag behind inflation changes (Koelsch, 1981:522). A constant increase in inflation would make it seem as if the property cycle is increasing constantly irrespective of the phase in which it is. This is because an increase in inflation is reflected in construction, income and household costs (Trass, 2004: 78-79).

In the long term general price increases are reflected in housing through two channels. Housing is both an investment good and a consumer good and changes in the prices of goods and services are transmitted through both channels. As a consumer good housing responds to inflation through construction: an increase in the cost of building material and labour translates into an increase in construction cost and a rise in the price of new homes. Thus newly developed residential real estate directly reflects the effects of inflation. Existing houses are a close substitute for new houses and, according to the principle of substitution, an increase in the price of new houses causes an increase in the price of existing housing (Anari, 2002 and Koelsch, 1981:522).

Residential real estate as an investment good responds to inflation through changes in its income stream measured by its future rents and value. Since the present value of a property equals the present value of anticipated future cash flows, a change in the expected income brought on by a change in expected inflation causes an increase in house prices (Anari, 2002 and Koelsch, 1981:526). As inflation increases more investors are drawn into the property market on the basis of an expectation of future appreciation in house prices. During periods of high inflation housing is seen as an effective hedge against inflation (Tse, Ho and Ganesan, 1999). Changes in house prices

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through the construction and labour channel are caused by actual inflation, whereas changes through the investment channel are caused by expected inflation. Since the South African residential market consists predominately of owner-occupied houses, the major influence on house prices should be actual inflation (Luüs, 2003). Figure 3.3 illustrates the year-on-year growth in house prices and inflation for 1974 to 2004.

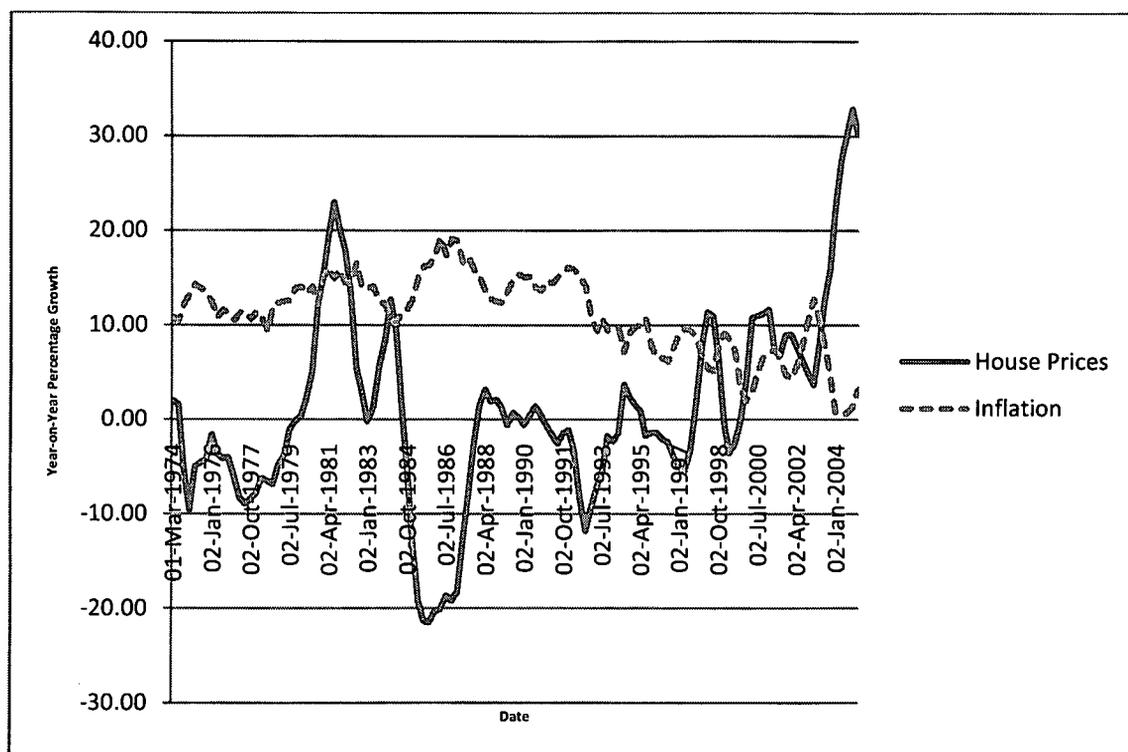


Figure 3.3: The year-on-year growth in real quarterly house prices and inflation for 1974 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The data are seasonally adjusted

Figure 3.3 presents the relationship between changes in consumer price inflation (CPI) and changes in house prices in South Africa for the period from 1974 to 2004. The figure shows that during the period from 1980 to 1982 house prices reflected an increase, but there was no noticeable effect on inflation. From 1984 to 1988 growth in house prices decreased, but inflation

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growth increased. This inverse relationship is also shown from 2002 to 2004. It is clear that the figure does not reveal any definitive relationship between the growth in house prices and inflation growth. The reason for this may well be that although inflation influences house prices, it is not one of the relevant key drivers (Trass, 2004:78-79). Residential prices can increase during periods of disinflation and decrease during periods of high inflation. The figure clearly shows that house prices are more volatile than inflation. House prices are generally seen as a cause of consumer inflation and thus inflation is a lagging indicator of changes in house prices (Black, Fraser and Hoesli, 2005).

3.2.4 Income

Under normal circumstances home buying is limited by personal income. This causes house prices and income to be linked by a long-term relationship (Gallin, 2003). It is expected that a more rapid rise in house prices than income would enhance income constraints, since income is the base for the prices that buyers are able to afford to pay and for recurring maintenance outlays (Grebler and Mittelbach, 1979). Thus a faster rise in income than in house prices should make property more affordable.

The influence of income on house prices is reflected in the relationship of income growth towards growth in house prices (Ortalo-Magné and Rady, 2000 and Trass, 2004:66). To a significant extent changes in income may account for the growth fluctuations of house prices (Ortalo-Magné and Rady, 2000). This is called an affordability ratio and is discussed as part of the relative performance measures later in the chapter. Figure 3.4 illustrates the relationship between growth in house prices and disposable income growth.

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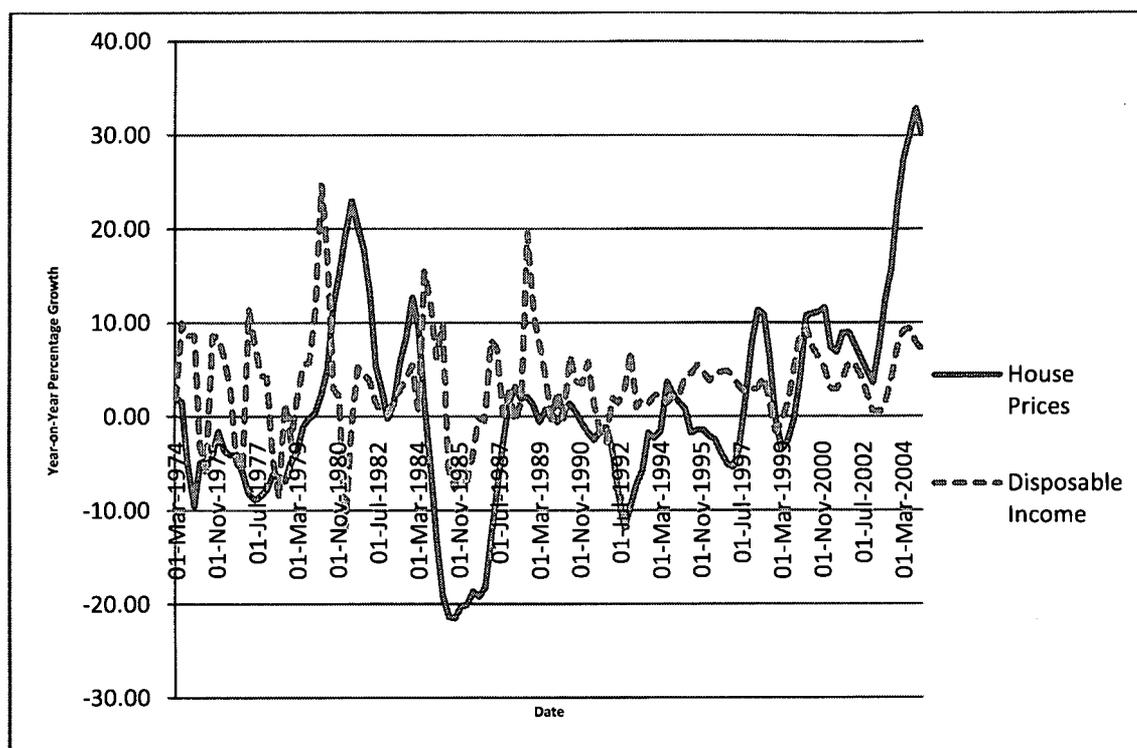


Figure 3.4: The year-on-year growth in quarterly house prices and disposable income for 1974 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: Data are seasonally adjusted

Figure 3.4 illustrates the high correlation between growth in house prices and disposable income. This is particularly evident for the period from 1999 to 2004. The co-integration of house price growth and income growth suggests that a lag between the two could help in forecasting house price growth changes (Gallin, 2003). Normally income growth would peak near the end of the boom and trough near the end of the slump (Trass, 2004:66).

3.2.5 Capital Gains Tax and Personal Income Tax

Tax, as a determinant of residential real estate prices, influences property prices through three channels: capital gains tax, deductions of interest

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payments and depreciation allowance (Nevile, Tran-Nam, Vipond, and Warren, 1987).

Countries, such as the UK and USA, make a distinction between the affordability of owning and renting properties by granting tax incentives in the form of an interest reduction and depreciation allowance to the ownership of properties (Bourassa, 1996). Since the deduction effectively insures that homeowners pay less for mortgage financing, the cost of financing determines the demand for and the price of housing. Positive changes in mortgage deduction should cause an increase in house prices (Boelhouwer, Haffner, Neuteboom and De Vries, 2004). Changes in income tax regulations relate to changes in the disposable income of households. A relief in income tax regulations causes an increase in disposable income, whereas an increase in income tax liabilities decreases disposable income.

Capital gains tax (CGT) impede the housing sector mechanism by making the housing assets less liquid, but the effect of CGT on the South African residential market is minimised. Capital gains tax is only applicable on profits relating to owner occupied houses above R 1,5 million, and of this profit only 50%, in the case of legal persons, and 25% for natural persons would be taxed at the marginal tax rate. Capital gains tax is applicable on all second homes. Speculation in second homes has never been a significant aspect of the residential market and this further minimises the effect of CGT (OECD, 2004 and Rode, 2000). Figure 3.5 illustrates the year-on-year growth in house prices from 1999 to 2004, which includes the period during which CGT was introduced.

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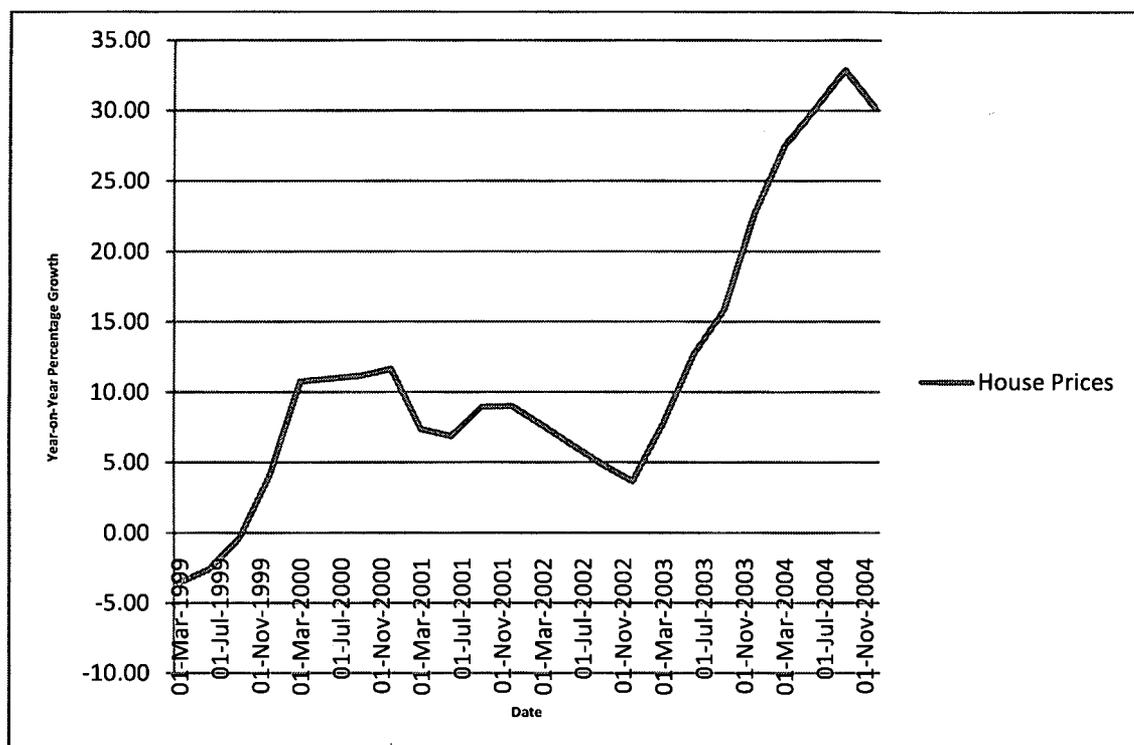


Figure 3.5: The year-on-year residential property growth cycle from 1999 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The data are seasonally adjusted

Figure 3.5 suggests that the introduction of CGT on 1 October 2001 occurred during a slight upswing phase in the growth cycle of the property market, but the cycle entered a downswing phase in the next month. This could be attributed to the introduction of CGT, but it was more likely caused by other determinants, since the announcement that CGT would be introduced, was already made on 23 February 2000. At the time of the announcement the residential property cycle was experiencing its first prolonged upswing in more than 15 years, but entered into a period of low and negative growth until late 2002.

According to the efficient market hypothesis, markets adjust to information as soon as it is introduced into the marketplace, but the real estate

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market has proven to be inefficient, making it difficult to pinpoint the effect on the residential real estate market because of the introduction of CGT (Rosenthal, 1999). The real estate market is also illiquid where liquidity refers to the inverse of the amount of time that elapses between the decision to sell the property and the receipt of the full value of the property by the seller. The liquidity of the market changes as demand for properties increase, but the market is not as liquid as the stock or bond market (Kluger and Miller, 1990)

The impact of changes in the tax regulations applicable to property could be summarised as follows: a positive amendment (e.g. reduction in CGT) could extend the boom and recovery phases of the property cycle, and shorten the contraction and recession phase. A negative amendment (e.g. reduction in the deduction of mortgage interest) may shorten the upswing phase of the cycle and lengthen the downswing phase (Trass, 2004:79).

3.2.6 Employment

Employment is defined as the percentage of people that are currently employed (Trass, 2004:64). High employment levels normally signify high income levels which translates into a lower affordability ratio. Changes in employment could be important determinants of residential prices (Luüs, 2003).

In South Africa, employment has not shown significant growth since the mid-1980s, especially during the period from 1985 to 1993. Rigid labour market conditions, instilled through restrictive labour laws and a highly unionised work force, make the probability of increases in employment unlikely (Luüs, 2003).

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3.3 Macro Supply Indicators

Traditionally demand variables exert a larger effect than supply variables on the increase of house prices and thus the supply indicators for housing have not been researched as much as the demand indicators (Anon, 2004a and Dipasquale, 1999). The supply of housing stock is positively related to real house prices, meaning that an increase in house prices causes an increase in the supply of housing (Tse, Ho and Ganesan, 1999 and Peek and Wilcox, 1991). Changes in the supply of housing are the result of decisions by home-owners and investors (Dipasquale, 1999). This decision is influenced by house prices, rental rates, construction activity and government regulations.

3.3.1 Construction Cost

As noted above, changes in the supply of residential properties are caused by the decisions of investors and home-owners. Their decisions are influenced by the future expected selling price of the house relative to its cost (Fair, 1972).

The cost of construction may be divided into two components. Component one is actual construction cost, that is, the sum of the actual labour and material costs, construction financing, management costs, overhead costs and profit. The actual cost of materials can fluctuate due the availability of supply of necessary construction materials. This will also influence the cost of construction. Component two is the price of land (Meikle, 2001 and Saltojanas, 1984). Construction prices are very closely related to demand for construction, because as the demand for housing rises, construction prices increase (Meikle, 2001). The cost of new houses could only affect the price of housing if new housing supply significantly changes the size of the housing stock. In all other instances an increase in the actual construction cost would only alter the

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relationship between component one and two (Abelson, Joyeux, Milunovich and Chung, 2005).

The changes in construction cost emanated in changes in demand for housing, offering the explanation that an increase in demand for housing causes an increase in construction cost (Peek and Wilcox, 1991). This is revealed by construction costs found to be highest during the peak of the construction cycle and lowest during a recession. The reason is that the contractors often pay a premium during the peak to secure resources and obtain discounts during the recession (Meikle, 2001) Land prices are also derived from house prices and thus do not exert any influence, but are rather influenced by house prices (Meikle, 2001).

Hendershott and Abraham (1994) found that in countries that have minimal governmental influence and where land is freely available, construction costs exert a bigger influence. Figure 3.6 illustrates the year-on-year growth in house prices and construction cost.

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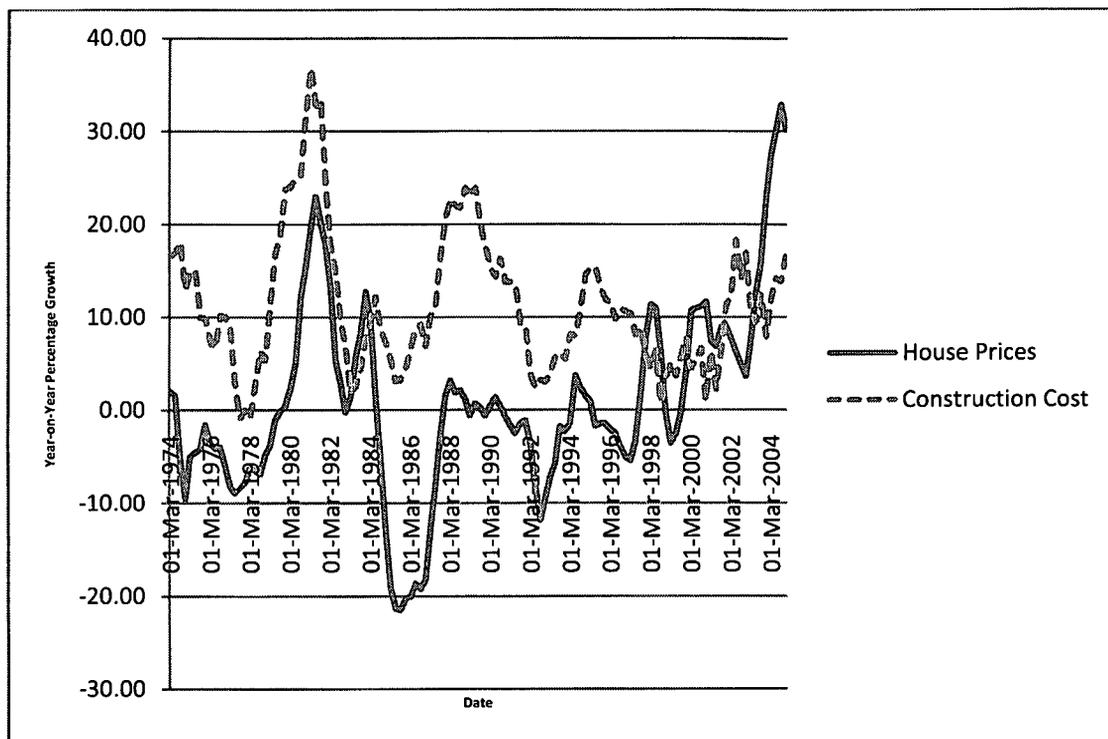


Figure 3.6: The year-on-year growth in South African house prices and construction cost from 1974 to 2004

Source: Data supplied by ABSA and the Bureau of Economic Research

Note: The data are seasonally adjusted

Observing the South African situation presented in Figure 3.6, the increase in the level of construction costs has been in step with the increase in house prices. This is especially evident in the period from 1978 to 1984. This relationship is not as clear from 1998 to 2004. During the complete data period construction cost has never experience a negative growth.

3.3.2 Rental Price Level

House prices are affected by rental levels through three channels: the capitalised value of rentals, the yield required from properties and the comparison of buying to renting.

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Rental levels are defined as the average amount of rents paid per month and are a direct influence on property prices according to the principle of capitalisation: the net operating income of a property divided by its capitalisation rate results in the price of the property (Rode, 2004). Thus the rental price value is capitalised into the price of housing. The capitalisation rate for the market is not easily assessable in South Africa, but Rode and Associates perform a monthly survey of net operating incomes and property prices to determine market capitalisation rates (Rode, 2004 and Spellman, 1981:206). This channel does not actually influence property prices; it is an approach to accurately determine the market values for properties.

Rental levels do influence property prices through average net rental yields, where the net rental yield is the annual rent for a property with allowances for maintenance, management fees and vacant periods (Economist, 2005a).

The residential property buyer has two tenure choices, renting or buying, with risks associated with each. Renting has the risk of rent fluctuations, whereas home-owning has an asset-price risk (where asset-price risk refers to the risk of a reduction in the value of a home). When considering a tenure choice, interested parties take into account the above two types of risk and compare these with the cost advantages of owning versus renting (Sinai and Souleles, 2003:3). External market factors also play a role in a tenure choice, but they are factored into the risk considerations. For example: a high inflation rate may drive more people to buy homes, but such action in turn increases rent risk.

The dominating consideration for most households is rent risk, which allows the rental price level to influence homeownership rates and house prices. As mentioned previously, house prices represent the capitalised value of future

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rent expectations, but house prices also include a premium for rent risk. An increase in rent risk increases demand for owner-occupation and causes a rise in house prices (Sinai and Souleles, 2003:3-6).

The demand for owner-occupied housing is also influenced by the cost of owning versus the cost of renting. It is normally more expensive to own a house than to rent one, but since most households consider rent risk, the difference between the two needs to reach very high levels before households would choose renting as a long term solution (Economist, 2005a and Sinai and Souleles, 2003:28-30). This is measured by the price-rent relationship and is discussed as a relative performance measure.

The rental price level in the residential property price cycle increases during a boom to compensate for the increase in demand and normally reaches unsustainably high levels. During the slump it under-compensates for the decrease in demand and reaches very low levels. Rents peak near the middle of the boom and trough near the end of the slump (Trass 2004:65-66).

3.3.3 Occupancy Rates

The occupancy rate indicates the level of occupancy in the property market and is the inverse of the vacancy rate. Occupancy levels in the property market indicate the balance between the supply and demand in the market. Occupancy levels influence rental growth rates through the interaction between supply and demand (Mueller, 1999:131). A high level of occupancy, coupled with demand, cause rental levels to rise and rental growth rates to increase. Low occupancy levels force owners/investors to lower their rental levels to remain competitive.

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The physical property market is only in equilibrium at two points during a long classical cycle: once during the upswing phase and once during the downswing phase when the demand and supply growth rates are equal. These two points are identifiable in the property cycle when it crosses the long term average occupancy (LTAO) (Mueller 1999:135). The LTAO is a rate calculated over a number of historical property cycles. The LTAO may be used to distinguish between the two phases of the upswing and the two phases of the downswing.

The occupancy rate has an indirect influence on house prices through rental price levels, but this does not mean that it could be discounted as an indicator for house prices. A low occupancy rate indicates an oversupply of residential properties and could indicate a decrease in house price growth. The occupancy rate normally peaks during the recovery phase and troughs during the slump (Trass, 2004:63). There are no vacancy statistics available for the residential property market in South Africa.

3.4 Performance Measures

Performance measures are popularly used in the media as indicators of the state of the residential property market. Absolute performance measures refer to values, such as property sales volume and personal savings, whereas relative performance measures refer to relationships between two variables, such as the debt-to-income relationship and the affordability relationship.

3.4.1 Absolute Measures

3.4.1.1 Volume of Property Sales

The volume of property sales refers to the number of actual property sales in a specific area during a specific period (Trass, 2004:70). Transaction

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volume is popularly used in the media as a measure of activity in the property market (Rode, 2005 and Krainer, 1999). It is further used as a property index, such as the First National Bank Residential Property Barometer (FNB). Even though sales volume may measure the state of the market, the question remains whether or not it could predict the direction of house prices.

Studies performed on the residential market in Hong Kong are ambiguous. Tse and Webb (2004) found that a growth in house prices causes changes in transaction volumes. This suggests that an increase in house prices cause an increase in transaction volume. Tse, Ho and Ganesan (1999) in turn found that transaction volume causes house prices to change in Hong Kong.

In the Australian market changes in transaction volume precedes changes in house prices. Transaction volume peaks near the end of the boom and troughs near the end of the slump (Trass, 2004:70). This does not solve the problem of whether the increase in house prices is influenced by transaction volume, but it does iterate the significance of transaction volume as a leading indicator of residential property prices.

3.4.1.2 Personal Savings

Personal savings by households is commonly regarded in the literature as an indicator of the state of the economy. The link between personal savings and house prices is not as prominent as commonly stated, but a tenuous link does exist. Engelhardt (1995) found that changes in personal savings are caused by changes in house prices, but the evidence is not conclusive. Real housing capital gains should result in a decrease in non-housing savings, but empirical evidence in the US does not support this assumption, whereas capital losses result in a decrease in households' propensity to save (Engelhardt, 1995).

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3.4.1.3 Gross Domestic Product (GDP)

In many countries growth in house prices and the business cycle are closely correlated (Girouard and Blöndal, 2001). Since gross domestic product is the popular measure of the business cycle, GDP may be used as an indicator of the state of the residential property market. Figure 3.7 illustrates the year-on-year growth in quarterly house prices and GDP for the period from 1974 to 2004.

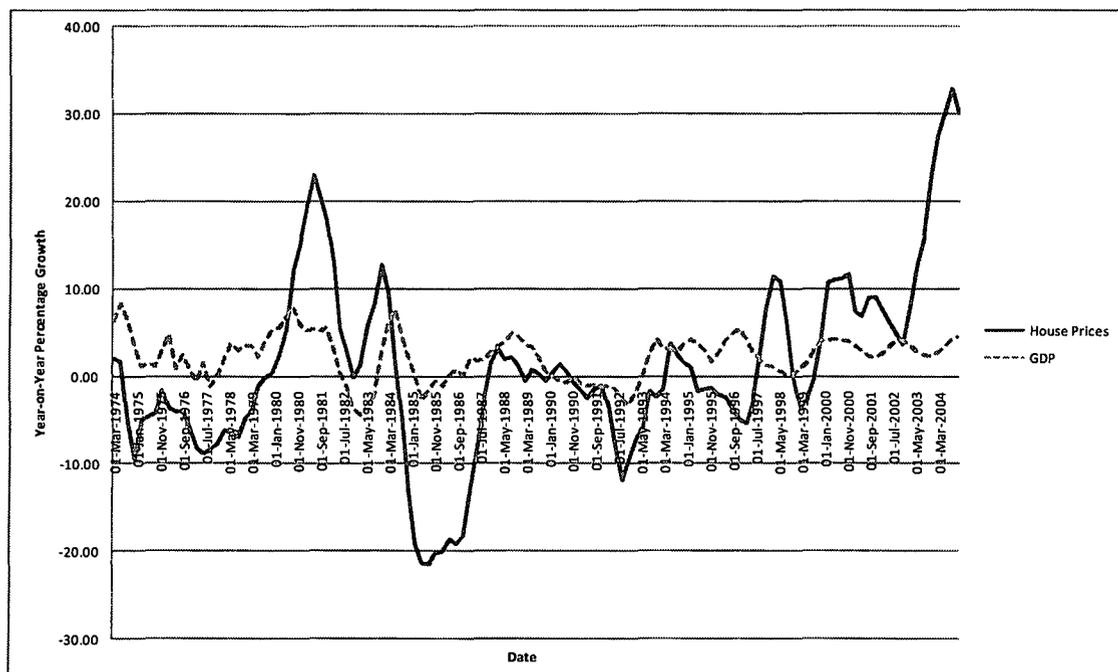


Figure 3.7: The year-on-year growth in quarterly house prices and GDP for 1974 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The data are seasonally adjusted

During the period from 1974 to 1984 Figure 3.7 shows that growth in GDP corresponded with growth in house prices. The figure shows no clear correlations with house prices after 1995. It does not seem as if a single factor

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can indicate why it would appear that the relationship between the growth in house prices and GDP growth changed after 1995.

3.4.1.4 Household Consumption

Changes in house prices and private consumption are correlated in most countries. House prices affect the level of household consumption through housing wealth channels. An increase in the value of a consumer's house causes an increase in the overall wealth of the household. The increase in the value of housing can improve access to credit for some households; depending on the credit constraints applicable in the country. The overall rise in wealth entices consumers to increase their household consumption (OECD, 2004). Figure 3.8 illustrates the year-on-year growth of house prices and household consumption.

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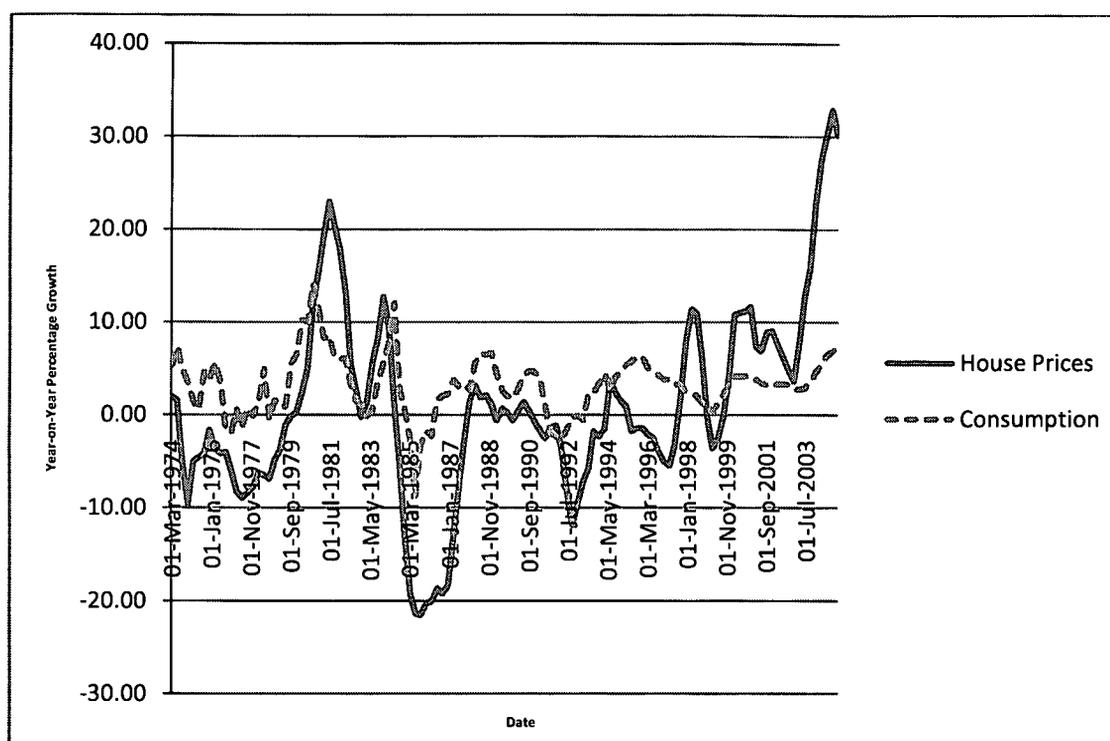


Figure 3.8: The year-on-year growth in house prices and household consumption for 1974 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The data are seasonally adjusted

Figure 3.8 illustrates a positive relationship between the growth in house prices and household consumption growth from 1974 to 1995. As with GDP the relationship is not clear after 1995. Household consumption still registers a positive relationship with the growth in house prices during the last years of the data set with an increase in growth during the same period when house prices showed significant increases from 2003 to 2004.

3.4.1.5 Stock Market

The interdependence between the financial asset market and the housing market is often discussed in literature (Oikarinen, 2006). There are common macroeconomic factors that drive the movements in the stock markets,

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bonds market and housing, for example interest rates and inflation. Furthermore a strong positive relationship between the stock market and housing market is likely because both markets are influenced by income. While the two linkages between the stock market and the house market are positive, there is nevertheless a suggestion of a negative relationship (Oikarinen, 2006).

The first positive link is that the appreciation of an asset class exerts some wealth effects on consumption and investment. An increase in house prices increases wealth that leads to greater consumption and thus growth in general economic activity. The positive relationship between house prices and construction activity further increases the economic activity. Growth in the economic activity strengthens the cash flow expectations in the stock market which enlarges the demand for equity. An increase in house prices relaxes credit constraints and the latter in turn allows investors to borrow for more investment in the stock market (Oikarinen, 2006).

Secondly, strategic portfolio allocation could raise the demand of one asset when the growth of the value of another asset increases significantly. That is to say, if an investor maintains the ratio of the assets in his portfolio on a constant level, an increase in stock prices would cause an increase in activity in the housing market and in house prices (Oikarinen, 2006).

A "feedback" effect could cause a negative relationship between the stock market and the housing market. The feedback has its roots in backward-looking investors' expectations of future returns on the asset. This increases the demand for one asset, while decreasing the demand for the other asset. The feedback effect is mostly a short-term effect (Oikarinen, 2006).

The housing market is not as efficient as the stock and bond markets and this causes that changes in prices are expected to start in the stock and

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bond market and thereafter flow to the housing market. This means that an increase in the stock and bond market should lead to an increase in the housing market (Oikarinen, 2006). Figure 3.9 shows the relationship between the growth in house prices and stock prices from 1974 to 2004.

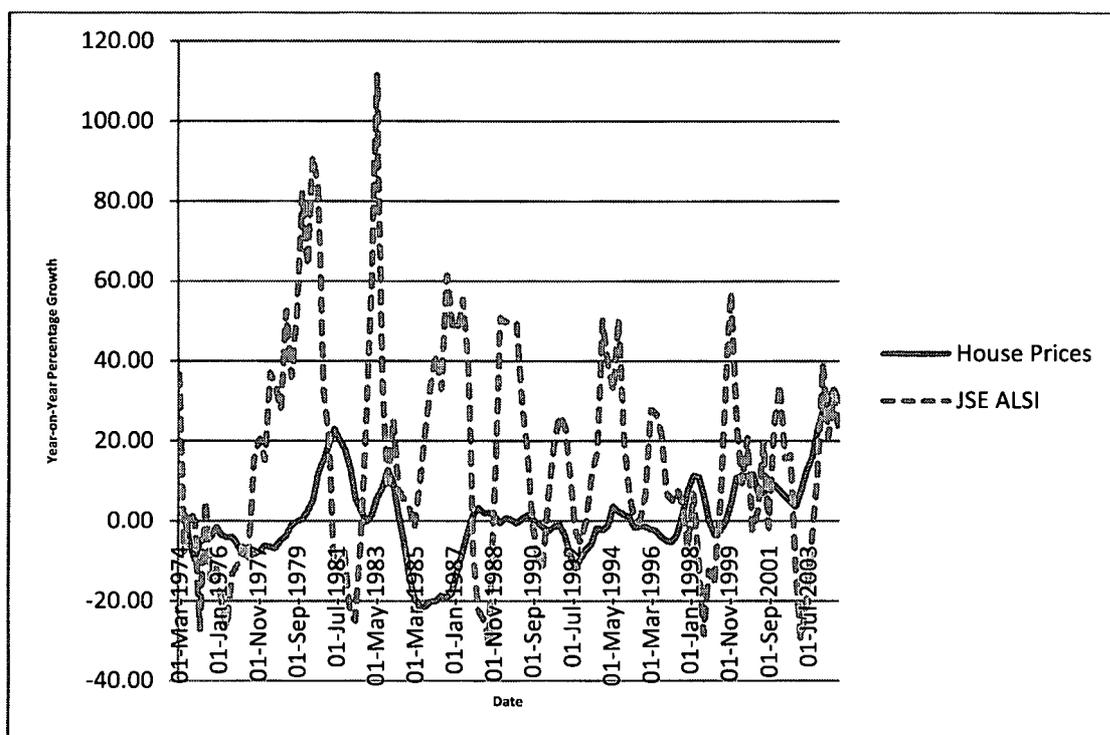


Figure 3.9: The year-on-year growth in house prices and the JSE All Share Index from 1974 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The data are seasonally adjusted

Figure 3.9 suggests that growth in the stock market is more volatile than the housing market, making the measurement of a relationship between the two markets difficult. In the short term the correlation between the price movements may be negative or positive, depending on the current market conditions, the rationality of the investors and on the length of the observation period. Psychological factors, such as the feeling of safety, may weaken the linkages between the stock market and housing (Oikarinen, 2006).

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3.4.2 Relative Measures

3.4.2.1 The Price-Rent Relationship

The price-rent relationship in the property market may be likened to the price-dividend relationship of stock on the market. This relationship is commonly used as an indicator to assess the state of the property market. A high relationship is interpreted as an overvalued property market with property prices increasing faster than rents. This is often interpreted as a bubble. The reverse is also true for a low relationship (Krainer, 2004).

Rental levels are capitalised into house prices: major fluctuations in the price-rent relationship stem from expected future returns, which are reflected in the expected level of house prices. These price changes are normally out of proportion to changes in rental values. This suggests that the price-rent relationship could be used as a predictive measure of future house prices (Krainer, 2004).

The price-rent relationship functions on a long term average rate, which indicates a long term equilibrium between house prices and their rental price levels. Deviations from this rate are analysed to predict the future direction of house prices or rental levels. With regard to what specific factor is suspected of adjusting to reach the equilibrium depends on changes in external economic factors. For example: if the rent-price relationship is above the equilibrium level house prices may adjust downward, house prices could stagnate or the rental prices can increase. In a high interest rate environment, house prices would stagnate or adjust downward. In a high inflationary environment, rental levels would adjust upwards. In the past the latter has normally been the case since house prices rarely adjust downward (Economist, 2005a and Economist, 2005b).

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More recently this has not proven to be the case, specifically in the UK and Australia. In both cases the downward trend in house prices has been preceded by minimal increases in interest rates. This does not disprove the historical relevance of the price-rent relationship, but it does cast some doubt on this relationship (Economist, 2005b). In conclusion, the price-rent relationship may be used as an indicator for the direction of rental values.

3.4.2.2 Affordability of Property

The affordability of property is a measure of how affordable it is to own or invest in property, but it may also be used as an indicator of the state of the residential property market. The definition of affordability refers specifically to ownership. Affordability is influenced by factors, such as finance availability and cost, income levels, rental levels, housing costs and tax systems (Bourassa, 1996; Muellbauer and Murphy, 1997; Saltojanes, 1984 and Trass, 2004:67).

The most common measure of affordability is the cost of property to disposable income ratio. According to the ratio, if a household pays more than thirty percent of its income on housing costs it has an affordability problem. (Housing costs are defined as mortgage payments, maintenance expenses and property taxes.) This test is not sufficient, since households with a minimum income would never have enough disposable income no matter how much money it spends on housing, while households at the top will have more than enough disposable income, even if they spend above the maximum thirty percent (Bourassa, 1996).

Further variations on the measurement of housing affordability are the medium house price-to-average income ratio and the housing loan-to-income ratio, but both are burdened by the same problem as above (Hsueh and Chen, 1999). This problem could be solved by dividing the population into the 8 Living

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Standards Measurement (LSM) groups developed by the South African Advertising Research Foundation (SAARF). For the purpose of this study the LSM groups are not useful, since they have only been in existence since 1989/90 and the measurement has changed considerably over the years. It may well be useful for further studies (Anon, 2004b).

The mortgage repayment-to-income and house price to income ratio as an indicator of affordability and the state of the residential property market are used regularly in the South African media (Preus, 2004). According to Jacques du Toit the house price to income ratio is the generally accepted method for measurement of affordability. Figure 3.10 illustrates the affordability of house prices from 1980 to 2004.

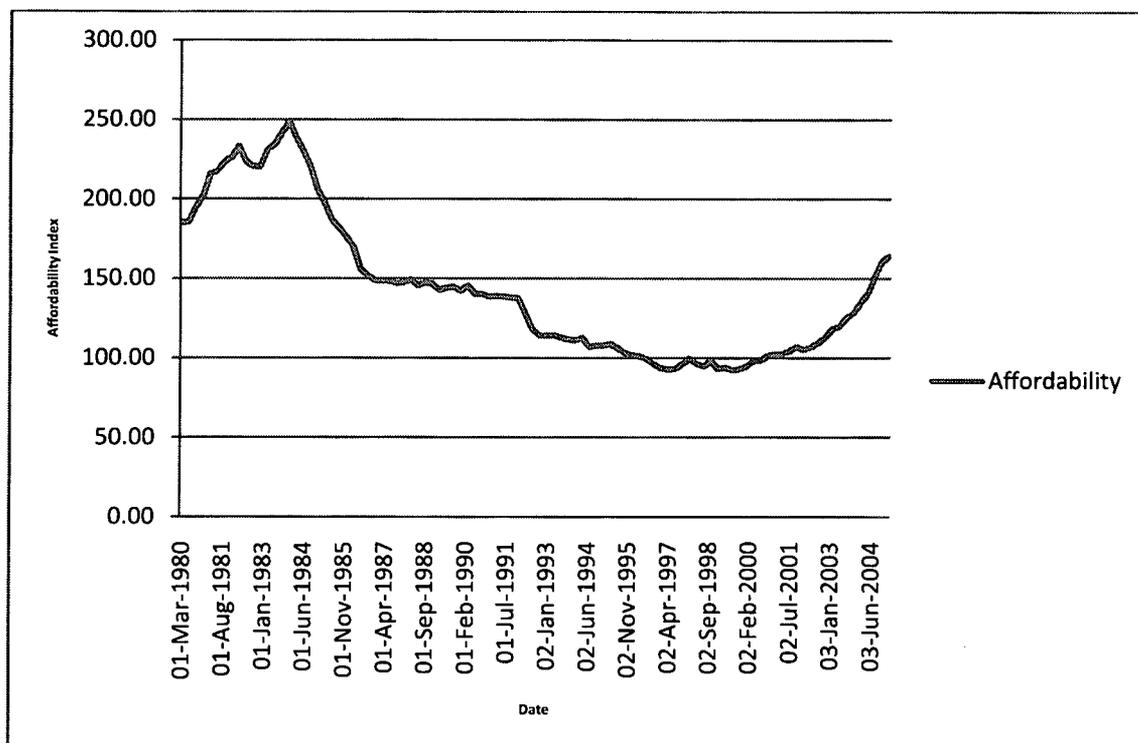


Figure 3.10: The affordability of house prices measured with nominal house price to nominal income from 1980 to 2004

Source: Data supplied by Absa

Note: The income is based on labour costs in the non-agricultural sector, remuneration per worker

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Figure 3.10 illustrates the affordability of housing, measured with the house price to income ratio, in South Africa since the early eighties. A rising rate means that house prices are rising faster than incomes and that housing becomes less affordable (Anon, 2005). After a long stretch of declining affordability, house prices increased faster than income and caused the affordability ratio to increase. If the ratio is small, the residential market could expect price increases, as demonstrated in Figure 3.11 (Donnel, 2003). Even though housing is currently becoming less affordable it is nowhere near the heights it reached in 1984.

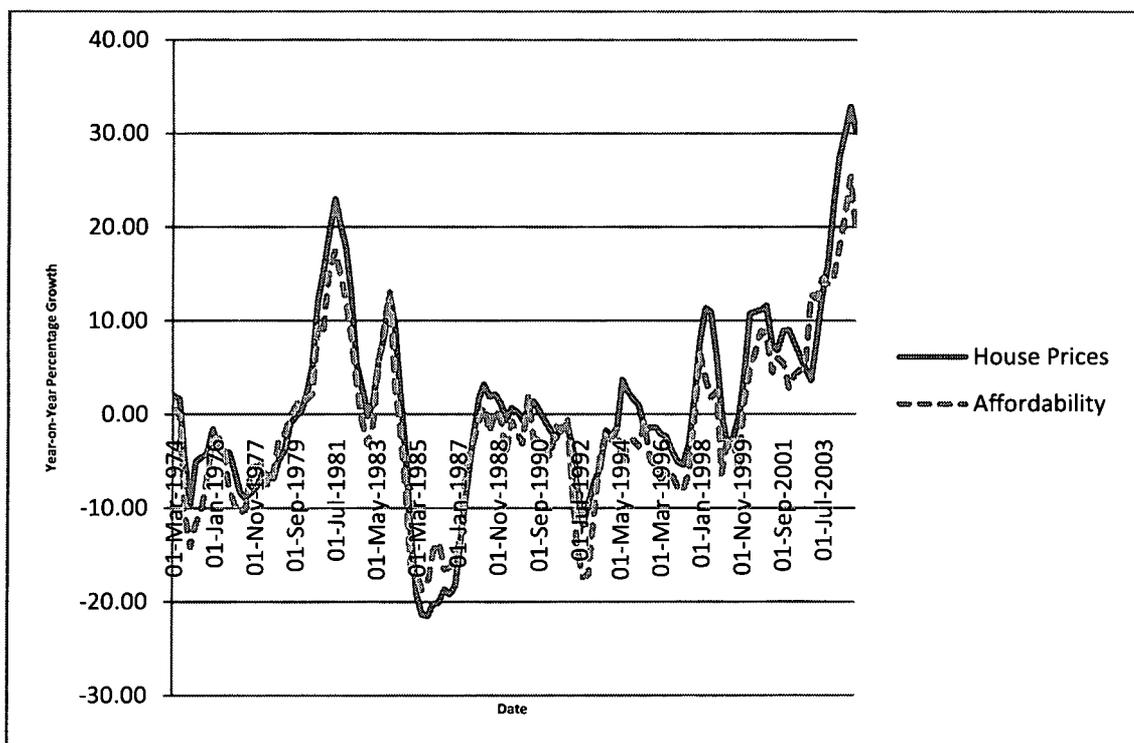


Figure 3.11: The year-on-year growth in quarterly house prices and affordability for 1974 to 2004

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The data are seasonally adjusted

Property affordability is an important indicator for property prices, since it could function as an early indicator for a rise or fall in property transactions.

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Property is least affordable during the beginning of a slump and most affordable during the recovery (Trass, 2004:67). Figure 3.11 illustrates that there is a close relationship between growth in house prices and growth in affordability during the entire sample period which is from 1974 to 2004. It appears that the affordability ratio consistently coincides with changes in house prices in South Africa. The house price data used for the growth in house prices and the growth in affordability are both provided by ABSA and may be the cause of the positive relationship shown in Figure 3.11.

3.4.2.3 Debt Measures

Housing debt measures is another popular indicator of the state of the housing market. There are two debt measures: the loan-to-value ratio and the debt-to-income ratio. The loan-to-value ratio is the relationship of mortgage debt towards the value of the underlying property and is used to measure financial leverage (Wikipedia, s.a.). Figure 3.12 illustrates the relationship between growth in house prices and growth in the debt-to-income ratio.

Determinants of the South African residential real estate growth

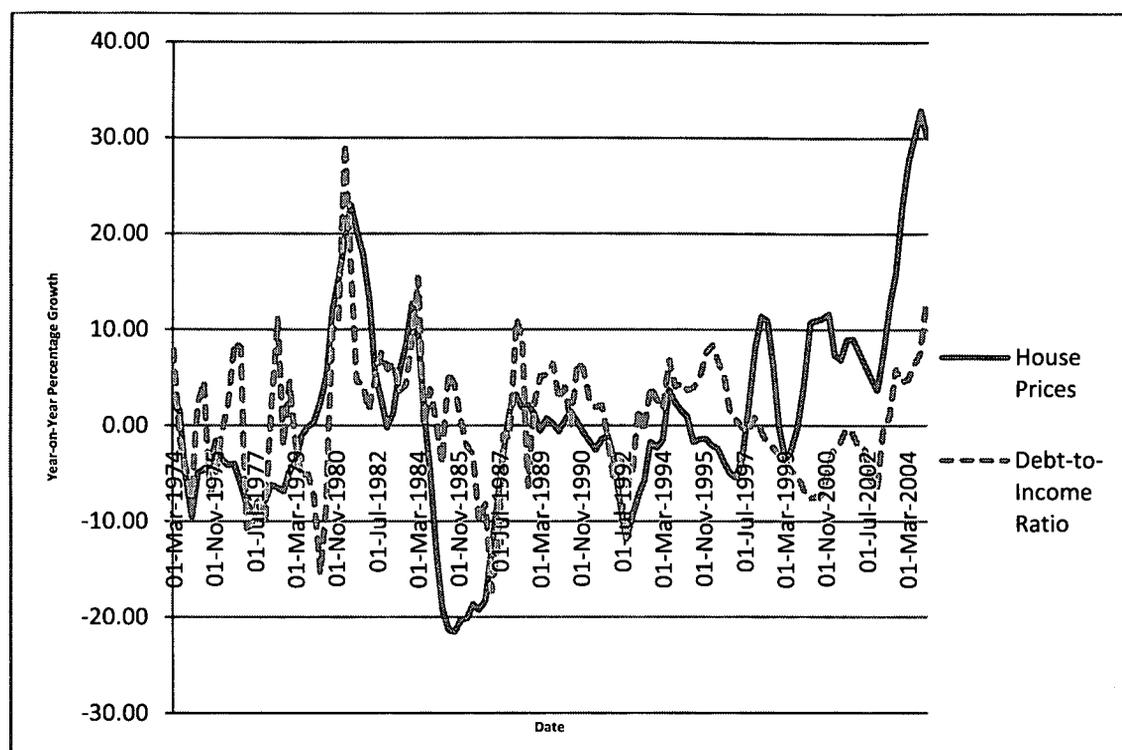


Figure 3.12: The year-on-year growth in quarterly house prices and the debt-to-income ratio for 1974 to 2000

Source: Data supplied by ABSA and the South African Reserve Bank

Note: The data are seasonally adjusted

The figure illustrates that changes in house price growth continuously leads changes in the debt-to-income ratio. This suggests the debt-to-income ratio to be a lagging indicator of changes in house prices. This is evident in the period from 1981 to 1983. The debt-to-income ratio is the ratio of mortgage payments to disposable income. A high ratio shows that households are becoming dependent on rising property values to service their debt (Wikipedia, s.a.). The debt-to-income ratio is mostly influenced by changes in interest rates (Loos, 2004b).

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3.4.2.4 The Exchange Rate

The exchange rate has a significant influence on an economy whose business cycle is driven by its current account. A weak exchange rate causes exports to increase and has a positive influence on the business cycle and by extension on the real estate cycle (Cloete, 1990:29). For this study the rand-dollar exchange rate was used to analyse the effect of the exchange rate on house price growth. The rand-euro exchange rate would also be applicable, but the euro has not been in existence for the complete data period. Figure 3.13 shows the growth in the rand-dollar exchange rate and house prices.

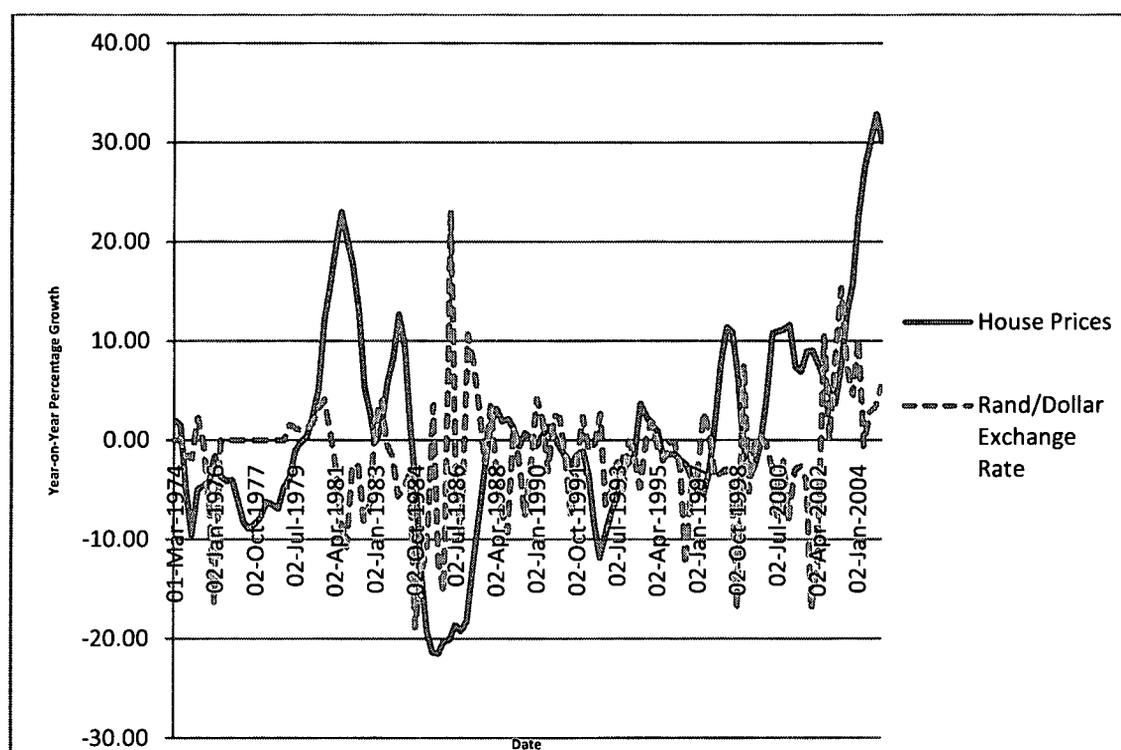


Figure 3.13: The year-on-year growth in house prices and the rand-dollar exchange rate from 1974 to 2004.

Source: Absa bank and the South African Reserve Bank

Note: The data are seasonally adjusted

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Figure 3.13 illustrates that the growth in the rand-dollar exchange rate is more volatile than the growth in house prices. From 1980 to 1989 it appears as if there is a negative relationship between the growth in house prices and the growth in the rand-dollar exchange rate. This is also apparent from 1997 to 2004, but it is not possible to determine visually whether the rand-dollar exchange rate is a leading, coincident or lagging indicator.

3.5 The Granger Causality Tests

The direction of the influence of the supply and demand variables and of the absolute and relative performance measures on house prices may be tested by means of the Granger Causality tests. These tests use the lagged values of the variables to test whether these variables have the ability to predict the future values of another variable (Green, 1997). For example, the Granger Causality Test analyses whether GDP causes or leads house prices. A time series, X is said to Granger-cause time series Y if it could be shown that the X values provide statistically significant information about the future values of Y. When using time series data, it is possible that a past event could cause events today or in the future (Gujarati, 2003:696).

The time series data were lagged by one quarter, as used in Chapters 4 and 5, to test the causality between the variables. The Granger Causality test was performed on the data from 1974 to 2004 on the following supply and demand variables and absolute and relative performance measures:

- GDP growth
- Disposable income growth
- Growth in the debt-to-income relationship
- Consumption growth
- Construction cost growth
- Building plans passed growth

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- Affordability growth
- Household savings growth
- Inflation growth
- Interest rates
- Growth in interest rates
- Growth in the JSE ALSI Index
- Growth in the rand-dollar exchange rate

The results from the application of the Granger Causality test revealed no predictive qualities between the variables and house prices, or between house prices and the variables. This is not surprising, since the test has been conducted over a 30 year time period in which the relationship between the variables, political and economic conditions in South Africa has changed significantly. This does not have an impact on the empirical studies performed in Chapter 4 and 5, because the Granger Causality test is subject to controversies where two extreme trains of thoughts exist: it is either believed that everything causes everything or the existence of causality is denied completely (Gujarati 2003:696). The predictive qualities of the variables are examined by means of more tests in Chapter 4 and 5.

3.6 Summary

The house price growth cycle is caused by the interaction between supply and demand economic variables. The residential market has an equilibrium point where demand equals supply, but is constantly in disequilibrium because of changing economic factors. These factors are the supply and demand variables that influence the house price growth cycle. The demand indicators identified in the chapter are:

- Population growth
- Short-term interest rates

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- Credit availability
- Inflation
- Disposable income
- Capital gains tax
- Personal income tax
- Employment growth
- Consumer spending

The supply indicators are:

- Construction cost
- Rental price level
- Vacancy rates

It is suggested that the status of the house price growth cycle can be determined through absolute and relative performance measures. The absolute performance measures identified and discussed in the chapter are:

- Property sales volume
- Personal savings
- Gross domestic product
- Consumption
- Stock market

The relative performance measures are ratios of some of the supply and demand variables as well as the rand/dollar exchange rate. The relative performance measures are:

- The price-to-rent relationship
- Property affordability
- Debt measures
- Exchange rate

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The variables appeared with different levels of frequency in the researched literature which indicates what variables are considered in the literature. Of the demand determinants interest rates are mentioned most frequently, followed by disposable income and income and CGT tax. Credit availability, inflation and population received a similar level of references in the literature. It seems as if the impact of employment and consumer expenditure is deemed negligible since it is only mentioned infrequently.

The literature for supply determinants suggests that construction is considered repeatedly as an important indicator of changes in house prices. Rental price levels and occupancy rates are mentioned infrequently.

Of the absolute performance measures gross domestic product (GDP) and the volume of sales transactions are considered to have a significant relationship with growth in house prices. It seems as if almost no research has been done on personal savings and household consumption in relation to house prices. The relative performance measures repeatedly mentioned in the literature is the affordability ratio.

The frequency of references to the supply and demand variables and absolute and relative performance measures in the researched literature does not indicate the level of importance of the variable towards the house price growth cycle, but only that research in this regard seems to have been limited. The following chapters consider the relationship between the variables and performance measures and the cycle by using various statistical techniques, such as regression analysis.

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CHAPTER 4 DEVELOPMENT OF A PREDICTIVE MODEL FOR THE RESIDENTIAL GROWTH CYCLE

4.1 Introduction

Residential property has recently been placed under scrutiny because of a world-wide increase in property prices over the past four to five years. The research focuses on topics ranging from the prediction of house prices to the influence of house prices on the overall state of the economy. It appears that limited attention has been given to the prediction of house price growth.

Previous chapters determined that house prices have two cycles, a classical cycle and a growth cycle, while the determinants that affect the growth of house prices were isolated through a literature search. The theoretical framework in the previous chapters will be used as a basis for the development of a predictive model for the year-on-year growth in residential property values.

The chapter is divided into five sections with section one as the introduction. In section two the methodology used for the development of the model is briefly discussed before the nature and scope of the data are examined in section three. The latter section refers to the sourcing of the data, the number of observations used in the analysis, the lagged variables included and the limitations and assumptions of the data. In section four the application of regression analysis is discussed, starting with the selection of the modelling technique, where after the results of the applicable modelling techniques are portrayed. Finally the findings that relate to the development of the model are interpreted before the summary of the chapter in section five.

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4.2 Methodology

The methodology used to develop the growth model covers four phases. Phase one consists of the collection and assessment of the relevant variables. In phase two the time series data for the applicable variables are evaluated through the use of tests for normality and the correlation between the variables are also assessed. The residuals of the initial regression are tested for normality, heteroskedasticity and autocorrelation. In phase three the variables are used to develop a linear regression model to determine which variables are useful in the development of a model and to diminish the number of variables for use in a best subset regression analysis. The best subset regression analysis is used in phase four to develop the final model for the prediction of the house price growth cycle. The methodology is illustrated in Figure 4.1.

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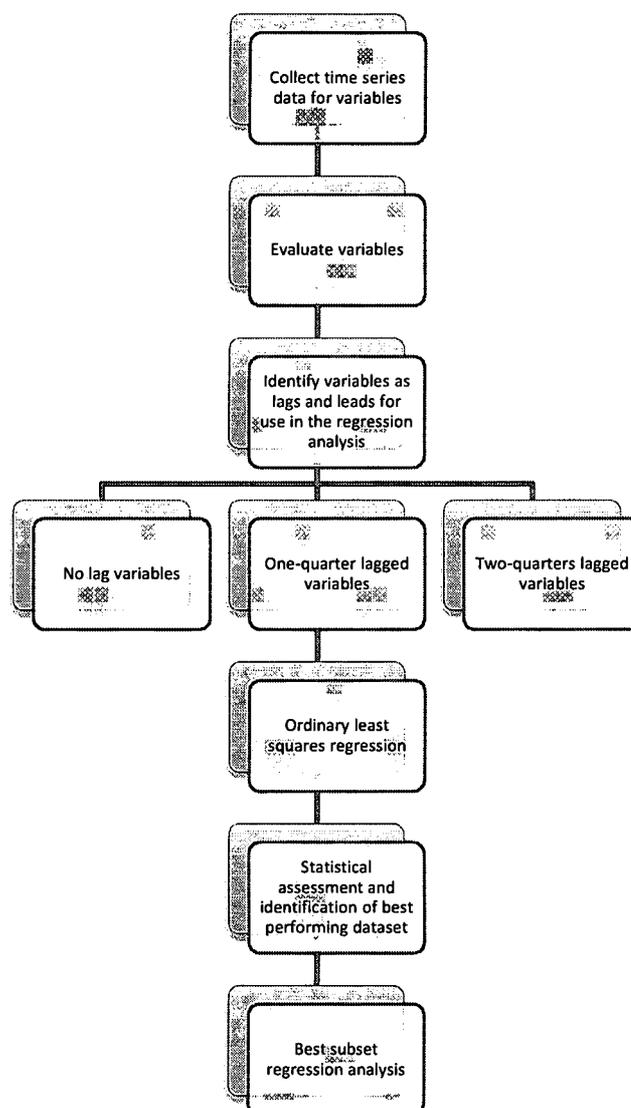


Figure 4.1: Flowchart of methodology used for development of the predictive model

Stage one entails an assessment of the 19 variables identified in Chapter 3 as determinants of the residential real estate growth cycle. The model is based on time series data, thus variables that do not cover a time series are excluded. For instance: Capital Gains Tax (CGT) was introduced in South Africa on 1 October 2001 and the tax is not applicable on all properties. Capital gains tax also differentiates between legal entities. This made it difficult to derive an accurate effect of CGT on house prices for the period from 2001 to

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2004 and it is not applicable for the whole period. The model is only applicable on a national basis and thus on variables that have an international influence, but no national influence is eliminated, such as income tax.

The complete growth cycles (upswing and downswing) provided by the Absa house price index has an average length of 10.333 quarters. Monthly data would normally provide the most accurate conclusions about the movement of the cycles, but only four of the variables are available in a monthly format. Most of the variables are compiled quarterly and thus the model is based on quarterly values. This is still useful for the evaluation of the interaction between the variables. The shortest cycle consists of four quarterly observations, which suggest that annual data were of limited value. This eliminates variables, such as population growth. It appears that for variables, such as property sales data and rental price volume, no data or no applicable data exist and these variables were thus excluded from the analysis.

The selected and evaluated time series data acquired were subjected to exploratory data analysis using two phases. In phase one the individual variables were tested for normality and a correlation analysis was performed to assess the strength of the relationship between them. In phase two the residuals of the complete set of variables were tested for normality, heteroskedasticity and autocorrelation.

The use of lagging and leading indicators in previous studies was researched and evaluated and the applicable lag periods were identified. This significantly increased the number of variables used in the regression analysis. Best subset regression analysis was identified as a multiple regression analysis technique to be used in the study, but was limited by the number of variables that may be included in the analysis. A large number of variables increased the

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number of models the best subset regression analysis can produce and complicated the selection of the appropriate model.

In order to solve the problem created by including lagged variables least squares regression was used to limit the number of variables introduced that could be used for the best subset regression analysis. The variables were grouped together according to the different lag periods, which resulted in the following groups of variables:

- no lagged variables,
- no lagged variables with $ar(1)$,
- no lagged variables with $ar(1)$ and $ar(2)$,
- one-quarter lagged variables,
- one-quarter lagged variables with $ar(1)$,
- one-quarter lagged variables with $ar(1)$ and $ar(2)$,
- two-quarters lagged variables,
- two-quarters lagged variables with $ar(1)$,
- a combination of one-quarter and two-quarter lagged variables and
- a combination of one-quarter lagged variables and no lag variables.

The $ar(1)$ and $ar(2)$ referred to autoregressive error correction where it corrected for serial correlation that may exist between the independent variables (Dielman, 1996:308). The autoregressive error correction was included in five groups of variables, but it was not necessary in the development of this model since all of the five models had a higher root mean square error than the models without the autoregressive error. A least squares regression model was developed for each group of variables and the performance of the models was evaluated on the basis of the root mean square error (RMSE) obtained for each group. The RMSE is a measure of prediction accuracy that indicates the difference between the values predicted by the model and the actual values (Ott and Longnecker, 2001:632).

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The groups of variables with the lowest RMSE indicated that it is most suitable for predicting the future values of house price growth. This group was used as the input variables for the best subset regression analysis conducted using the Statistica 7.1 software package. The time series data covers a period of 31 years, 27 years of which were used for the training of the model and the remaining four years were used to test the model. This translated into a 90 percent training sample and a 10 percent validation sample. The last four years of the sample period encompassed a complete growth cycle. A second analysis was conducted where a 60 percent training sample and a 40 percent validation sample was used.

A best subset regression analysis produces a multitude of models based on the various combinations of the variables. The models are evaluated using the coefficient of determination (R^2) produced. The R^2 refers to the level of variation in the dependant variable that could be explained by the independent variable (Keller and Warrack 2000:644). The coefficient of determination (R^2) can be artificially high because of relationships between the independent variables (correlation) included in the model, which is caused by high levels of multi-collinearity.

4.3 Nature and Scope of Data

4.3.1 Sources of Data

The data used in this study were obtained from four different sources: Absa Bank, the South African Reserve Bank (SARB), the Johannesburg Stock Exchange (JSE) and the Bureau of Economic Research (BER). The different datasets and their sources are listed in Table 4.1.

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Table 4.1: Summary of the individual variable datasets and their sources

Variable	Description	Source
Absa House Price Index	Year-on-year growth of the purchase price of new and old medium sized houses. Seasonally adjusted. Deflated with CPI*.	Absa (2005)
Affordability Index	Year-on-year growth of the affordability index, calculated by dividing the house price index by with labour costs. Seasonally adjusted.	Absa (2005)
Household Debt to Disposable Income	Year-on-year growth of the debt/income relationship. Seasonally adjusted. Deflated with CPI.	South African Reserve Bank (SARB) (2005)
Building Plans Passed	Year-on-year growth of a monthly index. Seasonally adjusted.	SARB (2005)
Household Consumption	Year-on-year growth of household consumption. Seasonally adjusted.	SARB (2005)
Disposable Income	Year-on-year growth of 2000 prices. Seasonally adjusted. Deflated with CPI.	SARB (2005)
Gross Domestic Product	Year-on-year growth of GDP. Seasonally adjusted.	SARB (2005)
Interest Rates 1	Real prime overdraft rate.	SARB (2005)
Interest Rates 2	Year-on-year growth of the real prime overdraft rate.	SARB (2005)
Household Savings	Year-on-year growth of household savings. Seasonally adjusted. Deflated with CPI.	SARB (2005)
Consumer Price Inflation	Year-on-year growth of CPI for all expenditure groups excluding house price inflation.	SARB (2005)
Rand-Dollar Exchange Rate	Year-on-year growth series.	SARB (2005)
Building Cost Index	Year-on-year growth of input costs and mark-ups of building contractors.	Bureau of Economic Research (2005)
JSE All Share Index	Year-on-year growth of the index.	Johannesburg Securities Exchange (2005)

* The CPI used for deflation is the consumer price inflation index for all expenditure groups excluding house prices.

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4.3.2 Screening of Data

A total of 19 variables that affect the residential property growth cycle are identified in the literature review. The variables were evaluated for their applicability to the South African context. This analysis eliminated the income tax rate as a variable, since there is no income tax relief for primary homeowners in South Africa. The development of the model was based on time-series data, which means that capital gains tax, which only started affecting the market when it was introduced in 2001, is excluded.

During data collection it became apparent that there was no national data set for volumes of property sales and this set too had to be excluded from the model. Credit availability could be measured through the number of mortgage loans approved, but such data are not made available to the public. Contact with the SARB, Absa Bank and Rode and Associates confirmed that there is no national data for the residential rental price level for the complete sample period. This caused the rental price level variable and the price-to-rent relationship variable to be eliminated from inclusion in the development of the model.

The model was based on quarterly data to provide the most accurate results and it included 14 of the variables. But another two variables were eliminated: population growth is only accurately available in a five yearly format (the SARB has a yearly format) and employment figures for the complete SA working sector are not available in quarterly format. After the elimination of the variables not suitable for inclusion in the model only 12 variables remained. Interest rate growth and the one-period lagged house price variable were two additional variables used in the dataset. Table 4.2 provides a summary of the variables available for inclusion in the model. The variables excluded are also listed in the table.

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Table 4.2: Summary of variables available for inclusion and the excluded variables in the regression analysis

Datasets Included	Datasets Excluded
Affordability Index	Employment Growth
Building Cost Index	Income Tax and Capital Gains Tax
Building Plans passed	Mortgage Availability
Consumer Price Inflation	Population Growth
Disposable Income	Property Sales Volume
Gross Domestic Product	Rent Price Level
Household Consumption	Rent-Price Relationship
Household Debt to disposable Income	
Household Savings	
JSE All Share Index	
Interest Rate	
Interest Rate Growth	
One-quarter Lagged House Prices	
Rand-Dollar Exchange Rate	

4.3.3 Description of Variables included in the Analysis

The house price growth cycle is represented by quarterly year-on-year percentage changes in real house prices. For the development of the model all the independent variables had to be in the same format as the house price (dependent) variable. The applicable variables were converted to quarterly year-on-year percentage changes and, where applicable, the datasets were deflated with the consumer price index (CPI).

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The dependent variable is provided by Absa in a monthly format and is seasonally adjusted. Absa deflates the nominal purchase price of residential properties with CPI since CPI excludes house price inflation. The CPI was further used to deflate all the necessary variables included in the development of the model. Absa also provided the affordability index which is calculated by dividing the house price index by labour costs in the non-agricultural sector, where labour cost is remuneration per worker.

The interest rate represents the prime overdraft rate of banks, and was made available by the SARB. It is included as two variables: a year-on-year growth variable and the quarterly prime overdraft rate. It was necessary to include the second variable (quarterly prime overdraft rate) without calculating its year-on-year growth, because the prime interest rate was stable for extended periods during the sample period which caused large sections of the year-on-year growth percentages to be zero.

Data for Johannesburg Stock Exchange (JSE) All Share Index (ALSI) are supplied by the JSE. It is provided in a quarterly format and the year-on-year growth rate is derived. The Building Cost Index is provided by Building Economics, Stellenbosch. It is compiled by the Bureau of Economic Research and is based on residential construction costs. The index is compiled monthly with 1995 as the base year. The index is converted to a quarterly index with 2000 as the base year.

4.3.4 Lagging of Variables

The use of time-series data enables current values of the dependent variable to be related to previous values of the independent variables (Dielman 1996:180-181). The previous values are called lagged variables. In literature studies of the property cycle (e.g. Quigley, 1999 and Rosenthal, 1999) variables

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were lagged for up to four periods. Rosenthal (1999) found that variables that lagged beyond two periods did not contribute to the prediction of changes in house prices and Quigley (1999) used only one-period and two-period time lags. The variables identified for inclusion in the regression model have all been lagged for one and two quarters respectively.

Case and Shiller (1989) and Quigley (1999) suggested a strong correlation between current house prices and previous house price changes. The high correlation achieved suggests that most of the variation in prices is predicted by previous price movements. For the purpose of developing a predictive model one and two period lagged dependent variables were also included.

The period of assessment commenced from the first quarter of 1974 to the fourth quarter of 2004 and included 124 quarterly observations. With the use of lagged variables a number of data points in the period of assessment were lost; subsequently the time series used in the development of the model was from the second quarter of 1974 to the fourth quarter of 2004. The development of the model was based on the first 107 observations in the training period and was tested on the last 16 observations, which translates to a 90 percent training set and a 10 percent validation set.

4.3.5 Assessment of Time Series Data

In this section the time series data were assessed in two phases. Firstly the individual variables were tested for normality and secondly the aim was to assess the levels of correlation between the variables, also referred to as multi-collinearity.

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Two tests could be used to confirm the normal distribution of the variables: a visual assessment of the distribution of the variables and a statistical test for normality (Ott and Longnecker, 2001:758-772). Both the visual test and the statistical tests were conducted in this analysis. Histograms were used for the visual test and the results are provided in Appendix 4.1. The histograms show visually that only GDP did conform to the assumption of normality.

The literature refers to six statistical tests that could be used to assess normality: the Shapiro-Wilk test, Lilliefors, Kolmogorov-Smirnov, Chi-square, Anderson Darling and Ryan Joiner tests; the first three of which are used most frequently. An evaluation of the three tests performed by Mendes and Pala (2003) suggests that the Shapiro-Wilk test consistently provides the most reliable results and has the best power properties when compared to the alternative tests.

The Shapiro-Wilk test measures the correlation between the time series data and their corresponding normal scores. The p-value for the Shapiro-Wilk test measures whether the null hypotheses can be rejected, where the null hypotheses states that W equals one. The Shapiro-Wilk test is recommended for small to medium samples sizes (Mendes and Pala, 2003).

The test was performed on all the one period lagged variables (the one-period lagged variables were used for the development of the final model) for all 124 observations. The results are provided in Table 4.3.

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Table 4.3: The Shapiro-Wilk test for normal distribution of the variables included in the analysis

Variable	Shapiro-Wilk's W	P-Value
Affordability	0.97526	0.02228*
Building Plans	0.94836	0.00013**
passed		
Construction Cost	0.94071	0.00004**
Consumption	0.97202	0.01116*
Debt/Income	0.97461	0.01934*
Disposable Income	0.95681	0.00056**
GDP	0.98677	0.27281
House Prices	0.95744	0.00063**
Household Savings	0.07297	0.00000**
Inflation	0.97032	0.00781**
Interest Rates	0.96489	0.00260**
Interest Rates2	0.95979	0.00097**
JSE-ALSE index	0.96714	0.00407**
Rand/Dollar	0.94652	0.00009**

* Significant at 5% level

** Significant at 1% level

The test confirmed that all the variables, except GDP, were not normally distributed. However, according to the General Limit Theorem, a sample size larger than 30 observations makes the assumption of a normal population unnecessary (Dielman 1996:34).

In a multiple regression analysis it is hoped that the independent variables are highly correlated with the dependent variable. However, a high correlation between the independent variables, called multi-collinearity, is not

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desirable. Correlation is usually present in multiple regression to some degree, but in the development of a model it is necessary to separate the predictive qualities of the individual variables.

A high degree of multi-collinearity causes the standard deviations of the regression coefficients to be disproportionately large, which result in small t-values and it causes the regression coefficients to be unstable (Dielman, 1996:316). Also, high correlations between variables may often account for overlapping pieces of the variability in the dependent variable, so that the predictive quality of the model, coefficient of determination (R^2), cannot be accurately estimated (Ott and Longnecker, 2001:647). The regression coefficients are discussed in section 4.4.2.

Collinearity provides a small problem if the variables are slightly correlated, but when variables are highly correlated it becomes difficult to distinguish between each variable's contribution to the overall model (Ott and Longnecker, 2001:646-647). The correlation between variables will always lie between -1 and +1. A negative correlation signifies a negative relationship between two variables and a positive correlation signifies a positive relationship. The closer the correlation is to one, the stronger the relationship between the two variables, for example a correlation of 0.3 is a weak relationship and 0.9 signifies a strong relationship (Keller and Warrack, 2000:128). Since multi-collinearity exists when there is a high correlation between independent variables it is necessary to define what is meant by 'high'. A popular rule of thumb is that multi-collinearity becomes a problem if any pairwise correlation is above 0.5 (Dielman, 1996:317). The correlation matrix of the variables is provided in Appendix 4.2.

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The matrix provided the following results:

- Affordability and the one-period lagged house price variable, and consumption and GDP indicated correlation above 0.7.
- The one-period lagged house price variable showed correlation above the 0.5 level with inflation and consumption.
- GDP and construction cost were correlated above the 0.5 level.
- Consumption was correlated with building plans passed, and construction cost and affordability recorded coefficients above the 0.5 level.

4.4 Assessment of the Entire Period

4.4.1 Selection of Modelling Technique

In previous studies several models for the assessment of demand and supply dynamics of house prices, house price prediction and investment in residential properties were proposed, but it appears that limited research has been done on the prediction of house price growth cycles. This limits the reference in the literature for the selection of an appropriate model. The above mentioned studies all used time series data and regression models, but no general model is apparent (Cho, 1996). Examples of the models used includes: non-linear error correction models, autoregressive distributed lag models and hedonic regressions combined with error correction equations.

The regression models could be applied to a number of variables. Figure 4.2 illustrates the different variables.

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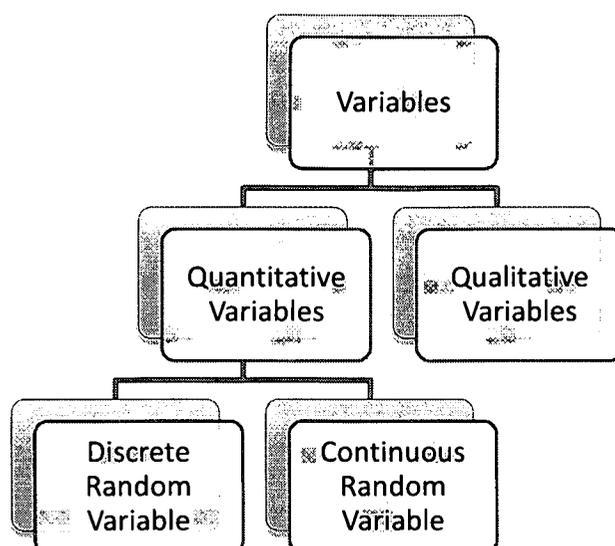


Figure 4.2: Flowchart of distinction between variables

Source: Adapted from Ott and Longnecker (2001:141-142)

Variables used in regression analysis may be classified in a variety of ways as shown by Figure 4.2. The variables identified for the development of this model are continuous random and quantitative variables meaning that the individual values of each variable could assume any possible value. To interpret the predictive value of the complete set of quantitative variables a multiple regression analysis is used (Ott and Longnecker, 2001: 141-142, 620). The complete set of quantitative variables consists of one dependent variable and 14 independent variables. None of the variables is a cross-product term, subsequently limiting the analysis to a first-order multiple regression model. A first-order regression model includes independent variables, but no cross-product terms or terms in powers of the independent variables (Ott and Longnecker, 2001:620). An example of a first-order multiple regression model with three independent variables is

$$y = \beta_0 + \beta_1x_1 + \beta_2x_2 + \beta_3x_3 + \varepsilon$$

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where β represents the expected change in y for a unit increase in x when all other x 's are held constant. y represents the dependent variable and x the individual independent variable (Ott and Longnecker, 2001:620-621). The ϵ denotes a random error of disturbance. This shows that each value for house price changes will not be exactly as predicted by the combination of independent variables denoted by the regression model (Dielman, 1996:149).

First-order multiple regression encompasses forward and backward stepwise regression, best subset regression, logarithmic transformation and nonlinear least squares as regression models. Correlation between independent variables makes it difficult to judge the impact of each variable on the model when using forward or backward stepwise regression. Other disadvantages of stepwise regression are that the calculated t-values no longer follow the t-distribution, it assumes that there is a single "best" model and relevant variables may be excluded because of the arbitrary order in which the selection takes place (Studenmund, 2001:172-173).

The possible exclusion of relevant variables was solved by deciding on the use of best subset regression analysis. This procedure runs all possible regressions between the dependent variable and all possible subsets of explanatory or independent variables. The coefficient of determination, R^2 , is used as the criterion to help evaluate alternative regression outcomes (Dielman, 1996:414-415). The R^2 refers to the level of variation in the dependant variable that could be explained by the independent variable (Keller and Warrack 2000:644). The coefficient of determination will be between zero and one and the closer R^2 is to one, the better the independent variables explain the variation apparent in the dependent variable (Dielman, 1996:105).

The major limitation of the best subset regression analysis is that it is not recommended that more than 14 independent variables are included in the

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analysis (Dielman, 1996:419). A large number of variables complicate the process of selecting a “best” model (Ott and Longnecker, 2001:716). The limitations of the best subset regression mentioned before are resolved through the use of least squares regression in Eviews 5 (2004) before the computation of the best subsets regression model in Statistica 7.1 (StatSoft 2005). Eviews 5 is used to perform the least square regression analysis.

The use of time series data in a multiple regression model is subject to four assumptions: the relationship is linear, the residuals have constant variance (homoskedasticity), the residuals are normally distributed, and that the residuals are independent (Dielman, 1996:217-218 and Ott & Longnecker, 2001:758-772). The residuals represent the differences between the values of the dependent variable and the values of the regression line. The assumptions are tested on the one-quarter lagged variables.

4.4.2 Results from the Application of the Regression Techniques

During the first stage of the regression the applicable variables were used to develop a linear regression model to determine which variables are useful. The results from the least squares regression were used to reduce the number of variables for use in the best subset regression analysis. During the second phase of the regression analysis the best subset regression was used to develop the final model for the prediction of growth in house prices.

4.4.2.1 Results from the Application of Least Squares Analysis

The least squares regression was conducted to reduce the number of variables and it produced the results depicted in Table 4.4. The analysis was performed over the time period from the second quarter of 1974 to the fourth quarter of 2000 which provided a dataset of 107 observations. In section 4.3.5

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one- and two-period lagged variables were identified as possible predictors of house price growth, and this increased the complete set of variables to 42. For the purpose of best subset regression analysis the variables had to be reduced to 14 in order to adhere to the recommendation of Dielman (1996). The 42 variables were divided into sets of no-lag variables, one-period lagged variables and two-period lagged variables. Combinations of one-period lagged variables and two-period lagged variables and of no-lag variables and one-period lagged variables were also included in the analysis.

Table 4.4: The RMSEs from the least squares regression analysis

Model Variables	Root Mean Squared Error
No lags	9.366446
No lags ar(1)	7.594521
No lags ar(1) ar(2)	13.36287
Lag 1	3.552979
Lag 1 ar(1)	6.004057
Lag 1 ar(1) ar(2)	10.67975
Lag 2	6.374917
Lag 2 ar(1)	9.792141
Lag 1 and Lag 2	3.257432
No lag and Lag 1	2.920195

Note: ar(1) and ar(2) refers to autoregressive error correction

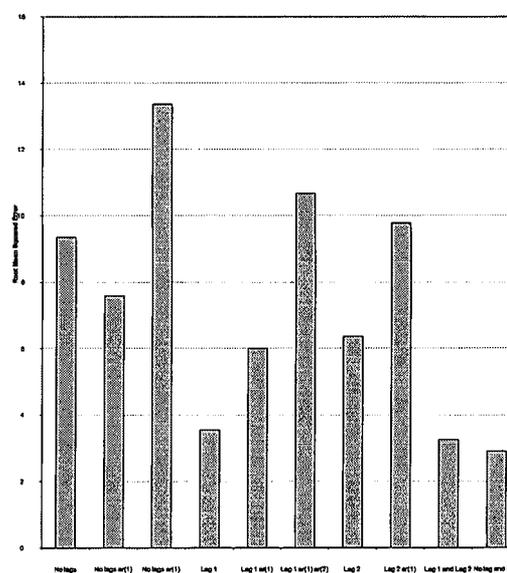


Figure 4.3: The histogram of the RMSEs of the individual datasets

The different combinations of variables are evaluated on the basis of their root mean squared errors (RMSE) and the results, shown in Table 4.4 and Figure 4.3, demonstrate that the lag 1 variables, the combination of lag 1 and

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lag 2 and the no-lag and lag 1 combinations have similar RMSEs. The RMSEs are obtained through the comparison of the predicted values to the actual values from 2001 to 2004. The combination of one-period lagged variables and no-lag variables has the lowest RMSE, followed by the combination of one-period and two-period lagged variables. The lag 1 variables have the third lowest RMSE. The RMSE showed that the three combinations have the lowest forecast error of the different combinations of variables.

The lag 1 and lag 2 combination as well as the no-lag and lag 1 combination had 28 independent variables and were discarded because of the restriction of best subset regression analysis. This, along with the low RMSE, resulted in the use of the one-period lagged variables for the development of the final model. Table 4.5 shows the results of the least squares regression analysis performed on the one-quarter lagged variables.

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Table 4.5: Results of least squares regression analysis of one-quarter lagged variables

One-Period Lagged Variables	Coefficient β	Standard Error	t-Statistic	Probability p-value
Building Plans passed	0.022493	0.012621	1.782188	0.0780
Construction Cost	0.397385	0.069640	5.706244	0.0000*
Consumption	0.372122	0.168058	2.214250	0.0293**
Debt/Income	-0.151663	0.073785	-2.055483	0.0426**
Disposable Income	-0.175159	0.094454	-1.854434	0.0668
GDP	-1.179889	0.189434	-6.228508	0.0000*
Household Savings	-3.26E-06	3.67E-05	-0.088677	0.9295
Inflation	-1.000310	0.118498	-8.441550	0.0000*
Interest Rates	-0.198392	0.086582	-2.291379	0.0242**
Interest Rates Growth	0.026824	0.018561	1.445198	0.1518
JSE Alsi Index	0.029585	0.012152	2.434643	0.0168**
Rand/Dollar Exchange Rate	0.043543	0.053734	0.810332	0.4198
Affordability	0.825498	0.048475	17.02949	0.0000*
Constant	13.67381	2.146275	6.370952	0.0000*
R-squared	0.920083	F-statistic	82.36240	
Adjusted R-squared	0.908912	Probability(F-stat)	0.000000	
SE of regression	2.658505	Durbin-Watson Statistic	1.137788	

* Significant at the 1% level

** Significant at the 5% level

The one-period lagged variables were further assessed through the coefficient, standard error, t-statistic and p-values of the individual variables. The coefficient (β) in Table 4.5 represented the expected change in house price growth for a one percent change in the growth of a variable, when all the other variables were held constant (Keller and Warrack, 2000:649). The accuracy of the coefficient was determined by the standard error, t-statistic and p-value of the variables which were first assessed before analysing the coefficients.

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The standard error in Table 4.5 referred to the estimated standard deviations of the variable coefficients. The standard error estimated the accuracy of the coefficients, which should be between ± 2 (Ott and Longnecker 2001:666). The larger the standard error, the larger the uncertainty in estimating the coefficients. Large standard errors are also indicators of a high correlation between independent variables (Keller and Warrack, 2000:685 and Ott and Longnecker, 2001:652). The individual variables, except household savings, all indicated standard errors between the ± 2 boundaries.

The t-statistics and p-values together provided an inference regarding the linear relationship between the individual variables and house prices. A linear relationship exists when the t-statistic is smaller than -2.617 and larger than +2.617 at the 1% significance level and smaller than -1.98 and larger than +1.98 at the 5% significance level for the training sample size (Keller and Warrack, 2000:642). Table 4.5 shows that construction cost, GDP, the JSE ALSI and affordability have predictive qualities at the 1% significance level. Consumption, building plans passed, the debt-to-income relationship, disposable income and interest rate have predictive qualities at the 5% significance level. It appears that the remaining variables do not contribute to the prediction of house price growth.

To assess the validity of the entire model it is necessary to evaluate the R^2 , adjusted R^2 , standard error of the regression and the F-statistic (Keller and Warrack, 2000:686). The R^2 of the one-quarter lagged variables was 0.920083, which implied that 92% of the changes in house prices from 1974 to 2001 could be explained by a combination of the independent variables. The standard error of the regression estimated the deviation around the regression line and it was 2.658505, which implied that the model has predictive qualities. The smallest value that the standard error could assume is zero and it could assume any value above zero (Keller and Warrack, 2000:640). The adjusted R^2 of

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0.908912 refers to the coefficient of determination when adjusted for the sample size and the number of independent variables (Keller and Warrack, 2000:685).

The F-statistic assesses the predictive power of the complete set of variables and house prices by evaluating the linear relationship between them. The statistic is significant if it falls outside the upper and lower boundaries (2.34 and -2.34 for the 99% confidence level). The large F-value of 82.36240 indicated that there is some degree of predictive value among the independent variables (Ott and Longnecker, 2001:521).

4.4.2.2 Results from Application of Best Subsets Regression

After the above assessment the one-period lagged variable data were imported to the software package Statistica 7.1, which was used to develop the model with best subset regression analysis. The procedure performed the regressions between the dependent variable and all possible subsets of independent variables (Dielman, 1996:414-415). The coefficient of determination (R^2) was used to evaluate the predictive qualities of each permutation (Dielman, 1996:415).

The model specified in Table 4.6 produced the highest R^2 of 0.92 and a RMSE of 2.665. The model was based on data from the second quarter of 1974 to the fourth quarter of 2000 and the testing period was from the first quarter of 2001 to the fourth quarter of 2004.

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Table 4.6: Results of the best subset regression model producing the highest R²

One-quarter Lagged Variables	House Prices Beta Coefficient	House Prices Standard Error B	House Prices t-statistic	House Prices p-value
House Prices	0.959950	0.032263	29.75382	0.000000
Interest Rates Growth	-0.209509	0.032106	-6.52551	0.000000
Construction Cost	0.189732	0.034292	2.92887	0.004205
Rand/Dollar Exchange Rate	0.213187	0.028973	2.75323	0.006998
	R-Squared	0.92418926	RMSE	2.665
	Adjusted R ²	0.92118686	F-Test	307.82
			<i>h</i> -stat	3.93383

Note: The following variables were excluded from the best subset regression model: affordability, building plans passed, inflation, disposable income, GDP, household consumption, debt-to-income ratio, household savings, JSE ALSI and interest rates.

A scatter plot of the predicted values of house price growth for the period 1974 to 2001 versus the actual values is shown in Figure 4.4. It shows that 92% (R² of 0.92) of the predicted movement in house price growth corresponded with actual house price growth. The root mean square error of 2.665 suggested that the deviation from the actual values was small.

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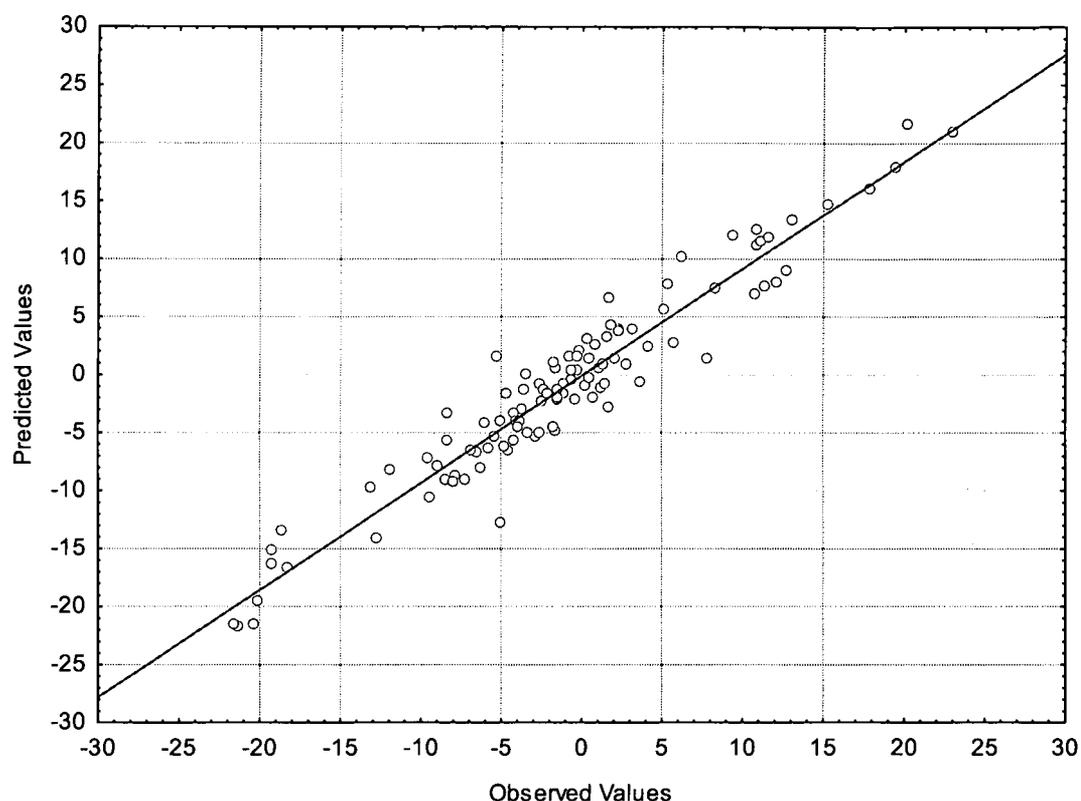


Figure 4.4: Scatter plot of the observed values of house price growth versus the values predicted by the best subset model for the period 1974 – 2000

4.4.3 Testing the Assumptions of the Model

Time series data in multiple regression analysis is subject to four assumptions mentioned previously in the chapter.

Firstly, it is assumed that the relationship between the dependent variable and the explanatory variables is linear. The linear relationship could be tested through a scatter plot of the residual values versus the values of the dependent variables (Dielman, 1996:222). In Figure 4.5 the widely distributed residual values show that the relationship was not violated. If the residuals show a pattern or are closely scattered around one point the relationship is violated.

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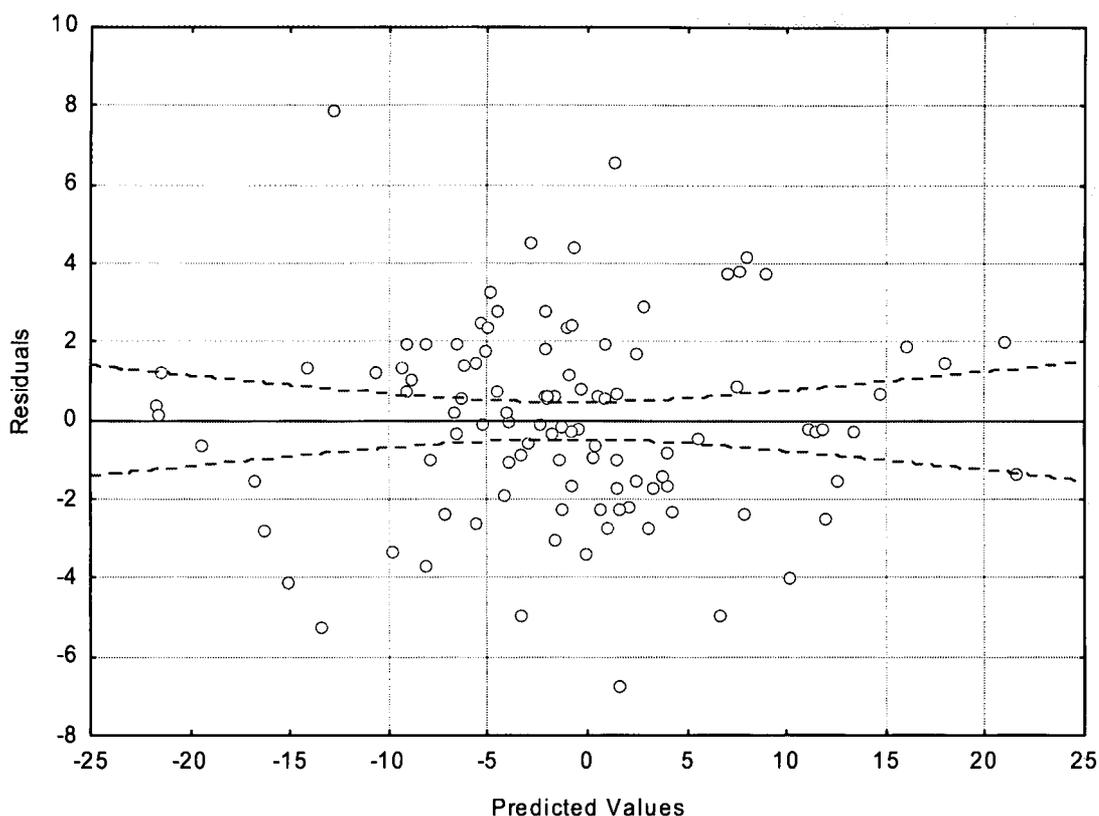


Figure 4.5: A scatter plot of the residual values versus the values of the dependent variable

The second assumption states that the residuals have constant variance around the regression line and this is referred to as homoskedasticity. A violation of this assumption is referred to as heteroskedasticity. The test for heteroskedasticity is performed visually by viewing a scatter plot of the residuals around the regression line as illustrated in Figure 4.5. If the residuals are randomly distributed around the regression line the model conforms to the assumption (Dielman, 1996:261). Figure 4.5 shows randomly distributed residuals suggesting that the residuals have a constant variance around the regression line.

The third assumption for multiple regression analysis is that of normality, which means that the residuals are normally distributed. Normal

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distribution may be tested through a normal probability plot as illustrated in Figure 4.6. The visual test shows that the residuals are normally distributed, except for a slight tail.

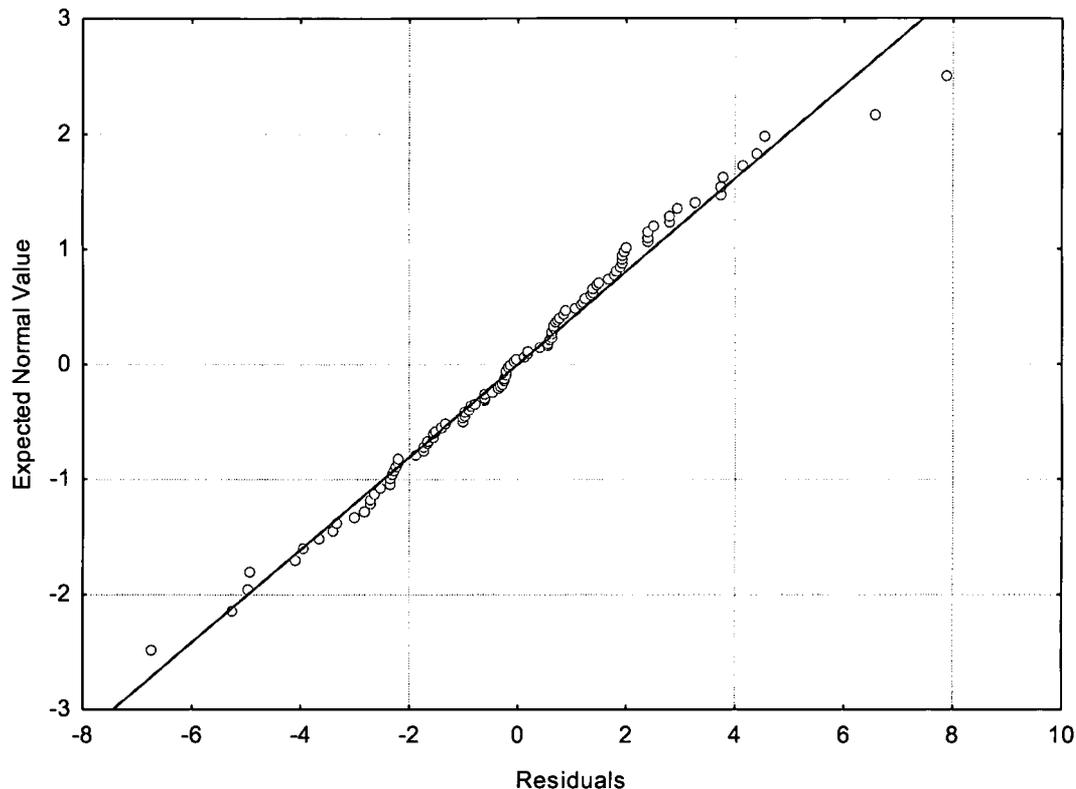


Figure 4.6: Normal probability plot of the residuals

Lastly, the explanatory variables in the multiple regression analysis have to conform to the assumption of independence. This implies that the error terms of the regression are uncorrelated. Correlation between the error terms is referred to as serial or autocorrelation. If the error terms exhibit autocorrelation, the standard errors of the coefficients will be biased. This means that the contribution of the independent variables to the regression model will not be accurately measured (Dielman, 1996:306-308).

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The test for autocorrelation would normally be performed by assessing the Durbin-Watson *d*-statistic in terms of the upper and lower bounds of the valid data points as indicated in the Durbin-Watson tables. When there is no autocorrelation between the variables, the *d*-statistic will fall above the upper boundary and if there is autocorrelation, it will fall below the lower boundary (Ott and Longnecker, 2001:758-772). The one-period lagged variables used in this model produced a statistic of 1.469634 when using the 107 observations used for the development of the model. The Durbin-Watson test is not applicable when using a lagged dependent variable in the regression (Keller and Warrack, 2000:714-723).

To compensate for the use of a lagged dependent variable, a serial correlation between the variables is tested by the use of the Durbin's *h*-test which is applicable when a lagged dependent variable is included as an independent variable. The variables used in the model show a serial correlation with an *h*-test of 3.93383 which is outside the boundaries of -1.96 and +1.96 for the 95 percent confidence level (Dielman, 1996:306-313).

When the residuals exhibit a serial correlation, the estimates of the coefficients will be unbiased, but the standard errors of the coefficients will be biased. There are two ways to correct for autocorrelation: finding an important variable that has been omitted from the regression or including a lagged dependent variable (Dielman, 1996:308-312). During the regression analysis a lagged dependent variable has already been included. In Chapter 3 the variables that influence house price growth were identified, but data on some of the variables were not available and thus the variables are not included in the regression. It is possible that variables such as population growth or rental levels could further explain house price growth and eliminate serial correlation.

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4.4.4 Interpretation of Findings

The results from the best subset regression analysis specified the one-period lagged house price variable, one-period lagged interest rate growth, one-period lagged construction cost and one-period lagged rand/dollar exchange rate as the combination of determinants best suited to predict the growth in house prices. One-period lagged house prices contributed 0.959950 to house prices for every one percent change in house price growth as shown by the coefficient in Table 4.6. Interest rate growth, construction cost and the rand/dollar exchange rate contributed -0.209509, 0.189732 and 0.213187 respectively to the performance of the model. The small standard errors (between +2.5 and -2.5) of the coefficients inferred that the coefficients were good predictors of growth in house prices (Ott and Longnecker, 2001:666).

The t-statistics for the individual variables specified in Table 4.6 were outside their upper and lower boundaries of +2.364 and -2.364 at the one percent significance level, which suggested that each of the independent variables had good predictive qualities (Dielman, 1996:152).

The statistically significant t-statistics also suggested that correlation between the independent variables was not a problem. The correlation matrix is presented in Table 4.7 and although the matrix does indicate some correlation between the variables, the t-statistics suggested that it did not affect the development of the model. A high correlation between variables caused insignificant t-statistics (Keller and Warrack, 2000:700). Another effect of severe correlation is large standard errors, but the standard errors in Table 4.7 were small, suggesting a low correlation (Ott and Longnecker, 2001:652). When high serial correlation is present in a time-series, the consequence is that the F-test cannot legitimately be applied and the R^2 is not reliable (Gujarati, 2003:489).

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Table 4.7: Correlation matrix of the relationship between the variables of the selected model

	House prices (-1)	Interest Rate Growth (-1)	Construction Cost (-1)	Rand/Dollar Exchange Rate (-1)
House prices (-1)	1.00			
Interest Rate Growth (-1)	0.08	1.00		
Construction Cost (-1)	0.39	0.41	1.00	
Rand/Dollar Exchange Rate (-1)	0.05	-0.22	0.05	1.00

Note: -1 indicates one-quarter lagged variables

The F-test of the model is a combination of all the individual t-statistics and is used to assess whether or not evidence of a linear relationship exists between the combination of independent variables and house prices. It is also used to test the validity of the model. An F-test is superior to an individual analysis of t-statistics, because it reduces the probability of erroneous conclusions about the linear relationship between the variables and house price growth (Keller and Warrack, 2000:691). The F-test for this model is 307.82 which falls well outside the upper and lower boundaries (+2.19 and -2.19). This suggests that there is at least one variable that indicates a linear relationship with house prices and that the model has predictive value (Ott and Longnecker, 2001:651). Correlation between independent variables does not affect the values provided by an F-test (Keller and Warrack 2000:700).

Figure 4.7 shows the scatter plot of the values predicted by the best subset model compared to the actual values obtained in the testing period. The testing period was from the first quarter of 2001 to the fourth quarter of 2004 and it was used to test the predictive ability of the model. The coefficient of determination (R^2) increased by one percent from 0.92 to 0.93 between the values used to develop the model and the values obtained from applying the

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model for prediction purposes. This suggested that the model could be used to accurately predict future values. Figure 4.7 shows a R^2 of 0.92 and a RMSE of 2.79.

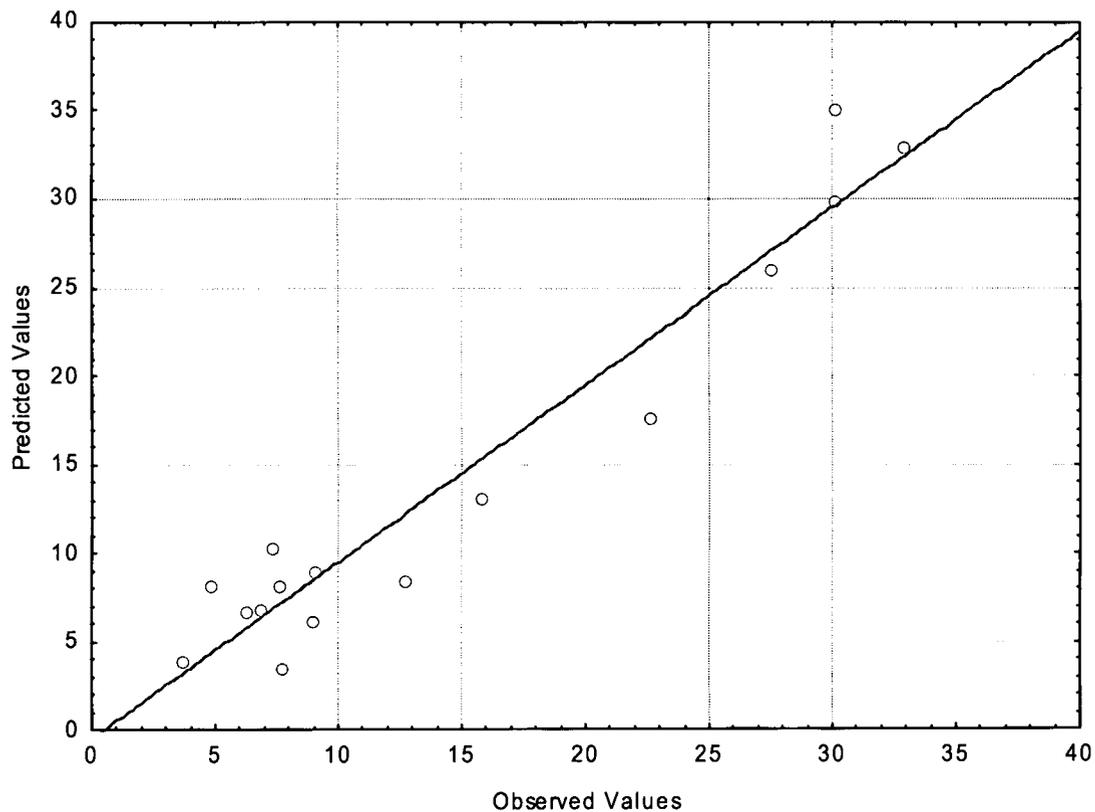


Figure 4.7: Scatter plot of observed values of growth in house prices versus the values predicted by the model for the period from 2001 to 2004.

4.5 Testing the Continuous Relationship between Variables

No single indicator series can consistently predict the direction of business cycle accurately, with the result that it is necessary to track many different series (Sherman and Kolk, 1996:382). The timing and strength of the relationship of the indicators with the aggregate economy change over time, further complicating forecasting. The indicator series, therefore, constantly change to reflect current relationships. The application of the best subset

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regression model was based on data from 1974 to 2000, but since economic conditions are in constant motion, the regression was also conducted on data from 1974 to 1995.

This roughly allowed for 70 percent of the data to be used for developing the model and 30 percent for the validation, whereas the previous model allowed for 90 percent used to develop the model and data used for validation and a 10 percent split between data. Table 4.8 illustrates the results of the best subset regression model for the period from 1974 to 1995.

Table 4.8: Results of the best subset regression model producing the highest R^2

One-quarter Lagged Variables	House Prices Beta Coefficient	House Prices Standard Error B	House Prices t-statistic	House Prices p-value
House Prices	0.908712	0.033102	27.45214	0.000000
GDP	-0.187324	0.032365	-5.78789	0.000000
Interest Rates	-0.194451	0.028914	-6.72527	0.000000
Building Plans passed	0.169900	0.032447	5.23626	0.000001

The model specified in Table 4.8 produced a R^2 of 0.90 and a RMSE of 4.36. The model was developed using data for the period from the second quarter of 1974 to the fourth quarter of 1994 and validated from the first quarter of 1995 to the fourth quarter of 2004. Figure 4.8 reflects the scatter plot of the observed values of house price growth versus the predicted values.

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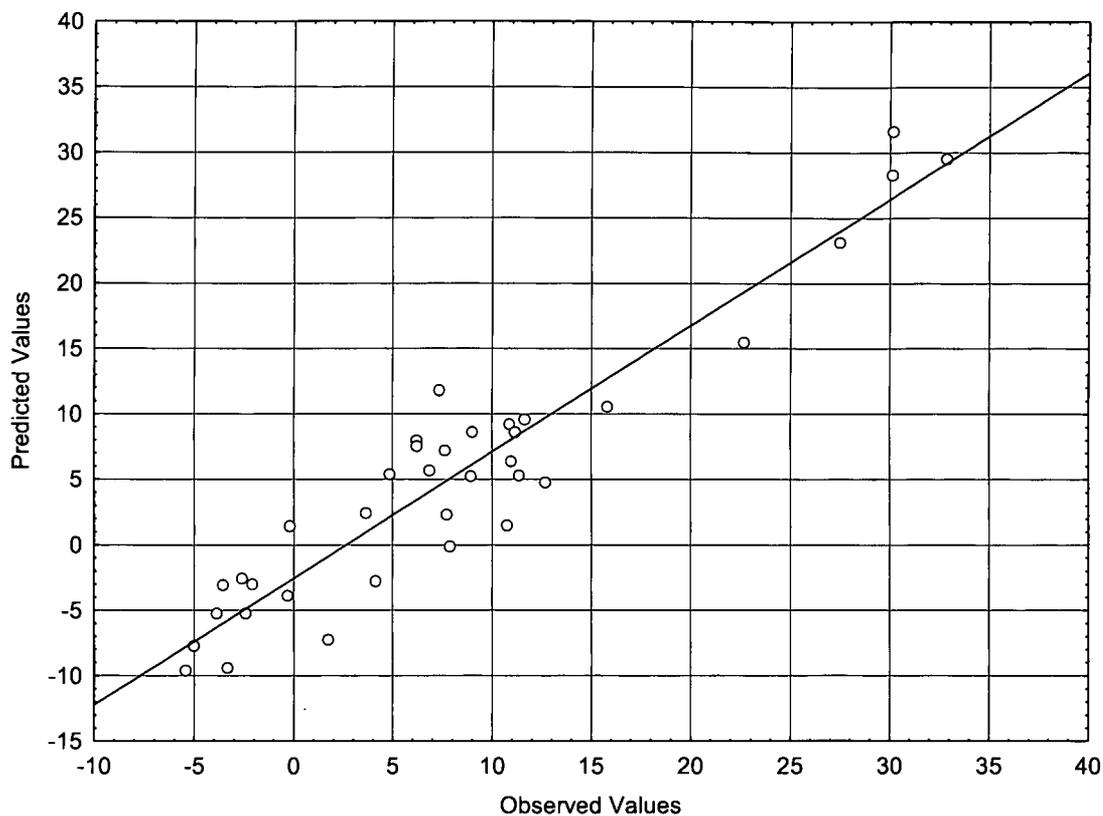


Figure 4.8: Scatter plot of the observed values of house price growth versus the values predicted by the best subset model for the period 1995-2004

A scatter plot of the predicted values of growth in house prices for the period 1995 to 2004 versus the actual values is shown in Figure 4.8. It reveals that 90% (R^2 of 0.90) of the predicted movement in growth rates of house prices corresponds with actual growth in house prices. The root mean square error of 4.36 suggests that the deviation from the actual values is relatively small. The R^2 and RMSE are respectively lower and higher than the initial model suggesting that the initial model has better predictive qualities. Table 4.9 shows a comparison between the combinations of variables that explained the most variation in house price growth for the two models.

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**Table 4.9: Comparison of variables for the model based on 1974 to 2000
and the model based on 1974 to 1995**

1974 to 2000 ($R^2 = 0.92$)	1974 to 1995 ($R^2 = 0.90$)
House Price Growth	House Price Growth
Interest Rate Growth	Interest Rates
Construction Cost Growth	GDP Growth
Rand/Dollar Exchange Rate Growth	Building Plans Passed Growth

The two models produced only one variable in common: the one-quarter lagged house price variable. Interest rates were substituted for interest rate growth and growth in building plans passed and GDP replaced growth in construction cost and the growth in the rand/dollar exchange rate for the model from 1974 to 1995.

4.6 Summary

The least squares regression analysis showed that a combination of the one-quarter lagged variables had a high predictive value and that all the applicable variables were statistically significant at the one percent significance level. The one-quarter lagged variables were then used in a best subset regression analysis which produced a large number of permutations.

This model showed that the following combination of variables could be used to predict the year-on-year changes in house prices with 93 percent accuracy:

- one-quarter lagged house prices,
- one-quarter lagged interest rate growth,
- one-quarter lagged rand/dollar exchange rate and
- one-quarter lagged construction cost.

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The F-statistic, individual t-statistics and standard errors showed that the predictive quality as well as the coefficients of the variables were accurate.

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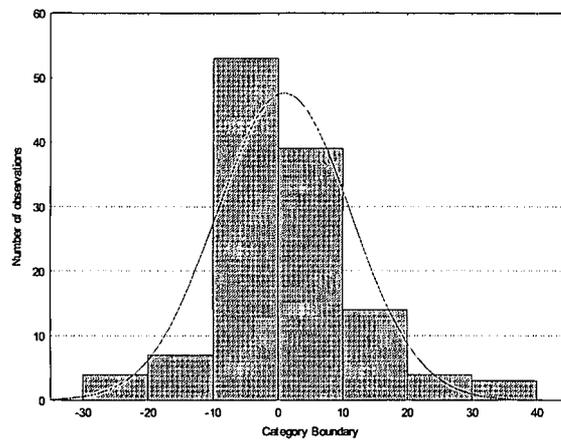
**Appendix 4.1: Histograms of normality for the one-period lagged variables
and the results of the Shapiro-Wilk W test**

Figure 4.9: Histogram of normality for the growth in one-period lagged house prices for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.95744 and a P-value of 0.00063. The red line indicates the expected normal

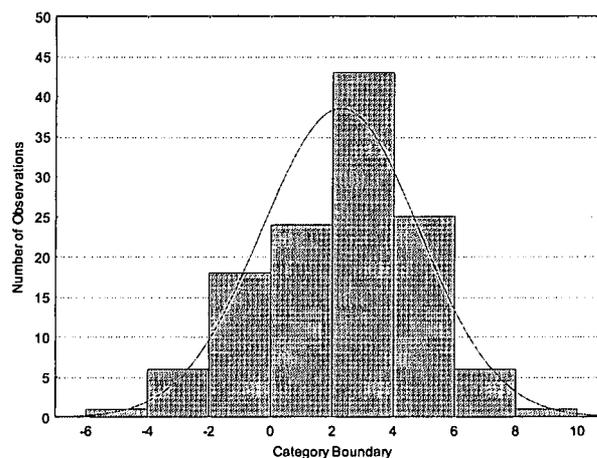


Figure 4.10: Histogram of normality for the growth in one-period lagged GDP for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.98677 and a P-value of 0.27281. The red line indicates the expected normal

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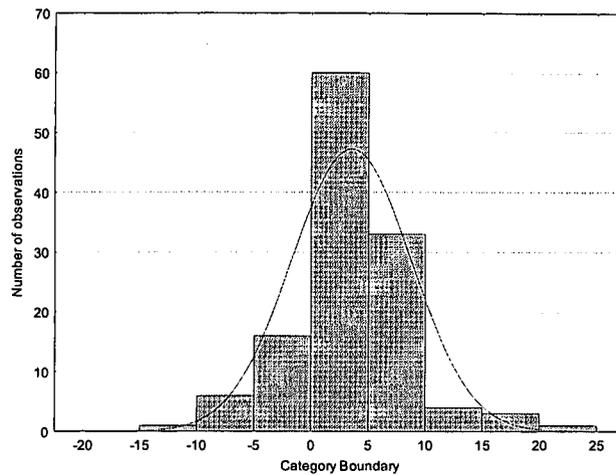


Figure 4.11: Histogram of normality for the growth in one-period lagged disposable income for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.95681 and a P-value of 0.00056. The red line indicates the expected normal

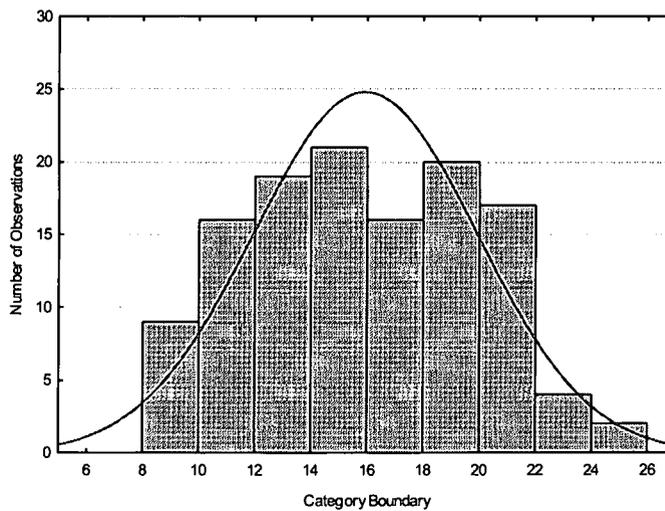


Figure 4.12: Histogram of normality for the one-period lagged interest rates for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.96489 and a P-value of 0.00260. The red line indicates the expected normal

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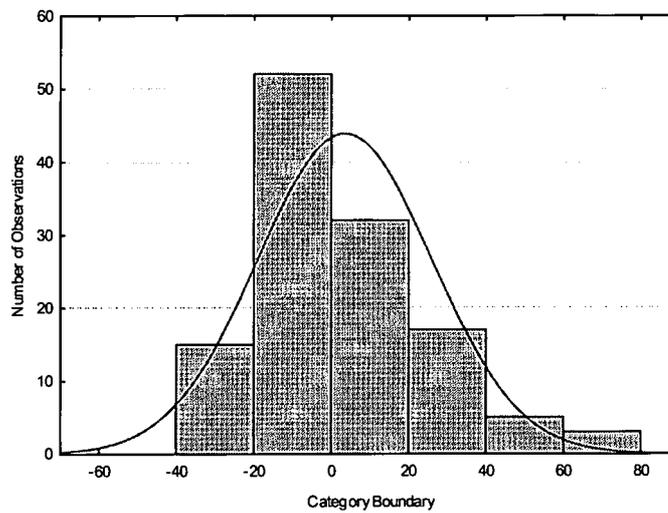


Figure 4.13: Histogram of normality for the growth in one-period lagged interest rate growth for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.95979 and a P-value of 0.00097. The red line indicates the expected normal

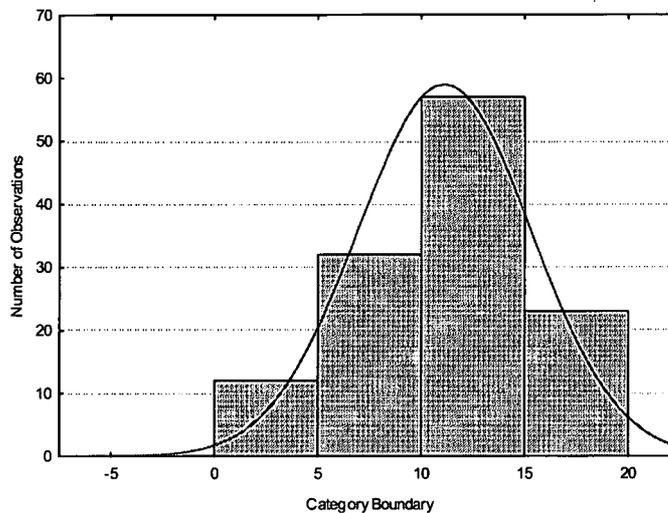


Figure 4.14: Histogram of normality for growth in the one-period lagged inflation growth for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.97032 and a P-value of 0.00781. The red line indicates the expected normal

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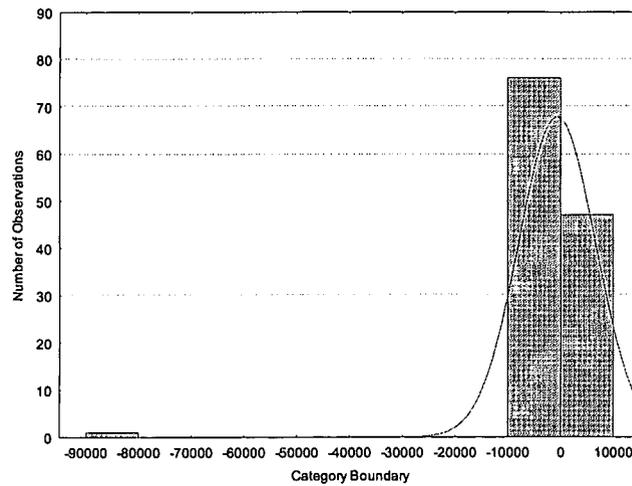


Figure 4.15: Histogram of normality for growth in the one-period lagged household savings for the period from 1974 to 1996

Note: Shapiro-Wilk W of 0.07297 and a P-value of 0.00000. The red line indicates the expected normal

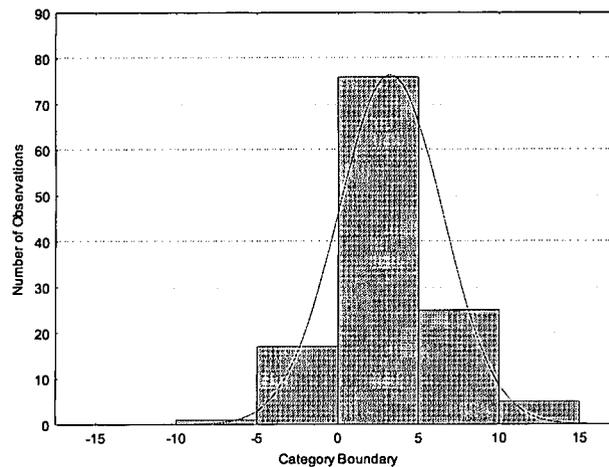


Figure 4.16: Histogram of normality for growth in the one-period lagged consumption for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.97202 and a P-value of 0.01116. The red line indicates the expected normal

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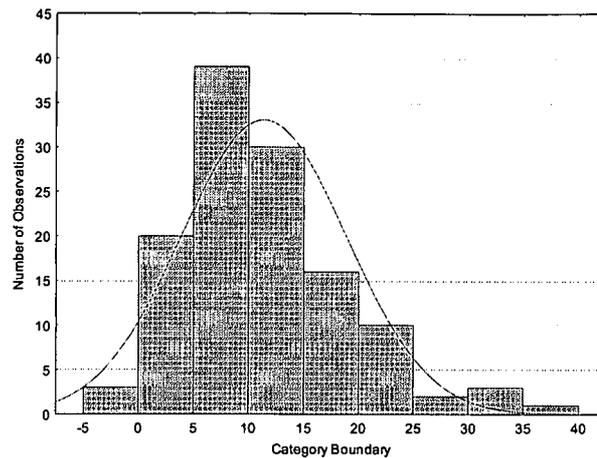


Figure 4.17: Histogram of normality for growth in the one-period lagged construction cost growth for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.94071 and a P-value of 0.00004. The red line indicates the expected normal

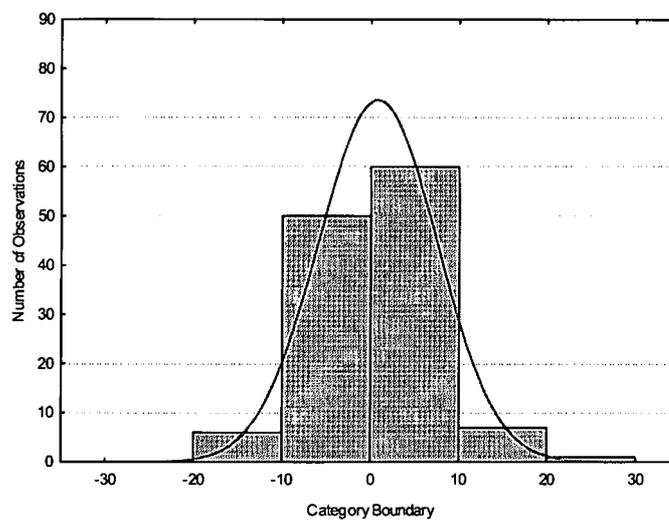


Figure 4.18: Histogram of normality for growth in the one-period lagged debt-to-income for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.97461 and a P-value of 0.01934. The red line indicates the expected normal

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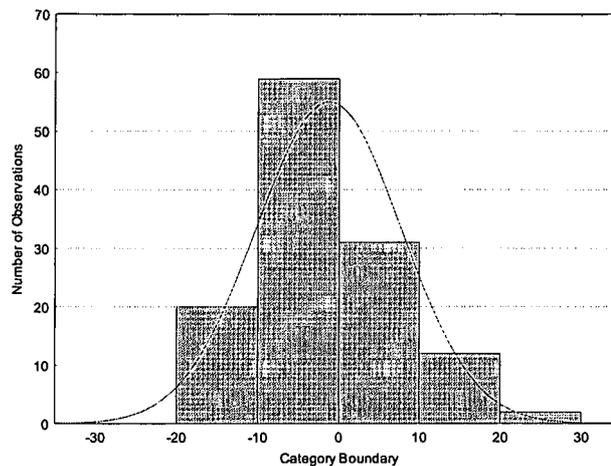


Figure 4.19: Histogram of normality for growth in the one-period lagged affordability ratio for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.97526 and a P-value of 0.02228. The red line indicates the expected normal

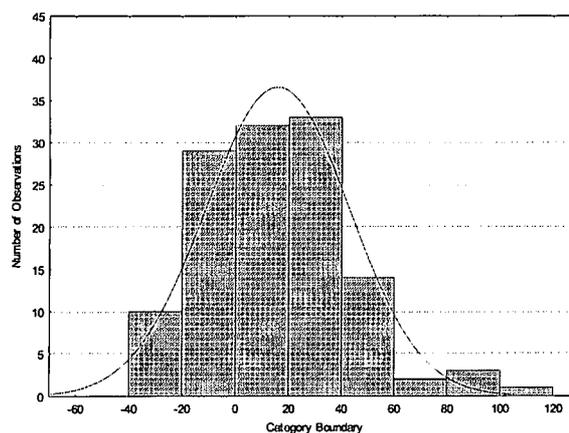


Figure 4.20: Histogram of normality for growth in the one-period lagged house prices for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.96714 and a P-value of 0.00407. The red line indicates the expected normal

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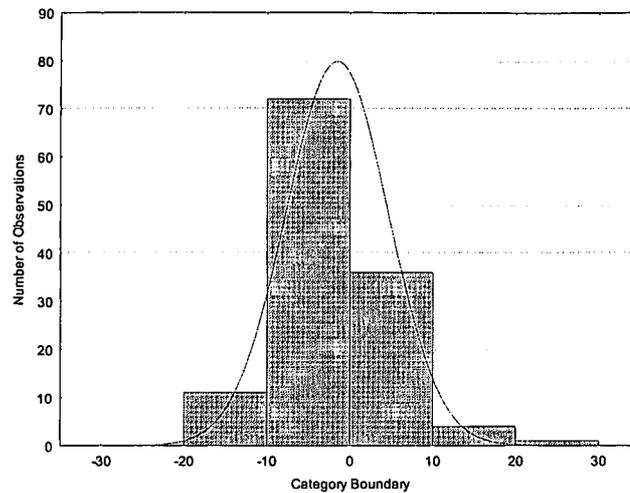


Figure 4.21: Histogram of normality for growth in the one-period lagged Rand/Dollar exchange rate for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.94652 and a P-value of 0.00009. The red line indicates the expected normal

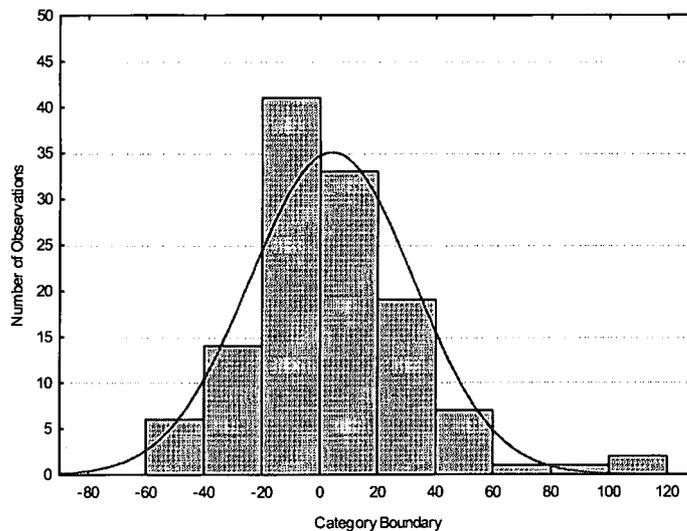


Figure 4.22: Histogram of normality for growth in the one-period lagged building plans passed for the period from 1974 to 1994

Note: Shapiro-Wilk W of 0.94836 and a P-value of 0.00013. The red line indicates the expected normal

Appendix 4.2: Correlation Matrix of One-Period Lagged Independent Variables and Depended Variable for the Complete Data Period

Marked correlations are significant at $p < .10000$
N=123

Variable	HP	HP(-1)	GDP(-1)	DI(-1)	IR(-1)	IRG(-1)	CP(-1)	HS(-1)	C(-1)	CC(-1)	DI(-1)	AI(-1)	AI3(-1)	RND(-1)	EEP(-1)	
House Prices	1.00															
House Prices(-1)	0.95	1.00														
GDP(-1)	0.36	0.41	1.00													
Disposable Income(-1)	0.21	0.22	0.37	1.00												
Interest Rates(-1)	-0.50	-0.20	-0.58	-0.12	1.00											
Interest Rates(-1)	-0.06	0.10	0.26	0.05	0.52	1.00										
Savings(-1)	-0.53	-0.54	-0.26	-0.26	0.07	0.25	1.00									
Household Savings(-1)	0.12	0.05	-0.08	-0.14	-0.18	-0.15	-0.01	1.00								
Consumption(-1)	0.55	0.57	0.75	0.46	-0.34	0.19	-0.20	0.01	1.00							
Construction Cost(-1)	0.37	0.34	0.55	0.16	-0.27	0.42	0.39	0.03	0.62	1.00						
Real Income(-1)	0.29	0.36	0.11	-0.47	0.15	0.25	-0.03	-0.05	0.23	0.34	1.00					
Affordability(-1)	0.93	0.94	-0.40	0.17	-0.24	0.05	-0.44	0.07	0.54	0.35	0.20	1.00				
JSE All Share Index(-1)	0.05	-0.06	-0.05	0.07	-0.28	-0.47	0.10	0.03	0.10	0.05	-0.08	-0.02	1.00			
Rand/Dollar Exchange Rate(-1)	0.13	0.02	-0.03	-0.13	-0.28	-0.21	0.05	0.25	-0.00	0.04	-0.09	0.10	0.17	1.00		
Building Repairs/Passes(-1)	0.53	0.48	0.36	0.15	-0.29	-0.06	-0.06	0.05	0.59	0.45	0.25	0.49	0.21	0.17	1.00	

- Note:
- HP - House Prices
 - HP(-1) - One-Period Lagged House Prices
 - GDP(-1) - One-Period Lagged Gross Domestic Product
 - DI(-1) - One-Period Lagged Disposable Income
 - IR(-1) - One-Period Lagged Interest Rates
 - IRG(-1) - One-Period Lagged Interest Rates Growth
 - CP(-1) - One-Period Lagged Consumer Price Inflation
 - HS(-1) - One-Period Lagged Household Savings
 - C(-1) - One-Period Lagged Consumption
 - CC(-1) - One-Period Lagged Construction Cost
 - DI(-1) - One-Period Lagged Debt/Income Relationship
 - AI(-1) - One-Period Lagged Affordability
 - AI3(-1) - One-Period Lagged JSE All Share Index
 - RND(-1) - One-Period Lagged Rand/Dollar Exchange Rate

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CHAPTER 5
DEVELOPMENT OF AN UPSWING AND DOWNSWING RESIDENTIAL
GROWTH CYCLE

5.1 Introduction

A residential real estate cycle consists of four phases: a recovery, expansion, recession and contraction phase, as shown in Figure 5.1. The economic indicators influencing the changes in house prices differ between the four phases of the growth cycle and an analysis of the separate phases may well provide some further insight for the prediction of house prices (Trass, 2004:26). Since it is almost impossible to determine the exact point where a recovery merges into an expansion and where a recession merges into a contraction phase, the recovery and expansion phases are grouped together as an upswing phase, and the recession and contraction phases as a downswing phase (Cloete, 1990:11-12 and Estey, 1956:84).

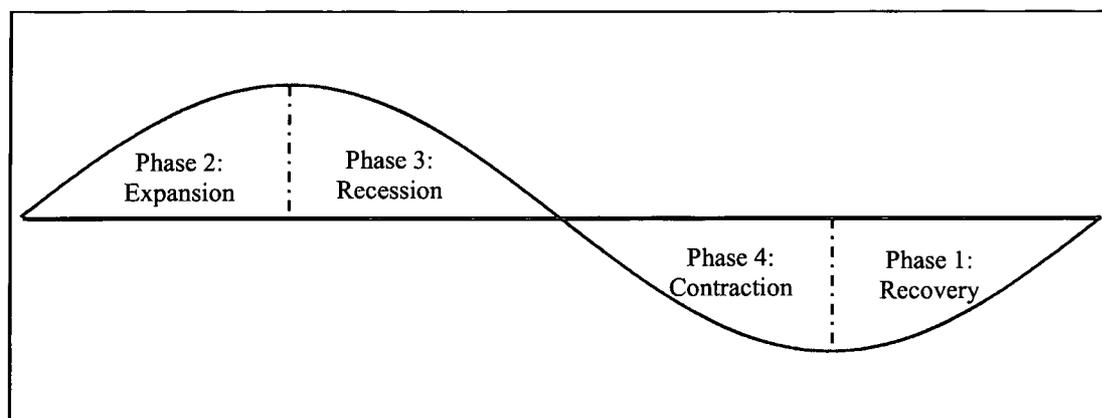


Figure 5.1: The phases of the residential real estate cycle

Source: Adapted from Peter Dag and Associates

In this chapter the variables identified and used in Chapters 3 and 4 will be used to develop regression models for the upswing and downswing phases

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of the residential real estate cycle. The same methodology applied in Chapter 4 will be used for the development of the regression models for an upswing and decline phase.

The one-quarter lagged variables are divided into two segments according to the upswing and downswing growth of house prices. An upswing or downswing phase is defined as two consecutive periods of growth in the same direction. The house price growth cycle, shown in Figure 5.2, is separated into 11 upswing phases and 12 complete downswing phases. The final quarter of 2004 represents the beginning of a downswing cycle, but it does not meet the requirements of two consecutive periods of negative growth to be classified as a complete downswing cycle. The December 2004 quarter is, however, included as the last observation in the downswing dataset. This may easily be observed in Figure 5.2.

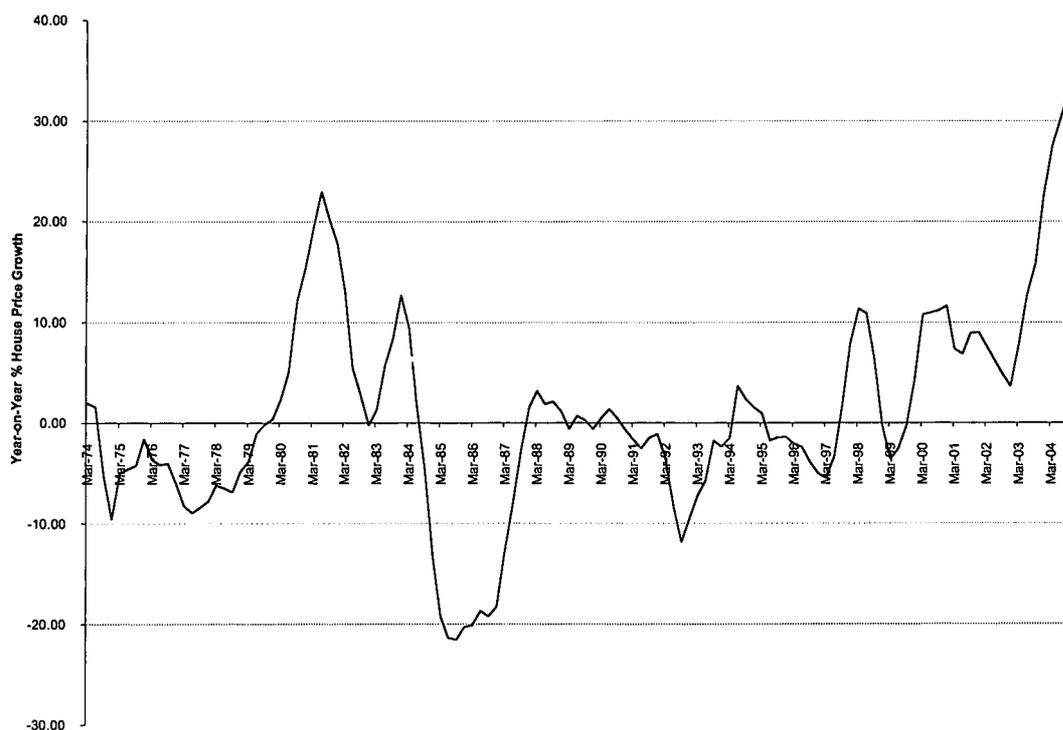


Figure 5.2: House price growth cycles in quarterly values from 1974 to 2004

Source: Adapted from data provided by Absa

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After the classification of the data into an upswing and downswing data set an assessment of the time series data will be performed, using tests for normality and multi-colinearity. Thereafter the best subset regression analysis, as discussed in Chapter 4, will be used to develop the models for the upswing and downswing phase of the datasets.

This chapter is divided into four sections where section one is the introduction. Section two is dedicated to the upswing phase of house price and section three to the downswing phase. The same methodology is used in section two and three, which is: firstly the upswing or downswing phase is defined where after an assessment of the time series data is conducted. The best subset regression is performed on the one-quarter lagged variables and the model with the highest R^2 is identified as the predictive model for the upswing and downswing phase. The assumptions of a multiple regression model are tested on the residuals and discrepancies are analysed before the findings of the model are discussed. Lastly the models based on data from 1974 to 2000 are compared to models based on data used to develop a model for the period from 1974 to 1995. The final section of the chapter provides a summary.

5.2 Assessment of the upswing phase

5.2.1 Definition of the upswing phase

An upswing phase of the cycle is defined as two consecutive periods of growth in the same direction. This translates to two quarterly growth periods, thus 6 months of positive growth. The upswing data for the whole period consisted of 65 observations, 11 upswing cycles, with an average length of 5.91 quarters or 17.73 months.

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5.2.2 Assessment of the time series data

The upswing data were assessed using two tests: firstly the variables were tested for normality and secondly the strength of the relationship between the variables during the upswing period was tested. As in Chapter, 4 the upswing data were tested for normality with the use of histograms and the Shapiro Wilk test (Ott and Longnecker, 2001:758-772). The results of the Shapiro Wilk tests are shown in Table 5.1 for each of the variables and the histograms are illustrated in Appendix 5.1. For the Shapiro Wilk test a p-value below 0.05 means that the assumption of a normal distribution cannot be accepted at 95% confidence level (Polhemus, 2005).

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Table 5.1: Shapiro Wilk test for normality

Variable	Shapiro-Wilk W	P-Value
Affordability	0.97565	0.22778
Building Plans passed	0.94113	0.00393
Construction Cost	0.90622	0.00012
Consumption	0.93107	0.00135
Debt/Income	0.94148	0.00408
Disposable Income	0.93338	0.00172
GDP	0.97937	0.34909
House Prices (dependent)	0.96904	0.10262
House Prices (lagged)	0.97144	0.13752
Household Savings	0.88745	0.00002
Inflation	0.94982	0.01038
Interest Rates	0.94830	0.00873
Interest Rates Growth	0.96468	0.06032
JSE-ALSI index	0.97755	0.28420
Rand/Dollar	0.93559	0.00217

The Shapiro Wilk test showed that affordability, GDP, the dependent house price variable, one-quarter lagged house prices, interest rate growth and the JSE-ALSI index were normally distributed for the upswing period at the 5% level. A visual assessment of the variables (see Appendix 5.1) confirms the above test.

The upswing data were further tested for multi-collinearity between the independent variables. High correlation between the independent variables results in disproportionately large standard errors and unstable regression coefficients (Dielman, 1996:316-318). The multi-collinearity was tested by using

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a correlation matrix of the one-quarter lagged variables for the upswing phase. The matrix is attached as Appendix 5.2. The results suggested the following relationship:

- House prices and affordability showed the highest correlation of 0.94. This was expected, since the affordability ratio was calculated using the house price variable.
- Consumption showed correlation above 0.7 with GDP, construction cost and building plans passed.
- Inflation and house prices, and disposable income and construction cost were correlated at a level of more than 0.6.
- House prices, interest rates and affordability had correlation with consumption of more than 0.5.
- Correlation between house prices and building plans passed, disposable income and household savings, disposable income and the debt-income relationship, household savings and the debt-income relationship, as well as construction cost and interest rate growth indicated correlation levels of more than 0.5.

Of the pairwise combinations that showed significant correlation, only consumption and house prices, and consumption and interest rates, appeared in the regression model that offered the best predictive ability. The colinearity between these pairs was still below 0.60 and did not present a problem when the t-statistics of the individual variables were evaluated.

5.2.3 Results from application of best subsets regression technique

The best subset regression was applied to 65 observations, thus using the upswing cycles from 1974 to 2000 and it was tested on the remaining 9 observations from 2001 to 2004. The regression was based on the 90 percent training sample and a 10 percent test sample as highlighted in Chapter 4. The

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statistics of the model are depicted in Table 5.2. The best subset regression analysis produced a multitude of models and the model with the highest coefficient of determination (R^2) was chosen as the model, which explained the most variation in house price growth (Dielman, 1996:414-415, 105). The model specified in Table 5.2 produced the highest R^2 of 0.97 with a RMSE of 1.6392. This means that the combination of variables explained 97 percent of the variation in house price growth during the upswing cycle (Dielman, 1996:105-106). The R^2 was obtained when the model was tested on the period from the first quarter of 2001 to the final quarter of 2004.

Table 5.2: Results of the best subset regression model for the upswing cycle producing the highest R^2

One-quarter Lagged Variables	House Prices Beta Coefficients	House Prices Standard Error B	House Prices t-statistic	House Prices p-value
House Prices	0.941190	0.033526	28.07350	0.000000
Interest Rates	0.074297	0.032706	2.27168	0.027533
Household Savings	0.063171	0.027443	2.30187	0.025633
Consumption	0.090703	0.038554	2.35264	0.022701
JSE-ALSI index	0.052416	0.027811	1.88469	0.065411
Rand-Dollar Exchange Rate	0.048399	0.026715	1.81167	0.076168
	R-Squared	0.9691	RMSE	1.6392
	Adjusted R^2	0.9654	F-Test	256.4172
			<i>h</i> -test	1.46

Note: the following variables are excluded: construction cost, building plans passed, CPI, disposable income, GDP, debt-to-income ratio and interest rate growth.

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A scatter plot of the predicted values of house price growth versus the actual values for the period from 1974 to 2000 is depicted in Figure 5.3. In the scatter plot the values produced by the model for the period 1974 to 2000 were tested against the actual values. It showed that 97 percent (R^2 of 0.97) of the predicted growth during upswing phases for the period 1974 to 2000 corresponded with the actual growth in house prices. The root mean square error (RMSE) of 1.6435 suggested that the deviation from the actual values was relatively small.

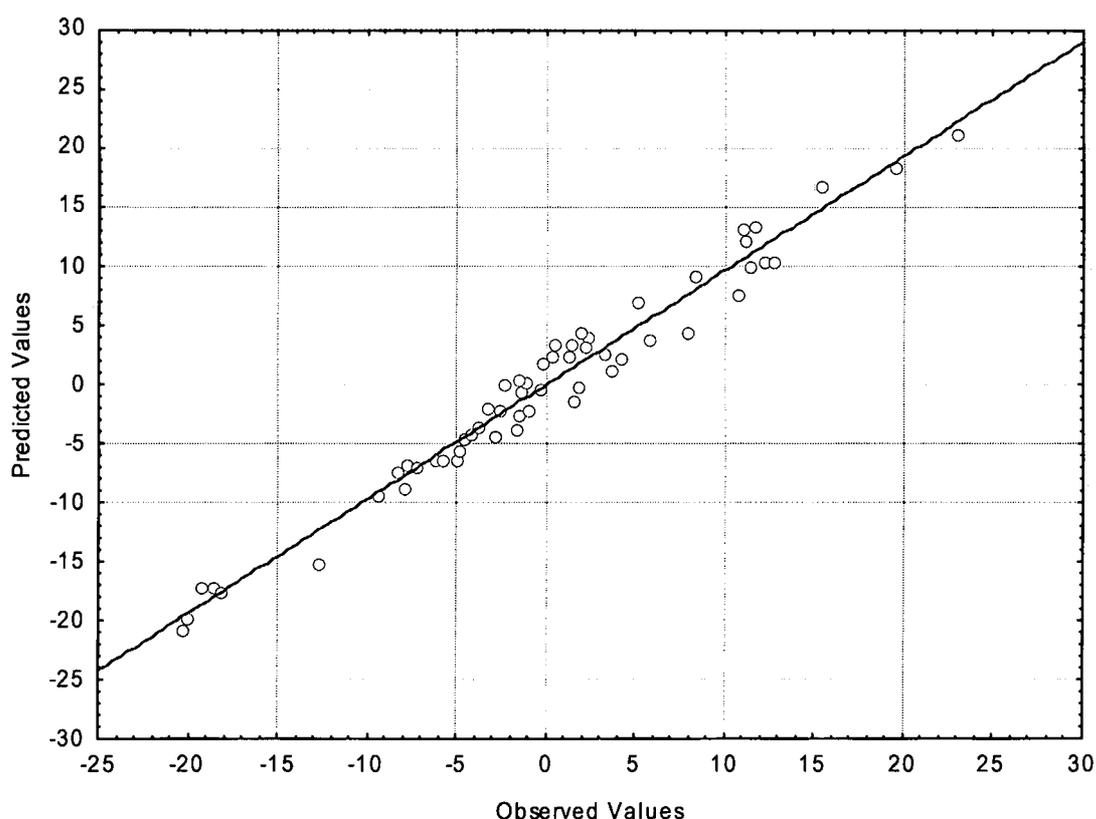


Figure 5.3: Scatter plot of the observed values of house price growth versus the values predicted by the best subset model for the upswing phases from 1974 to 2000

The coefficient of determination (R^2) is a useful indicator of how well the prediction values fit the data, but to confirm the value of the R^2 an additional

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test was performed, the F-test, which determines whether or not the overall model is useful for predicting growth in house prices (McClave, Benson and Sincich, 1998:523). The F-test for this model produced a value of 256.4172, with a p-value of 0.000. This was well outside the boundary of 1.84 for the 95 percent confidence level and 2.35 for the 99 percent confidence level, which confirmed that the model could be useful for predicting house prices (Dielman, 1996:105, 526).

5.2.4 Testing the assumptions of the model

A multiple linear regression model has four assumptions applicable to its residuals which offer the 'ideal' conditions for estimating and deducing conclusions about the predictive ability of the model. The four assumptions of homoskedasticity, linearity, independence and normality may be confirmed through scatter plots of the residuals versus the regression line (Dielman, 1996:217-218). In order to determine whether the residuals conformed to the assumption of homoskedasticity a scatter plot of the residuals versus the predicted values shown in Figure 5.4 was assessed. The scatter plot showed that the residuals were randomly distributed, which suggests that heteroskedasticity was not present during the development of the model. The assumption of homoskedasticity would be violated if the residuals formed any form of discernable pattern (Ott and Longnecker, 2001:761-762).

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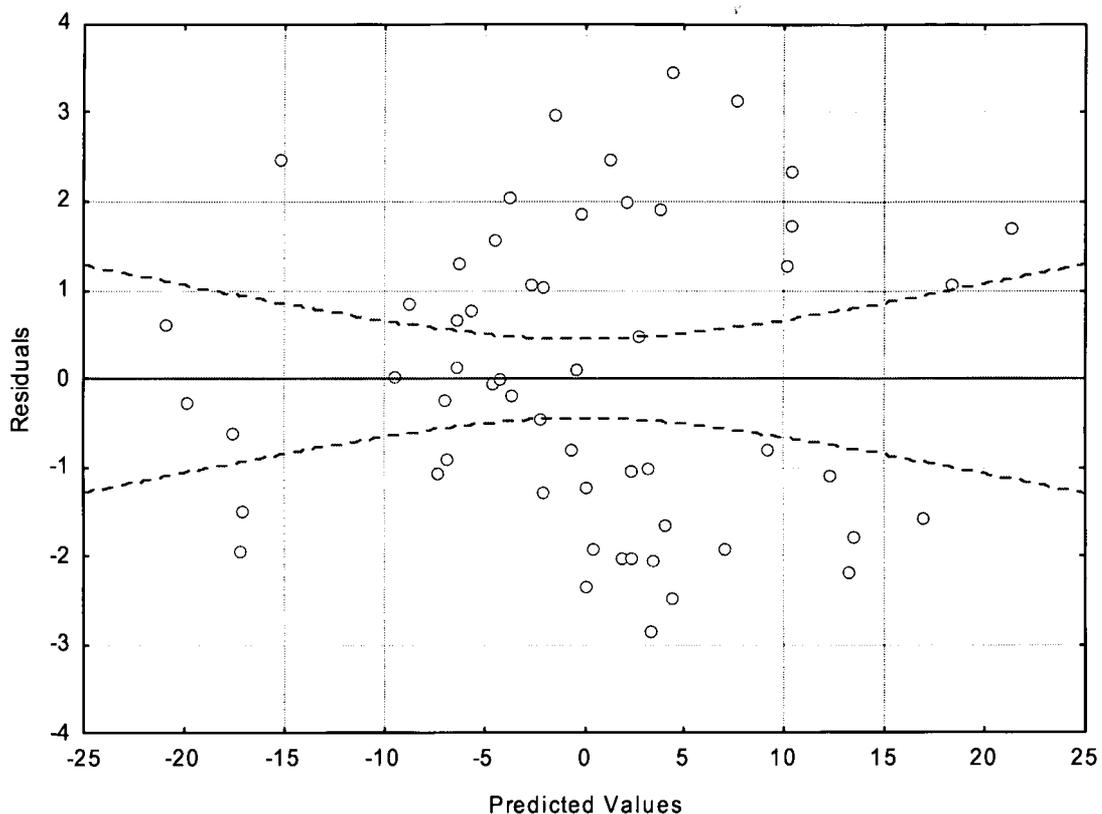


Figure 5.4: Scatter plot of residuals versus predicted values

In a linear multiple regression the relationship between the dependent variable and the explanatory variables should be linear. This relationship could be assessed through a scatter plot of the residuals versus the predicted values. If the residuals are randomly distributed there is evidence of a linear relationship. It is evident in Figure 5.4 that the residuals were randomly distributed and thus it suggests that the relationship between house prices and the explanatory variables is linear (Dielman, 1996:222-226).

The assumption of independence refers to the absence of serial correlation (autocorrelation) between the residuals (Dielman, 1996:306-307). When lagged dependent variables are used as explanatory variables, Durbin's *h*-test is used to test for serial correlation. There was no serial correlation between the residuals when the *h*-test is between -1.96 and +1.96 for the 95

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percent confidence level (Dielman, 1996:312-313). The h -test for the upswing model was 1.46 suggesting that there was no serial correlation between the residuals. Figure 5.5 depicts the normal probability plot of the residuals versus their expected value.

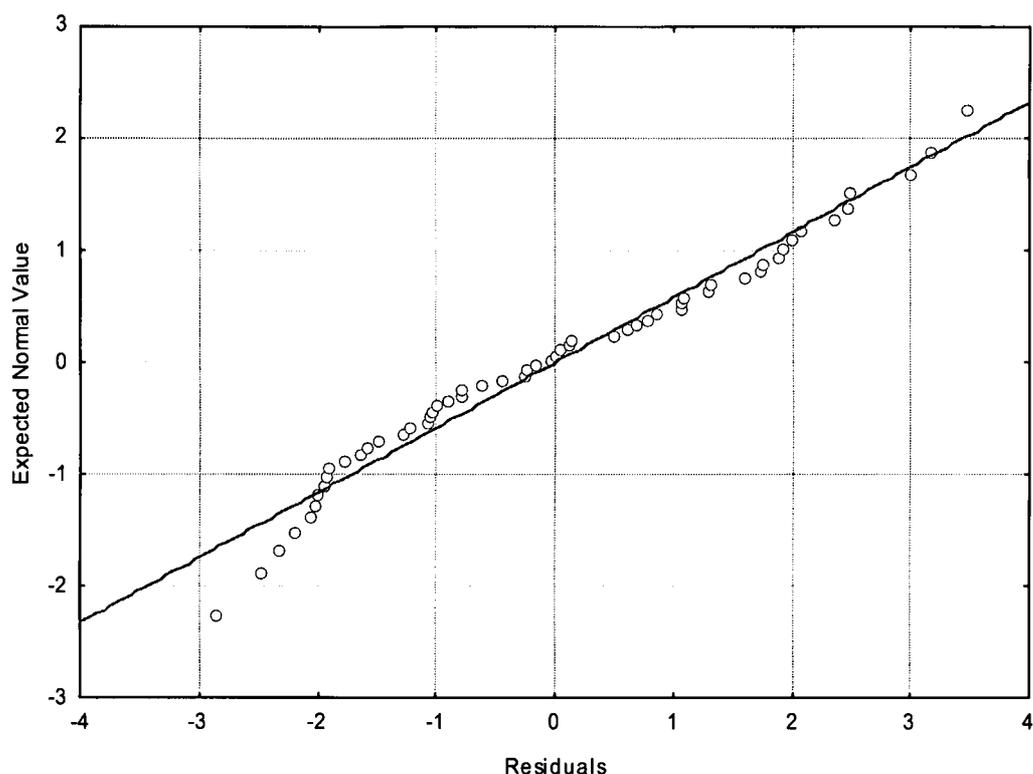


Figure 5.5: Normal probability plot of residuals versus expected normal value

Non-normality may be detected through a normal probability plot of the residuals, as shown in Figure 5.5. The probability plot shows that the residuals were slightly skewed to the left (Ott and Longnecker 2001:765-766). The assumption of normally distributed residuals is not necessary when using least squares regression to produce a regression model and best subset regression consisting of a series of least squares regressions (Dielman 1996:288).

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5.2.5 Interpretation of findings

The results of the best subset regression model depicted in Table 5.2 specified the one-quarter lagged house price variable, one-quarter lagged interest rates, one-quarter lagged household savings, one-quarter lagged consumption, one-quarter lagged JSE-ALSI index and the one-quarter lagged Rand-Dollar exchange rate as the combination of variables to predict the growth in house prices during an upswing cycle.

The beta coefficients in Table 5.2 infer the value that each variable contributed to growth in house prices for every one percent change. One-quarter lagged house prices contributed the most to the prediction with 0.941190, followed by consumption with 0.090703 and interest rates with 0.074297. Household savings, the JSE-ALSI and the Rand-Dollar exchange rate contributed 0.063171, 0.052416 and 0.048399 respectively. The JSE-ALSI and the Rand-Dollar exchange rate was significant at the 90% confidence level.

The t-statistics indicate whether or not the relationship between the independent variables and the dependent variable was linear. To determine, with 95 percent confidence, whether the relationship is linear, the t-statistic should be outside the upper boundary of +2 and the lower boundary of -2 and the p-value should be less than 0.05. House prices, interest rates, consumption and household savings conformed to both the requirements. The JSE-ALSI and the Rand-Dollar exchange rate had p-values between 0.05 and 0.1 suggesting that the t-statistics was significant at the 90 percent confidence level (Dielman 1996:152).

A scatter plot of the observed values of house price growth versus the predicted values for the period from 2001 to 2004 as displayed in Figure 5.6, showed that there were only minor deviations from the regression line. The

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RMSE of 1.692, shown in Table 5.2, confirmed that the deviations from the regression line were relatively small which showed that the model was useful for prediction of house price growth (Dielman 1996:105).

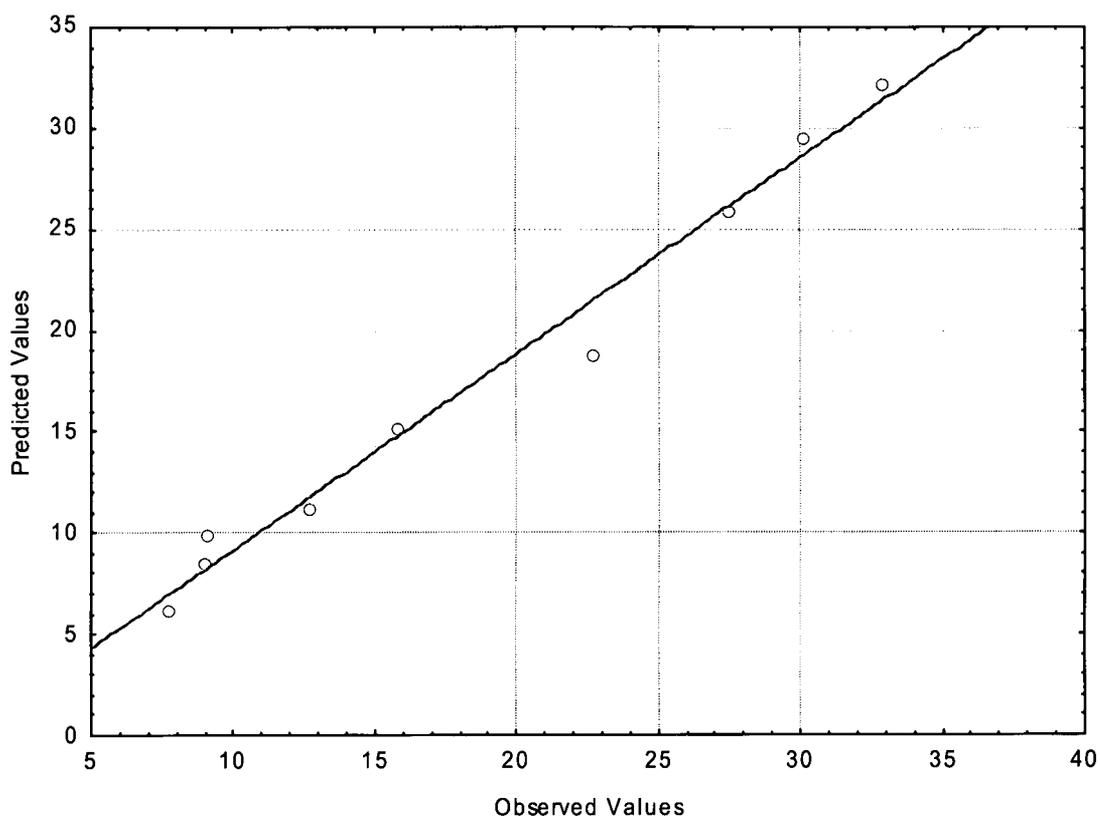


Figure 5.6: Scatter plot of the observed values of house price growth versus the values predicted by the best subset model for the upswing phases over the period 2001 to 2004

The statistically significant t-statistics suggested that multi-collinearity was not a problem. The correlation matrix in Table 5.3 showed that only consumption had a significant relationship with house prices and with interest rates.

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Table 5.3: Correlation matrix of variables used for the upswing cycle regression model variables

One-quarter Lagged Variables	House prices	Interest Rates	Household Savings	Consumption	JSE-ALSI index	Rand/Dollar Exchange Rate
House prices	1.00					
Interest Rates	-0.23	1.00				
Household Savings	-0.12	-0.27	1.00			
Consumption	0.59	-0.51	-0.07	1.00		
JSE-ALSI index	-0.05	-0.33	0.04	0.24	1.00	
Rand/Dollar Exchange Rate	0.14	-0.17	0.12	0.10	0.09	1.00

5.2.6 Testing the continuous relationship between the variables

As in Chapter 4, the continuous relationship between the variables and house price growth were tested using a model based on the time period from 1974 to 1995 and tested over the period of 1996 to 2004 which represents 60 percent of the data used for training the model and the analysis period and 40 percent for the testing period. The best subset regression produced two models with similar coefficients of determination (R^2), but with two and six variables respectively. The two variable model produced a R^2 of 0.97 and a RMSE of 1.61. The results are shown in Table 5.4.

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Table 5.4: Upswing two variable regression model

Lagged 1 Variables	House Price Beta Coefficient	House Prices Standard Error B	House Prices t-statistic	House Prices p-value
House Prices	0.901477	0.034887	25.83993	0.000000
Building Plans passed	0.120915	0.034887	3.46590	0.001231

The six variable model, shown in Table 5.5, produced a R^2 of 0.98 and a RMSE of 1.35. The higher RMSE of the first model suggested that it was less effective in forecasting future rates of growth in house prices than the two variable model (Dielman 1996:105).

Table 5.5: Upswing six variable regression model

Lagged 1 Variables	House Prices Beta Coefficients	House Prices Standard Error B	House Prices t-statistic	House Prices p-value
House Prices	1.000342	0.045617	21.92937	0.000000
Inflation	0.088596	0.035614	2.48765	0.017363
Household Savings	0.063584	0.025201	2.52303	0.015940
Consumption	0.100327	0.047939	2.09279	0.043098
Construction Cost	-0.167691	0.049145	-3.41214	0.001543
Building Plans passed	0.095417	0.041899	2.27731	0.028483

The two variable and the six variable models had the one-quarter lagged house price variable and building plans passed in common as predictive

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variables. The best subset regression analysis was firstly based on the period 1974 to 2000 and secondly on the period 1974 to 1995 and it produced three models which are discussed below.

The model based on the period from 1974 to 2000 identified the following variables as predictors of growth in house prices:

- Growth in one-period lagged house prices
- One-period lagged interest rates
- One-period lagged household savings
- One-period lagged consumption
- One-period lagged JSE ALSI
- One-period lagged Rand-Dollar exchange rate

The two variable model based on the period from 1974 to 1995 identified the following variables as predictors of growth in house prices:

- Growth in one-period lagged house prices
- One-period lagged building plans passed

The two variable model based on the period from 1974 to 1995 identified the following variables as predictors of growth in house prices:

- Growth in one-period lagged house prices
- One-period lagged building plans passed
- One-period lagged household savings
- One-period lagged consumption
- One-period lagged inflation
- One-period lagged construction cost

An assessment of the three models showed that the six-variable model based on data from 1974 to 1995 and the six-variable model based on data from 1974 to 2000 had the most variables in common. The one-quarter lagged

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house price variable, household savings and consumption were consistently identified as predictors of the upswing phase of the house price growth cycle.

5.3 Assessment of the downswing period

5.3.1 Definition of the downswing period

A downswing is defined as two consecutive periods of movement in a downwards direction (Trass, 2004). This translates to two quarterly negative growth periods, thus six months of negative movement. The downswing data for the whole period provides 59 observations, 12 downswing cycles, with an average length of 4.92 quarters or 14.75 months. The dataset for the downswing cycle lost one observation due to the use of one-quarter lagged data, which reduced the number of observations to 58.

5.3.2 Assessment of the time series data

As in the previous sections the downswing data was assessed through two tests: firstly the variables were tested for normality and secondly the correlation between the variables during the downswing period was tested. The Shapiro Wilk test for normality produced the results shown in Table 5.7.

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Table 5.7: Shapiro Wilk W test for normality

Variable	Shapiro-Wilk W	P-Value
Affordability	0.95586	0.03175
Building Plans passed	0.97936	0.41359
Construction Cost	0.95684	0.03536
Consumption	0.93368	0.00315
Debt/Income	0.98381	0.61936
Disposable Income	0.96283	0.06874
GDP	0.98507	0.68379
House Prices	0.94570	0.01067
Household Savings	0.12257	0.00000
Inflation	0.94570	0.14186
Interest Rates	0.96323	0.07180
Interest Rates Growth	0.90093	0.00016
JSE-ALSI index	0.97085	0.16795
Rand/Dollar	0.92549	0.00143

The Shapiro-Wilk test showed that building plans passed, the debt-income relationship, disposable income, GDP, inflation, interest rates and the JSE-ALSI index were normally distributed for the period from the second quarter of 1974 to the fourth quarter of 2000. This was confirmed through a visual test performed with histograms, which are attached in Appendix 5.3.

The upswing data were further tested for multi-collinearity between the independent variables. High correlation between the independent variables resulted in disproportionately large standard errors and unstable regression coefficients (Dielman 1996:316-318). The multi-collinearity was tested through a

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correlation matrix on the one-quarter lagged variables for the upswing periods. The matrix is attached as Appendix 5.4. The results were as follows:

- Affordability and house prices showed correlation of 0.96.
- GDP and consumption were correlated above 0.70.
- Consumption showed correlation of above 0.50 with house prices, affordability and construction cost.
- Interest rate growth and construction cost were correlated above the 0.5 level.

Of the variables listed above that showed a significant relationship, only interest rate growth and construction cost were present in the final model.

5.3.3 Results from application of best subset regression technique

The best subset regression analysis was performed on the 52 downswing cycle observations for the period from 1974 to 2000 in keeping with the complete cycle analysis. The model was tested on the remaining seven observations included in the 2001 to 2004 testing period. The permutations produced were evaluated based on their R^2 and RMSE. The model specified in Table 5.8 produced the highest R^2 of 0.9566 with a RMSE of 1.65499.

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Table 5.8: Results of the best subset regression model producing the highest R²

One-quarter Lagged Variables	House Prices Beta Coefficients	House Prices Standard Error B	House Prices t-statistic	House Prices p-value
House Prices	0.926006	0.036768	25.18514	0.000000
Interest Rates Growth	-0.186643	0.039726	-4.69825	0.000023
Household Savings	0.075508	0.031619	2.38803	0.021010
Construction Cost	0.181549	0.042774	4.24440	0.000102
	R-Squared	0.9566	RMSE	1.65499
	Adjusted R ²	0.9529	F-Test	258.8899
			<i>h</i> -test	2.3296

A scatter plot of the predicted values of house price growth for the period 1974 to 2001 versus the actual values is shown in Figure 5.7. It shows that 96 percent (R² of 0.96) of the predicted movement in house price growth corresponded with the actual house price growth during the period of analysis. The root mean square error (RMSE) of 1.655 suggested that the deviation from the actual values was relatively small (Dielman 1996:105).

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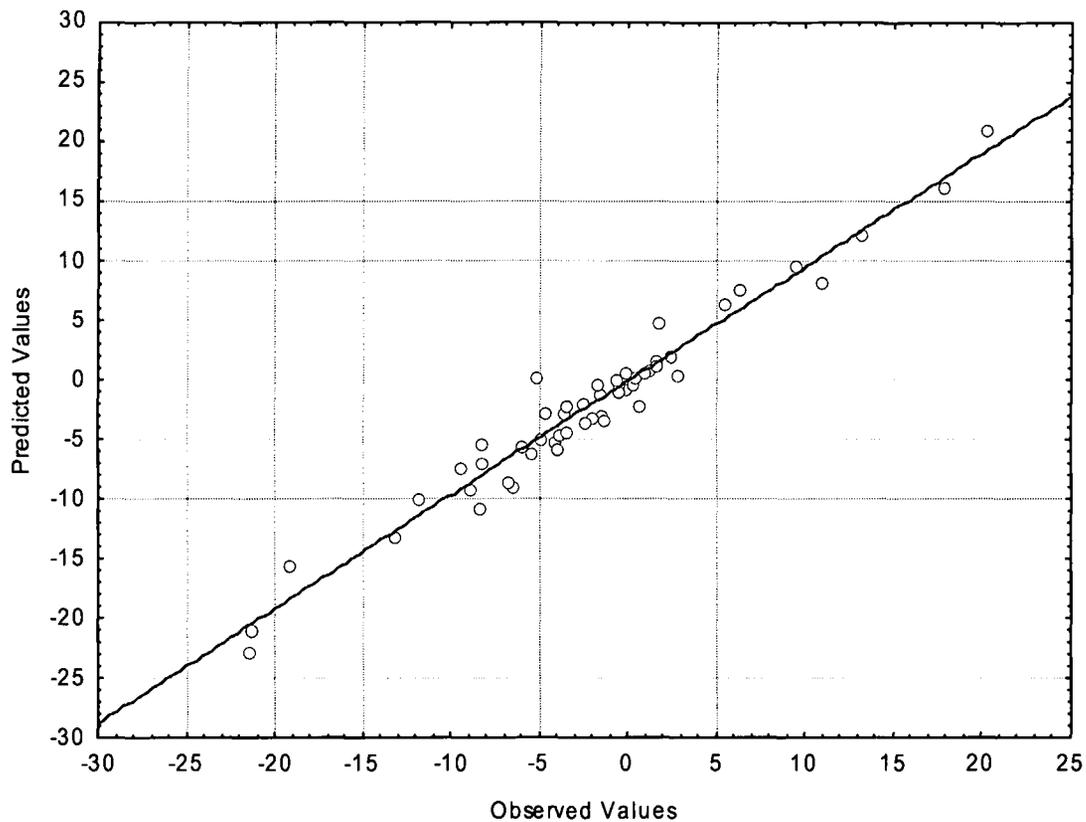


Figure 5.7: Scatter plot of the observed values of house price growth versus the values predicted by the best subset model for the period 1974 to 2000

The model produced an F-value of 258.8899 with a p-value of 0.0000, as shown in Table 5.8. This was well outside the boundary of 2.35 for the 95 percent confidence level, which confirmed that the model is useful for predicting future house price growth values (Dielman 1996:105, 526).

5.3.4 Testing the assumptions of the model

As in the previous sections, the four assumptions of the model were tested. Figure 5.8 shows a random distribution of the data in a scatter plot suggesting that the linearity assumption was not violated at the 95 percent confidence level.

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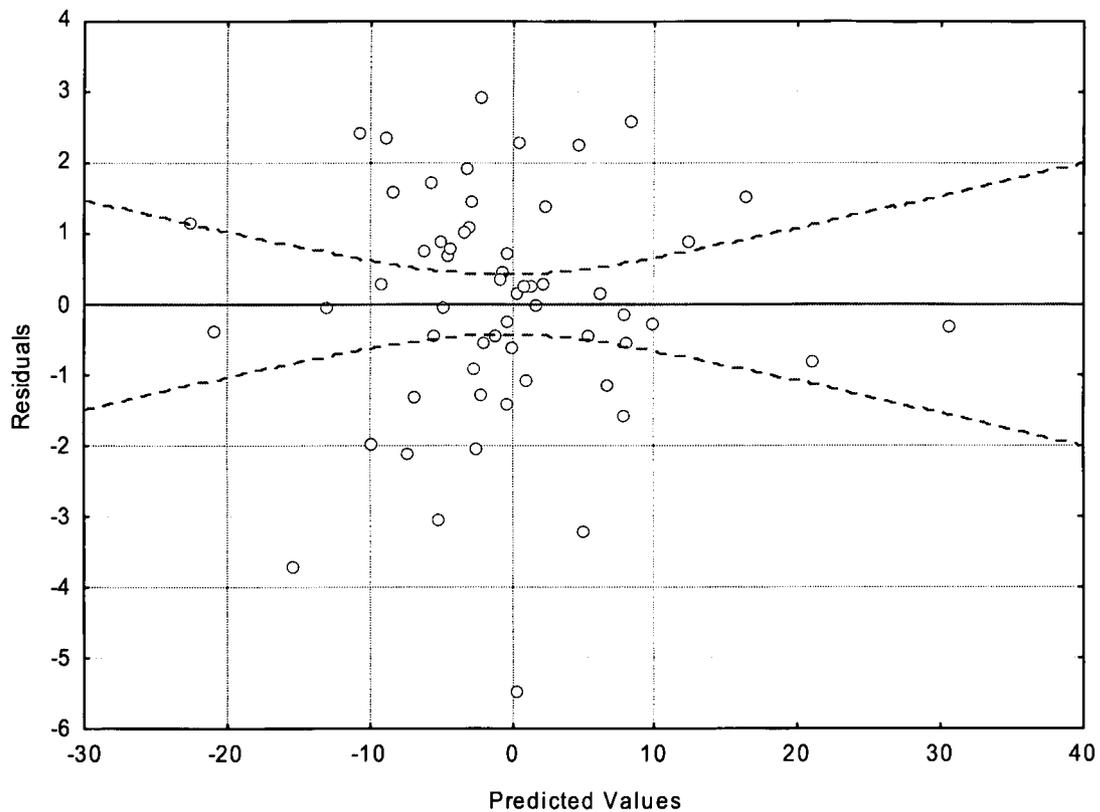


Figure 5.8: A scatter plot of the residual values versus the values of the dependent variable

Figure 5.8 shows randomly scattered residuals which suggested that the residuals were homoskedastic and that the assumption was not violated.

Figure 5.9 shows that, although the residuals show skewness to the right and outliers to the left, the residuals normally distributed. However, the assumption of normally distributed residuals is not necessary for least squares estimation to produce a regression equation. The outlier in the lower left corner of Figure 5.9 represents the difference between the predicted house price growth and the actual house price growth for the third quarter of 1974. This quarter showed the first period of negative growth of -5.215 during the downswing phase.

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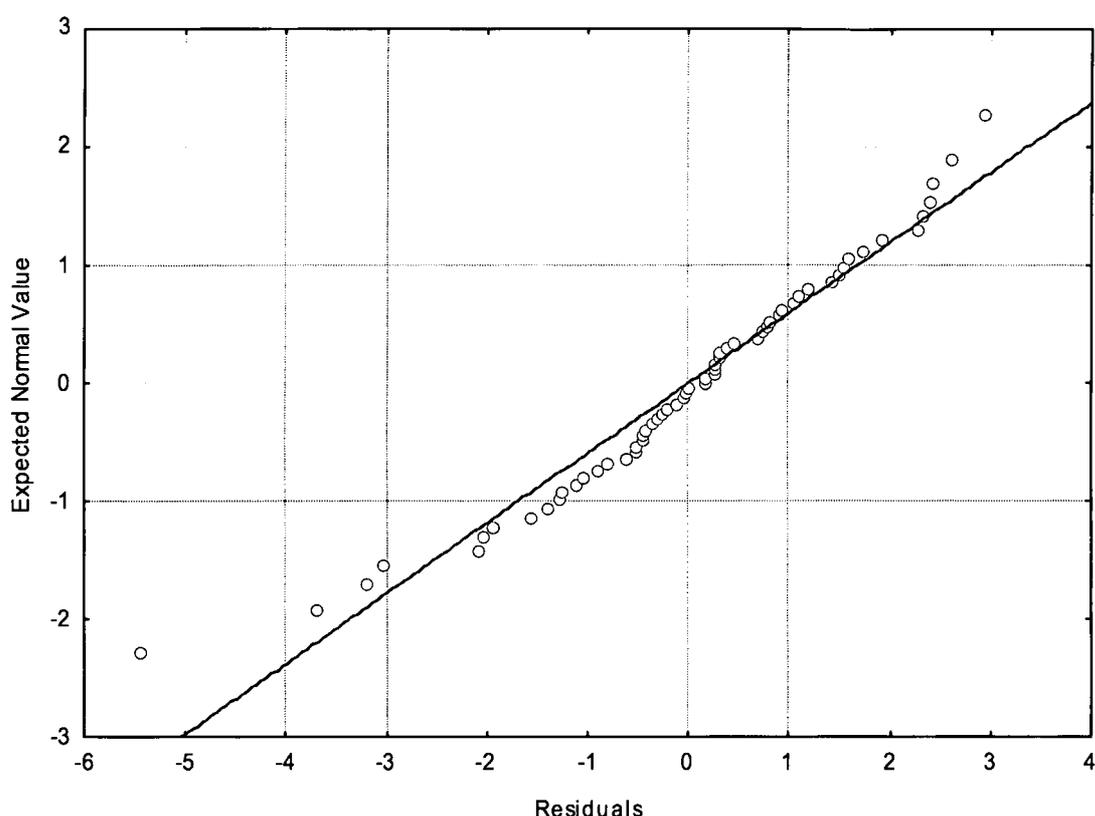


Figure 5.9: Normal probability plot of the residuals versus the expected normal values

The serial correlation between the variables was tested with the use of the Durbin's h -test. The variables used in the downswing model showed serial correlation with an h -test of 2.3296 which was outside the boundaries of -1.96 and $+1.96$ for the 95 percent confidence level (Dielman, 1996:306-313).

When the residuals exhibit serial correlation, the estimates of the coefficients would be unbiased, but the standard errors of the coefficients would be biased. There are two ways to correct for autocorrelation: finding an important variable that may have been omitted from the regression or including a lagged dependent variable (Dielman, 1996:308-312). During the regression analysis a lagged dependent variable was included. In Chapter 3 the variables that influence house price growth were identified, but data on some of the

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variables were not available and thus these variables were not included in the regression. It is possible that variables, such as population growth or rental levels, could further explain the house price growth, thereby eliminating serial correlation.

5.3.5 Interpretation of findings

Results from the best subset regression analysis specified the one-quarter lagged house price variable, the one-quarter lagged interest rate growth, one-quarter lagged household savings and one-quarter lagged construction cost as the best combination of variables used to predict the downswing of a house price growth cycle. One-quarter lagged house prices contributed 0.926006 to house prices for every one percent change in house price growth as shown by the coefficient in Table 5.8. Interest rate growth, household savings and construction cost contributed 0.186643, 0.075508 and 0.181549 respectively to the performance of the model. The small standard errors of the coefficients inferred that the coefficients were accurate.

The t-statistics for the individual variables specified in Table 5.8 were outside their upper and lower boundaries of -2 and $+2$ at the 95 percent confidence level, which suggested that each of the independent variables contributed to the prediction of the dependent variable (Dielman, 1996:152)

The statistically significant t-statistics showed that multi-colinearity was not present during the best subset regression. The correlation matrix is presented in Table 5.9 and although the matrix did indicate some correlation between the variables, the t-statistics suggested that it did not affect the predictive ability of the model. High correlation between the variables causes insignificant t-statistics (Dielman, 1996:316-317).

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Table 5.9: Correlation matrix of variables for the downswing phase

One-quarter Lagged Variables	House prices	Interest Rates Growth	Household Savings	Construction Cost
House prices	1.00			
Interest Rates Growth	0.40	1.00		
Household Savings	0.08	-0.16	1.00	
Construction Cost	0.55	0.60	0.07	1.00

The F-test of the model is 258.8899, which fell outside the boundary of +2.53 (Dielman, 1996:526). This suggested that there was at least one variable with a linear relationship with house prices and that the model has predictive value (Ott and Longnecker, 2001:651). Figure 5.10 depicts the scatter plot of the observed values of house price growth versus the values predicted by the model for the testing period from the first quarter of 2001 to the fourth quarter of 2004. The predicted values lie in the proximity to the observed values which visually confirmed the R^2 of 0.99 and the RMSE of 1.0798.

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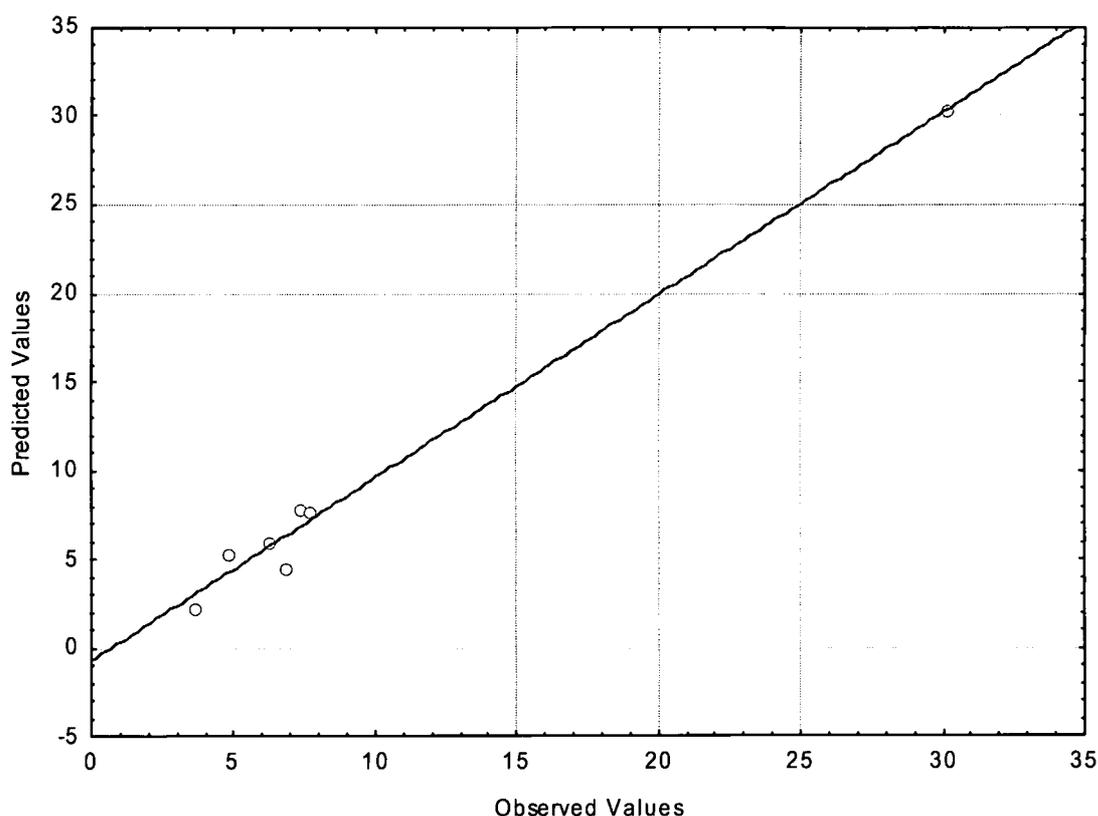


Figure 5.10: Scatter plot of observed values of house price growth versus the values predicted by the model for the period from 2001 to 2004

5.3.6 Testing the continuous relationship between the variables

To test whether the relationship between house prices and the identified economic variables was consistent over a period of time two best subset regression analyses were performed. The first regression analysis (as shown in Table 5.8) was performed on a 90 percent analysis sample and a 10 percent test sample, while the second analysis with the results presented in Table 5.10 was performed on a 60 percent analysis sample and a 40 percent test sample. Table 5.10 depicts the downswing regression model produced by the second best subset regression. It produced a R^2 of 0.96 and a RMSE of 1.85.

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Table 5.10: The downswing regression model based on the data from 1974 to 1995

Lagged 1 Variables	House Prices Beta Coefficient	House Prices Standard Error B	House Prices t-statistic	House Prices P
House Prices	0.920671	0.049773	18.49736	0.000000
Interest Rate Growth	-0.206194	0.046770	-4.40871	0.000094
Construction Cost	0.202340	0.057121	3.54228	0.001146

A comparison of the variables identified as predictors of the downswing cycle of house price growth is shown in Table 5.11. The two models produced three variables in common and household savings were identified as an additional predictor in the regression model based on data from 1974 to 2000. The two models produced similar coefficients of determination of 0.96.

Table 5.11: Comparison between the findings of the model based on 1974 to 2000 and the model based on 1974 to 1995

1974 to 2000 ($R^2 = 0.96$)	1974 to 1995 ($R^2 = 0.96$)
House Prices	House Prices
Interest Rate Growth	Interest Rate Growth
Construction Cost	Construction Cost
Household Savings	

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5.4 Summary

During this chapter the complete set of data used in Chapter 4 were sub-divided into upswing and downswing growth periods according to the definition of an upswing and a downswing growth phase. This produced two separate sets of data, which consisted of 65 and 59 observations for the upswing and downswing phase respectively. The downswing dataset lost one observation through the use of one-quarter lagged data, as explained in Chapter 4. The best subset regression analysis was performed on observations for both the upswing and downswing phases.

The regression model for the upswing period with the highest R^2 of 0.97 identified six variables as predictors of positive house price growth, whereas the downswing model (R^2 of 0.96) identified four variables, which could predict changes in the downswing of growth in house prices. Table 5.12 shows a comparison between the variables of the upswing and downswing model. The models had only the one-quarter lagged house price variable and household savings as common factors.

Table 5.12: A comparison between the variables identified as predictors for the upswing and downswing cycle of house price growth

Upswing Cycle Growth Model	Downswing Cycle Growth Model
House Prices	House Prices
Interest Rates	Interest Rate Growth
Household Savings	Household Savings
Consumption	Construction Cost
JSE-ALSI Index	
Rand-Dollar Exchange Rate	

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A comparison between models based on 1974 to 1995 (60 percent of the data) and based on 1974 to 2000 (90 percent of the data) was performed for both the upswing data and the downswing phases. The findings showed that the following variables were consistently identified as predictors for the upswing phases:

- one-quarter lagged house price growth,
- one-quarter lagged interest rates,
- one-quarter lagged household savings growth and
- one-quarter lagged consumption growth.

For the downswing phases the following three variables were consistently identified as predictors:

- one-quarter lagged house price growth,
- one-quarter lagged construction cost growth and
- one-quarter lagged interest rate growth.

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APPENDIX 5.1: Histograms of variables of data for the upswing period

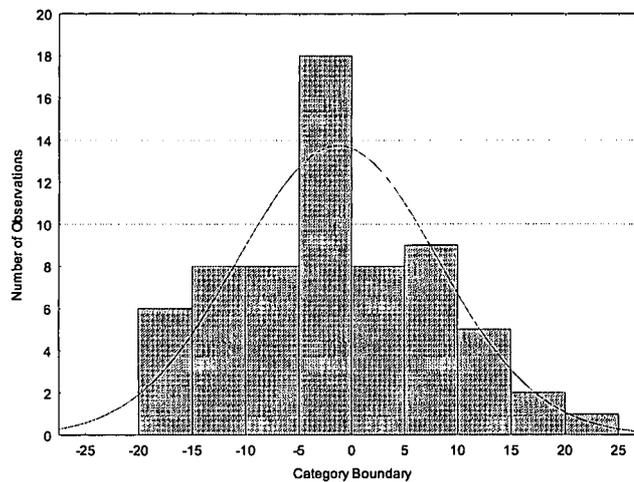


Figure 5.11: Histogram of normality for growth in the one-period lagged affordability for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.97565 and a P-value of 0.22778. The red line indicates the expected normal

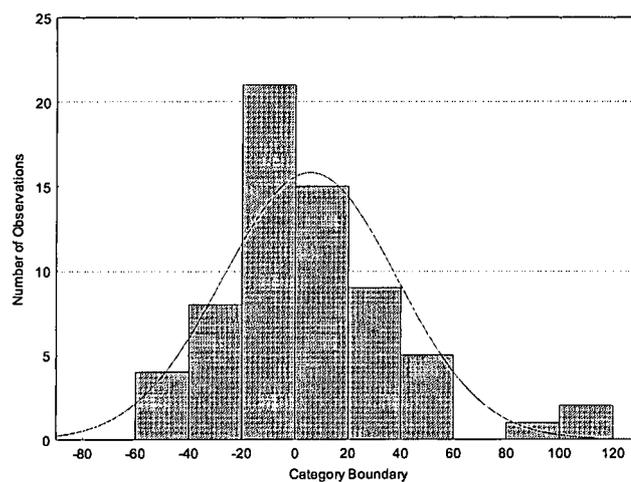


Figure 5.12: Histogram of normality for growth in the one-period lagged building plans passed for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.94113 and a P-value of 0.00393. The red line indicates the expected normal

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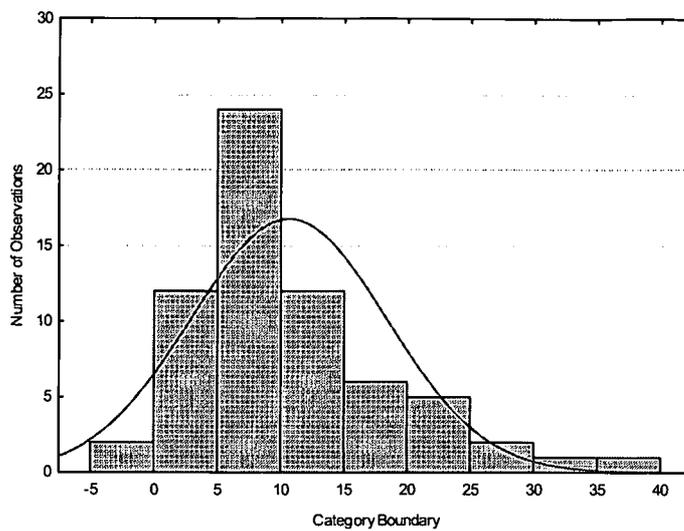


Figure 5.13: Histogram of normality for growth in the one-period lagged construction cost for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.90622 and a P-value of 0.00012. The red line indicates the expected normal

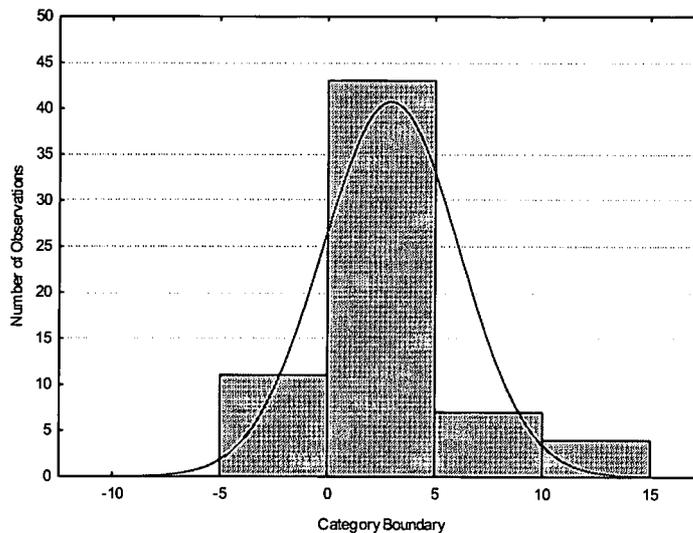


Figure 5.14: Histogram of normality for growth in the one-period lagged consumption for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.93107 and a P-value of 0.00135. The red line indicates the expected normal

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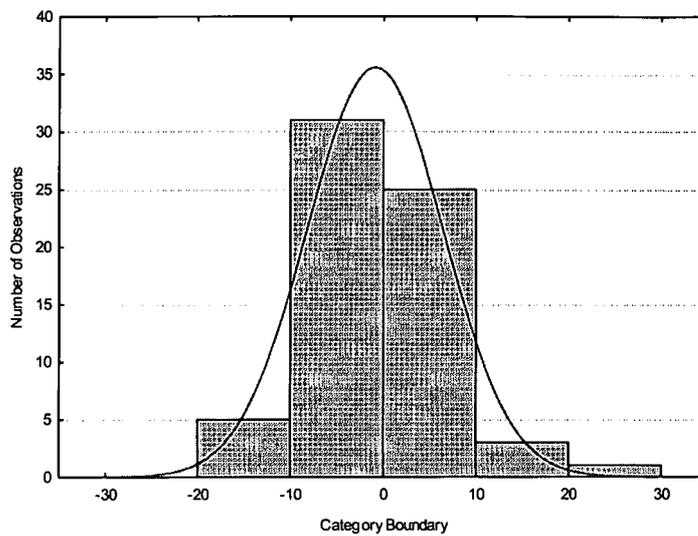


Figure 5.15: Histogram of normality for growth in the one-period lagged debt-to-income for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.94148 and a P-value of 0.00408. The red line indicates the expected normal

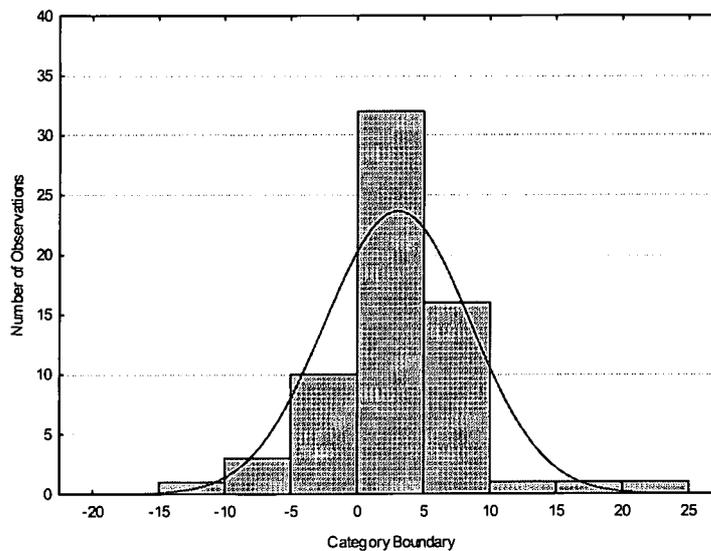


Figure 5.16: Histogram of normality for growth in the one-period lagged disposable income for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.93338 and a P-value of 0.00172. The red line indicates the expected normal

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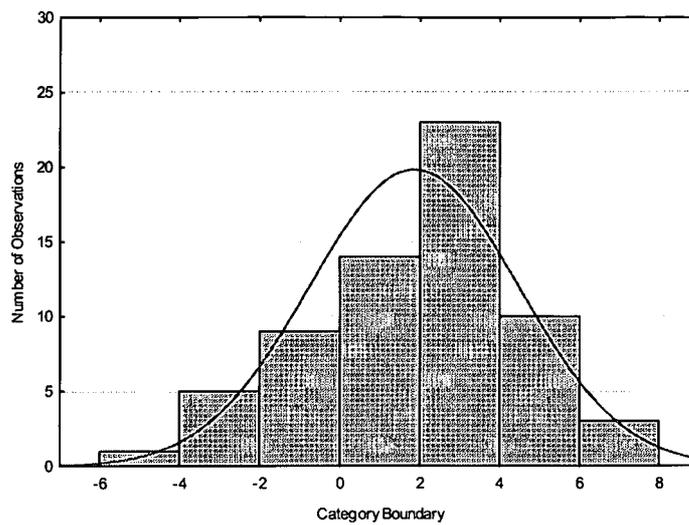


Figure 5.17: Histogram of normality for growth in the one-period lagged GDP for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.97937 and a P-value of 0.34909. The red line indicates the expected normal

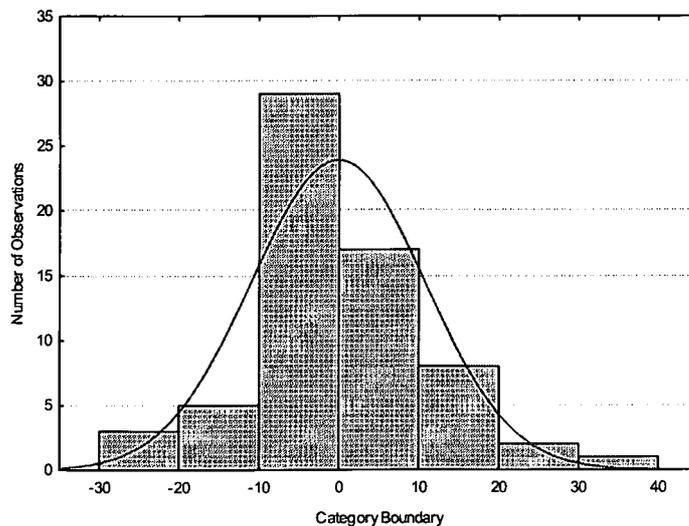


Figure 5.18: Histogram of normality for growth in the one-period lagged house prices for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.97144 and a P-value of 0.13752. The red line indicates the expected normal

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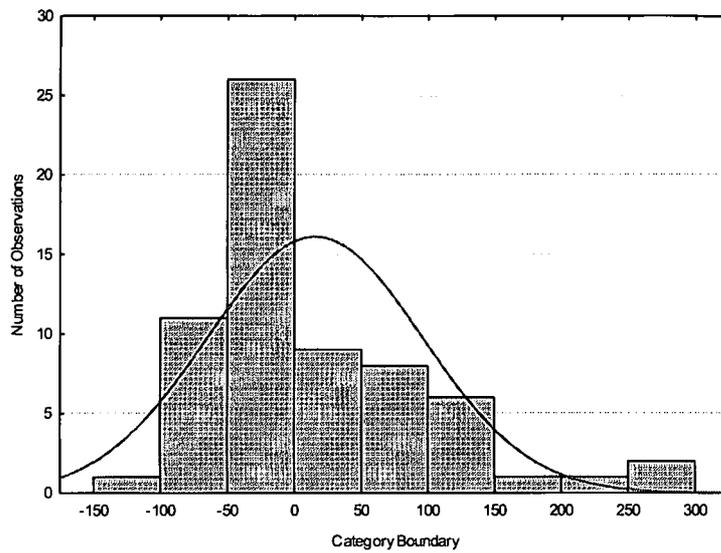


Figure 5.19: Histogram of normality for growth in the one-period lagged household savings for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.88745 and a P-value of 0.00002. The red line indicates the expected normal

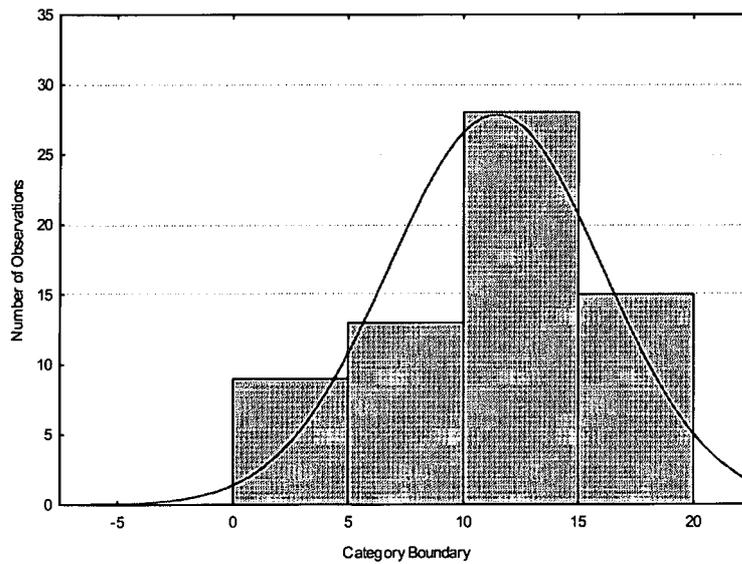


Figure 5.20: Histogram of normality for growth in the one-period lagged inflation for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.94982 and a P-value of 0.01038. The red line indicates the expected normal

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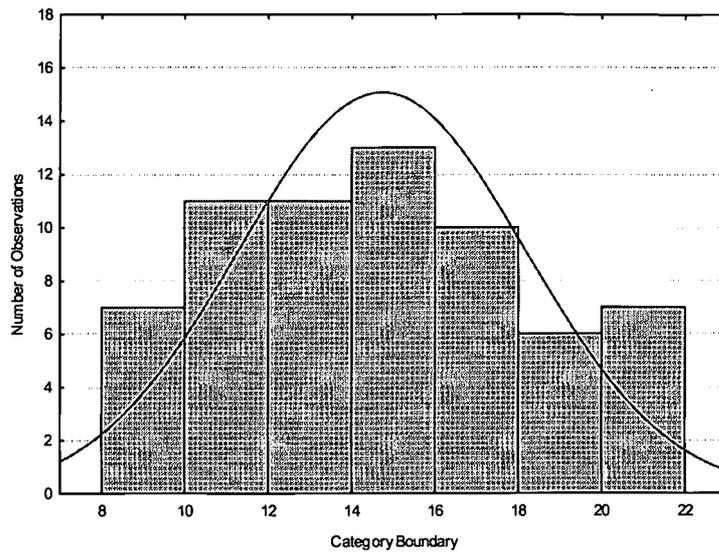


Figure 5.21: Histogram of normality for the one-period lagged interest rates for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.94830 and a P-value of 0.00873. The red line indicates the expected normal

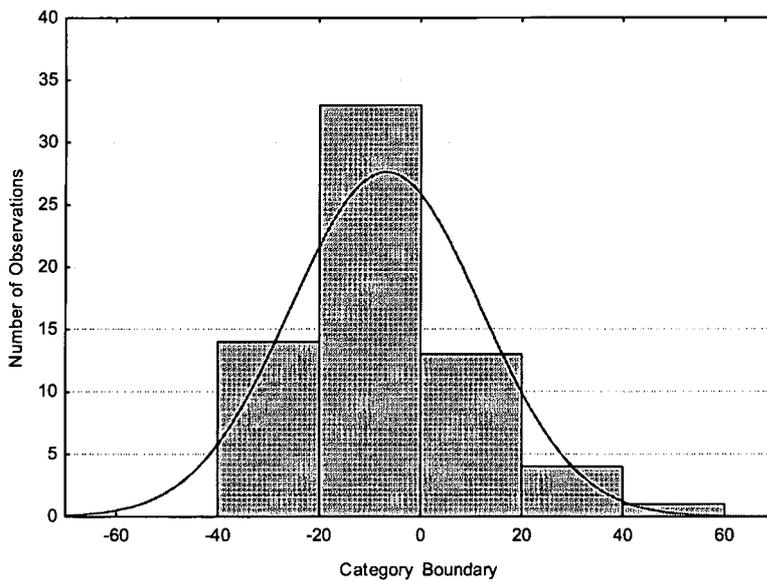


Figure 5.22: Histogram of normality for growth in the one-period lagged interest rates for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.96468 and a P-value of 0.06032. The red line indicates the expected normal

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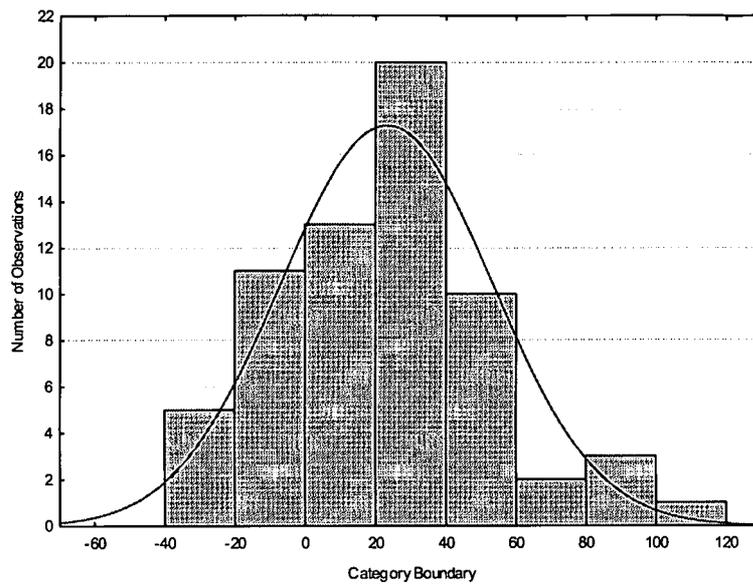


Figure 5.23: Histogram of normality for growth in the one-period lagged JSE ALSI for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.97755 and a P-value of 0.28420. The red line indicates the expected normal

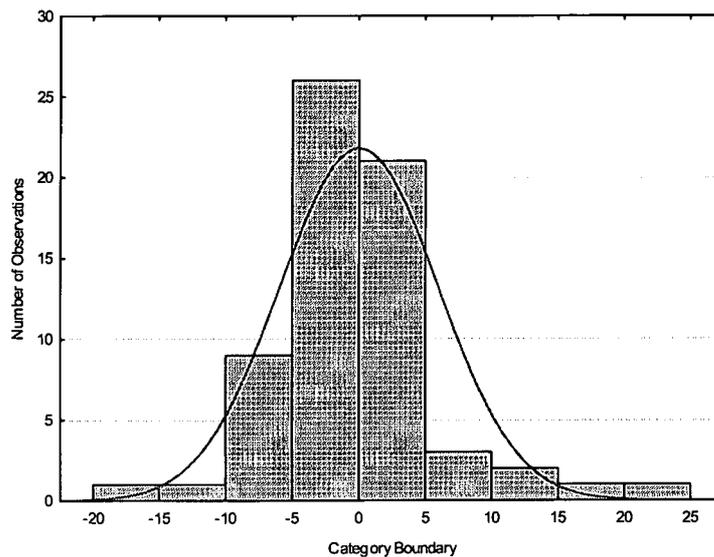


Figure 5.24: Histogram of normality for growth in the one-period lagged Rand/Dollar exchange rate for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.93559 and a P-value of 0.00217. The red line indicates the expected normal

Appendix 5.2: Correlation Matrix of One-Period Lagged Independent Variables for Upswing Cycles Dataset

Variable	HP(-1)	GDP(-1)	DI(-1)	IR(-1)	IRG(-1)	CP(-1)	HS(-1)	C(-1)	CC(-1)	DI(-1)	A(-1)	ALSI(-1)	RDX(-1)	ESP(-1)
House Prices(-1)	1.00													
GDP(-1)	0.44	1.00												
Disposable Income(-1)	0.00	0.35	1.00											
Interest Rates(-1)	-0.23	-0.50	-0.35	1.00										
Interest Rates Growth(-1)	0.01	0.12	-0.18	0.43	1.00									
Inflation(-1)	-0.65	-0.26	-0.38	-0.04	0.19	1.00								
Household Savings(-1)	-0.12	0.02	0.56	-0.27	0.04	-0.06	1.00							
Consumption(-1)	0.39	0.75	0.43	-0.51	0.07	-0.16	-0.07	1.00						
Construction Cost(-1)	0.35	0.61	0.08	-0.45	0.29	0.28	-0.11	0.72	1.00					
Debt Income(-1)	0.45	0.02	-0.57	0.09	-0.21	-0.03	-0.54	0.19	0.57	1.00				
Affordability(-1)	0.29	0.45	0.23	-0.20	0.00	-0.58	-0.16	0.54	0.54	0.39	1.00			
JSE All Share Index(-1)	-0.05	0.09	0.26	-0.33	-0.50	0.22	0.04	0.24	-0.13	-0.13	0.00	1.00		
Rand/Dollar(-1)	0.14	0.12	0.06	-0.17	0.04	0.04	0.12	0.10	0.13	-0.08	0.21	-0.09	1.00	
South Africa Passed(-1)	0.61	0.43	0.27	-0.32	0.01	0.00	-0.08	0.71	0.65	0.26	0.50	0.25	0.16	1.00

- Notes:
- HP - House Prices
 - HP(-1) - One-Period Lagged House Prices
 - GDP(-1) - One-Period Lagged Gross Domestic Product
 - DI(-1) - One-Period Lagged Disposable Income
 - IR(-1) - One-Period Lagged Interest Rates
 - IRG(-1) - One-Period Lagged Interest Rates Growth
 - CP(-1) - One-Period Lagged Consumer Price Inflation
 - HS(-1) - One-Period Lagged Household Savings
 - C(-1) - One-Period Lagged Consumption
 - CC(-1) - One-Period Lagged Construction Cost
 - DI(-1) - One-Period Lagged Debt Income Relationship
 - A(-1) - One-Period Lagged Affordability
 - ALSI(-1) - One-Period Lagged JSE All Share Index
 - RDX(-1) - One-Period Lagged Rand/Dollar Exchange Rate
 - ESP(-1) - One-Period Lagged South Africa Passed

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APPENDIX 5.3: Histograms of Variables of Data for the Downswing Period

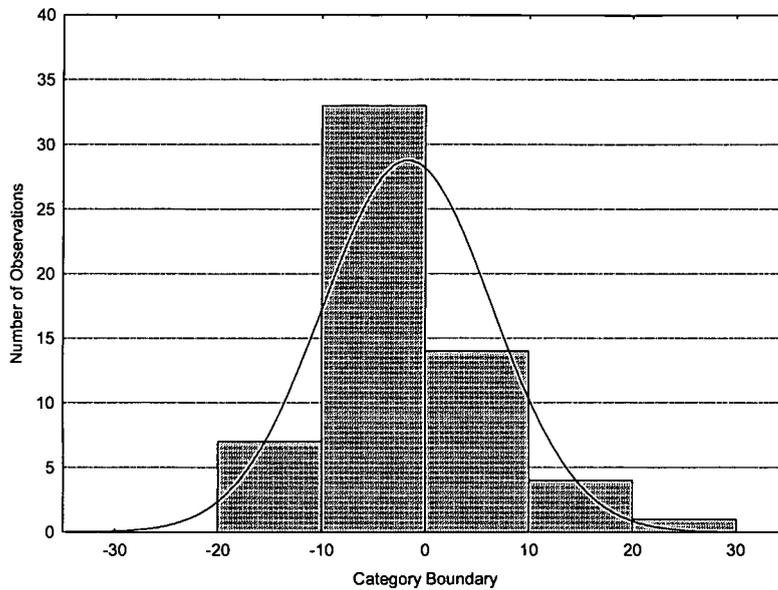


Figure 5. 25: Histogram of normality for the growth in one-period lagged affordability for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.95586 and a P-value of 0.03175. The red line indicates the expected normal

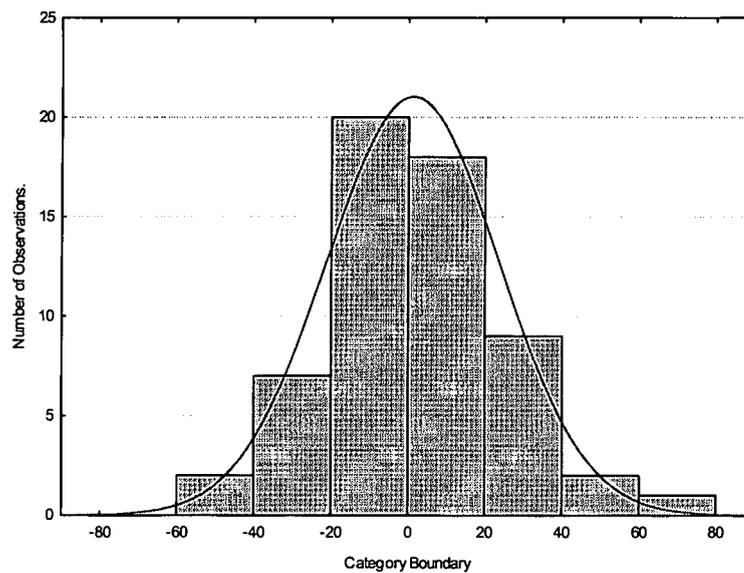


Figure 5.26: Histogram of normality for the growth in one-period lagged building plans passed for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.97936 and a P-value of 0.41359. The red line indicates the expected normal

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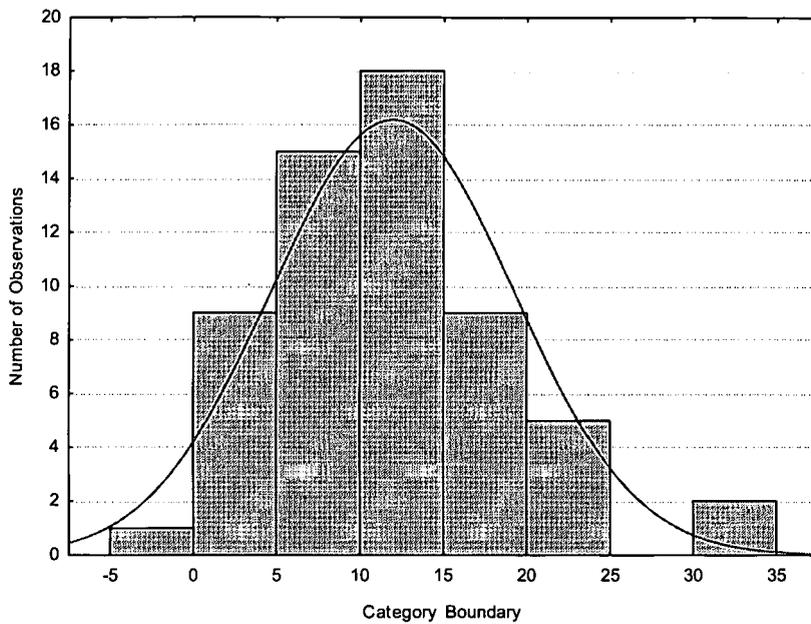


Figure 5.27: Histogram of normality for the growth in one-period lagged construction cost for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.95684 and a P-value of 0.03535. The red line indicates the expected normal

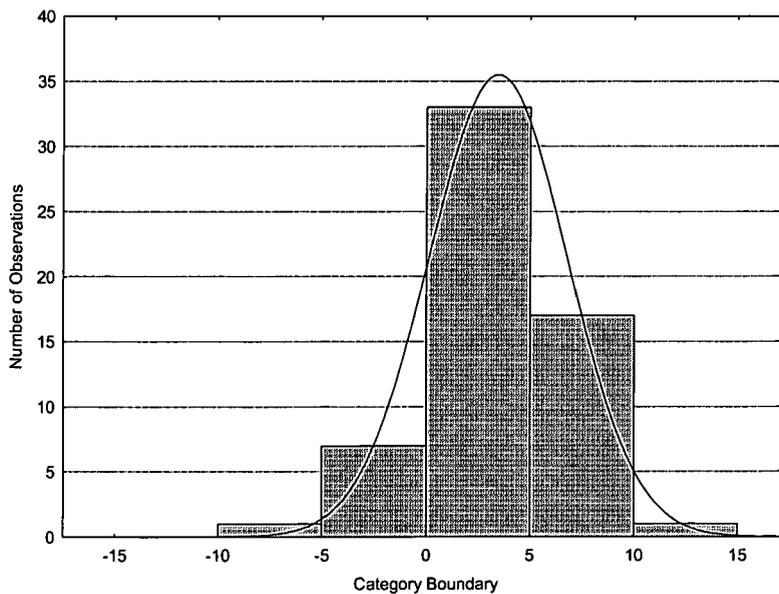


Figure 5.28: Histogram of normality for the growth in one-period lagged consumption for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.93368 and a P-value of 0.00315. The red line indicates the expected normal

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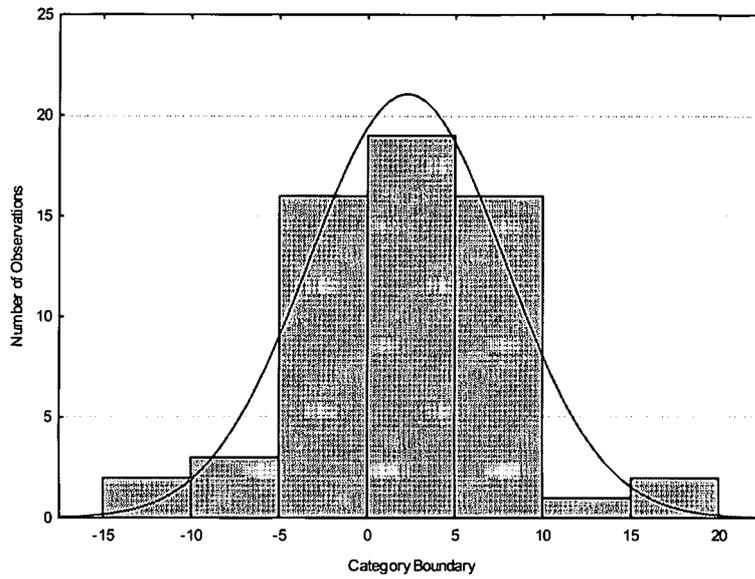


Figure 5.29: Histogram of normality for the growth in one-period lagged debt-to-income for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.98381 and a P -value of 0.61936. The red line indicates the expected normal

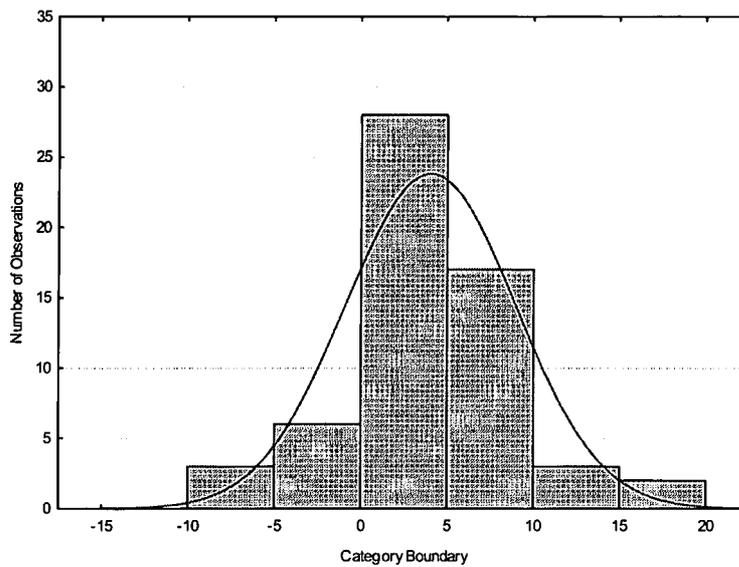


Figure 5.30: Histogram of normality for the growth in one-period lagged disposable income for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.996283 and a P -value of 0.06874. The red line indicates the expected normal

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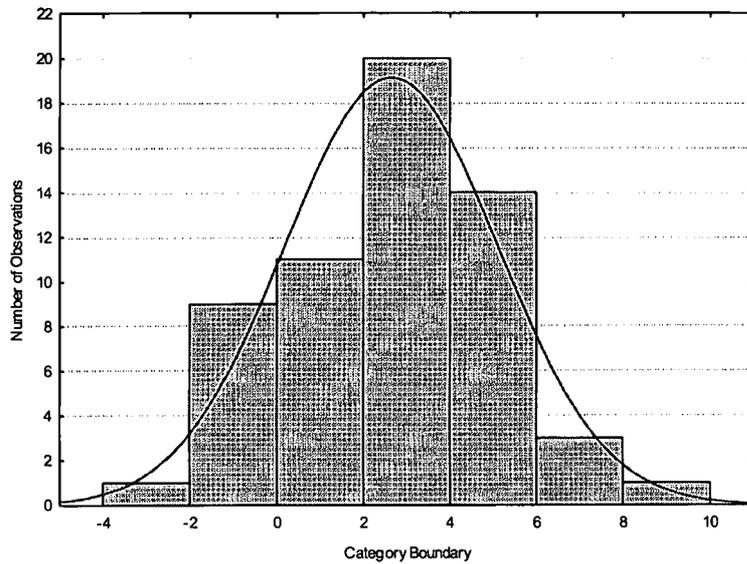


Figure 5.31: Histogram of normality for the growth in one-period lagged GDP for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.98507 and a P-value of 0.68379. The red line indicates the expected normal

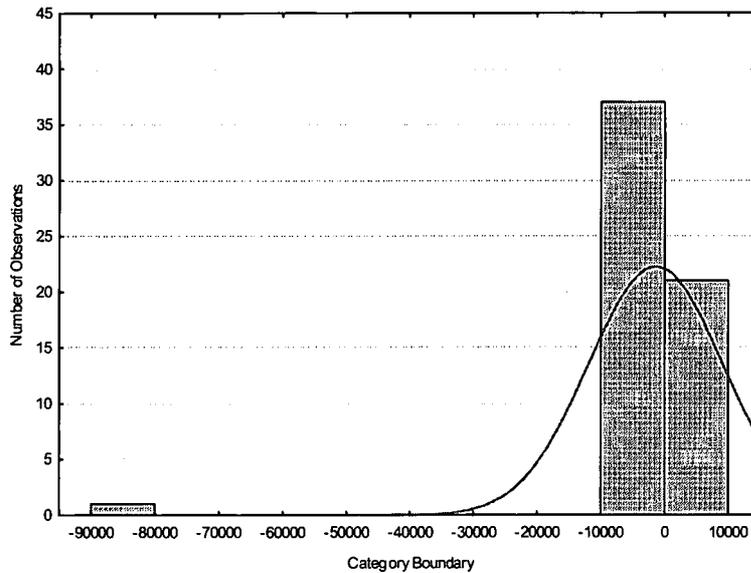


Figure 5.32: Histogram of normality for the growth in one-period lagged household savings for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.12257 and a P-value of 0.00000. The red line indicates the expected normal

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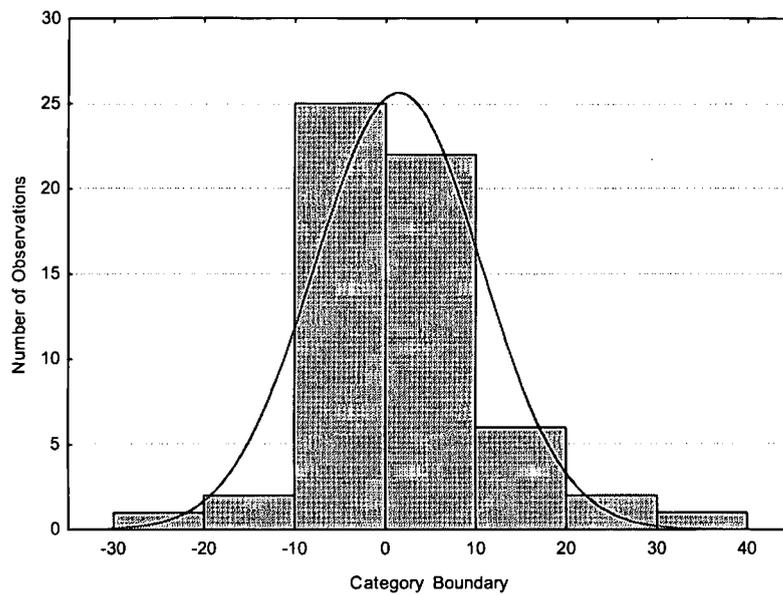


Figure 5.33: Histogram of normality for the growth in one-period lagged house prices for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.94570 and a P-value of 0.01067. The red line indicates the expected normal

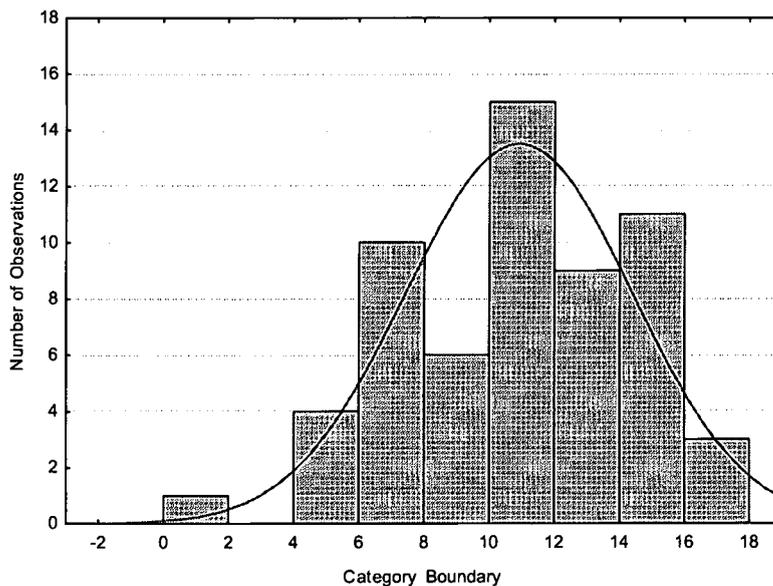


Figure 5.34: Histogram of normality for the growth in one-period lagged inflation prices for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.96932 and a P-value of 0.14186. The red line indicates the expected normal

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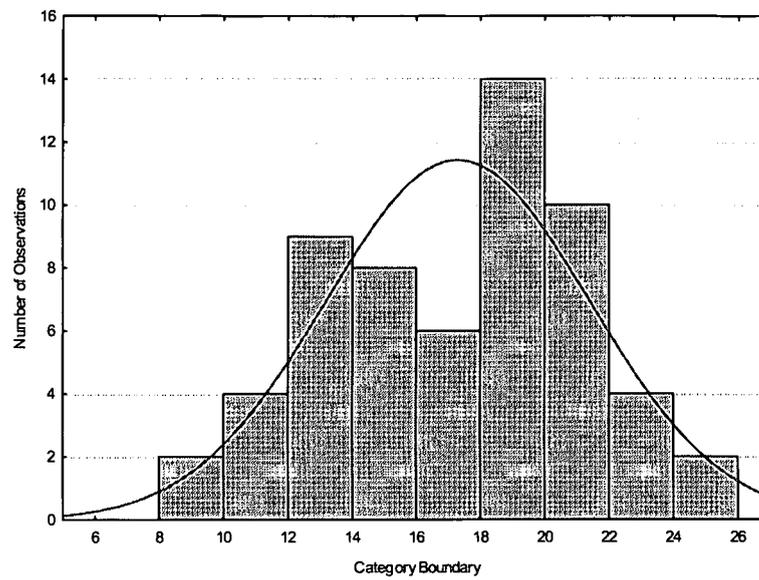


Figure 5.35: Histogram of normality for the one-period lagged interest rates for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.96323 and a P-value of 0.07180. The red line indicates the expected normal

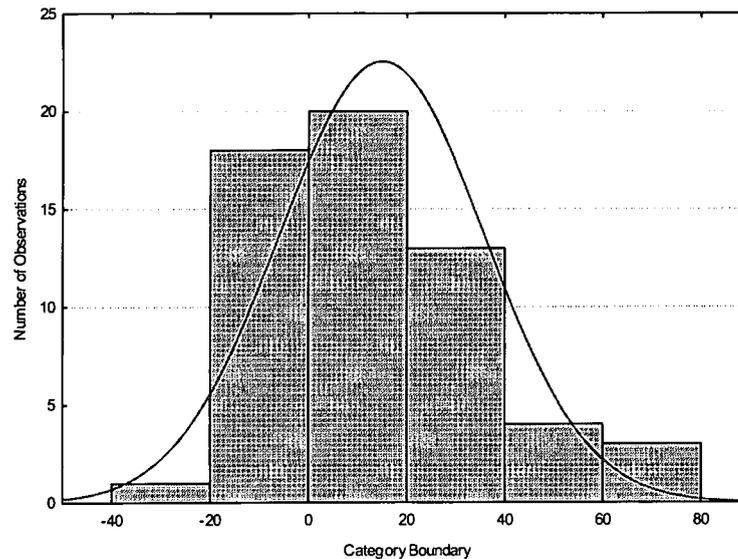


Figure 5.36: Histogram of normality for the growth in one-period lagged interest rates for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.90093 and a P-value of 0.00016. The red line indicates the expected normal

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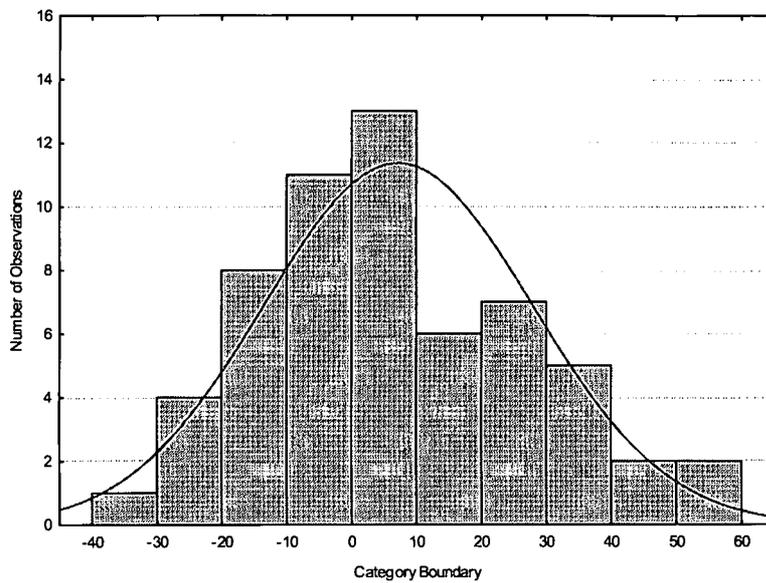


Figure 5.37: Histogram of normality for the growth in one-period lagged JSE ALSI for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.97085 and a P-value of 0.16795. The red line indicates the expected normal

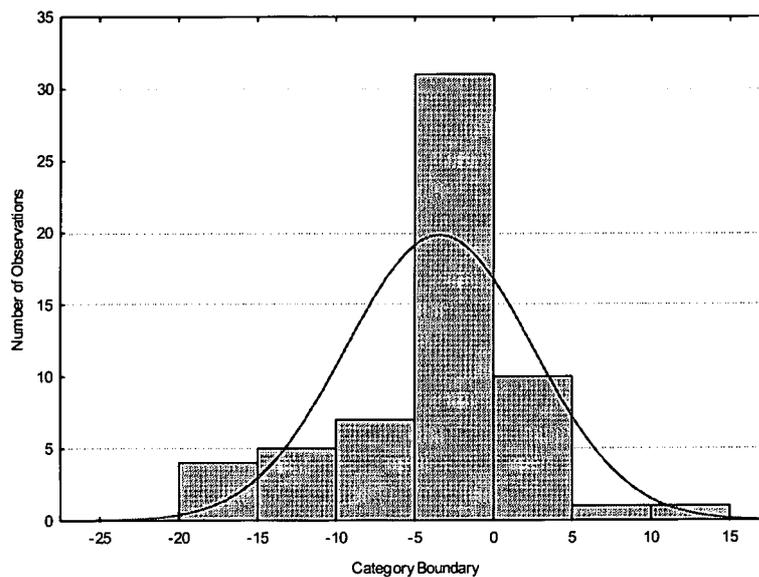


Figure 5.38: Histogram of normality for the growth in one-period lagged Rand/Dollar Exchange Rate for the period from 1974 to 2004

Note: Shapiro-Wilk W of 0.92549 and a P-value of 0.00143. The red line indicates the expected normal

Appendix 5.4: Correlation Matrix of One-Period Lagged Independent Variables for Downswing Cycles Dataset

Variable	HP(-1)	GDP(-1)	DI(-1)	IR(-1)	IRG(-1)	CP(-1)	HS(-1)	C(-1)	CC(-1)	DI(-1)	A(-1)	ALSI(-1)	RD(-1)	EBPR(-1)
House Prices(-1)	1.00													
GDP(-1)	0.35	1.00												
Disposable Income(-1)	0.08	0.36	1.00											
Interest Rates(-1)	-0.24	-0.45	0.02	1.00										
Interest Rates:Growth(-1)	0.14	0.55	0.21	0.25	1.00									
Inflation(-1)	-0.31	-0.25	-0.06	0.27	0.49	1.00								
Household Savings(-1)	0.09	-0.11	-0.21	0.22	-0.16	-0.03	1.00							
Consumption(-1)	0.57	0.73	0.44	0.23	0.28	-0.26	0.03	1.00						
Construction Cost(-1)	0.44	0.46	0.28	0.16	0.57	0.30	0.06	0.52	1.00					
Debt Income(-1)	0.24	0.18	-0.14	0.04	0.13	0.01	-0.04	0.28	0.31	1.00				
Affordability(-1)	0.46	0.36	0.08	-0.28	0.15	-0.23	0.11	0.56	0.46	0.22	1.00			
JSE All Share Index(-1)	-0.01	0.13	-0.18	-0.02	-0.26	-0.19	0.01	0.00	0.05	0.27	-0.04	1.00		
Rand/Dollar(-1)	-0.09	-0.12	-0.31	-0.19	-0.22	-0.03	0.24	-0.07	0.01	0.04	-0.06	0.10	1.00	
Building Permits Passed(-1)	0.48	0.51	-0.06	-0.20	-0.08	-0.19	0.10	0.46	0.26	0.29	0.50	0.08	0.15	1.00

- Note:
- HP - House Prices
 - HP(-1) - One-Period Lagged House Prices
 - GDP(-1) - One-Period Lagged Gross Domestic Product
 - DI(-1) - One-Period Lagged Disposable Income
 - IR(-1) - One-Period Lagged Interest Rates
 - IRG(-1) - One-Period Lagged Interest Rates:Growth
 - CP(-1) - One-Period Lagged Consumer Price Inflation
 - HS(-1) - One-Period Lagged Household Savings
 - C(-1) - One-Period Lagged Consumption
 - CC(-1) - One-Period Lagged Construction Cost
 - DI(-1) - One-Period Lagged Debt Income Relationship
 - A(-1) - One-Period Lagged Affordability
 - ALSI(-1) - One-Period Lagged JSE All Share Index
 - RD(-1) - One-Period Lagged Rand/Dollar Exchange Rate
 - EBPR(-1) - One-Period Lagged Building Permits Passed

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CHAPTER 6 CONCLUSION

6.1 Summary

During the course of the research four sections were covered: section one considered and described business cycles, general property cycles, house price cycles, construction cycles and residential property cycles. The cycle research was divided into classical and growth cycles. The remainder of the research focused on residential property growth cycles.

Section two was devoted to indicators of the house price growth cycle. It covered supply and demand indicators as well as absolute and relative performance measures. At the end of the chapter a Granger causality test was conducted on the variables and the results showed no significant causality between the indicators and growth in house prices.

Empirical analysis was conducted for the last two sections of the research. Section three used data from 1974 to 2004 to analyse the effect of the indicators on growth in house prices with an application of multiple regression analysis. The analysis was performed on the data using 90 percent of the data for training and 10 percent for testing the predictive abilities of the model. Thereafter it was repeated on a 60 percent training sample and a 40 percent test sample. This was done to confirm that there was a continuous relationship between the indicators of house price growth.

The data were divided into upswing and downswing growth phases according to the house price growth cycle for the analysis conducted in section 4. The multiple regression analysis was performed separately on the upswing and downswing phases to determine the indicators that directly affect the

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phases. This was again conducted with a 90 percent training sample and a 10 percent test sample, whereafter it was repeated on a 60 training sample and a 40 percent test sample.

6.1.1 The Real Estate Cycle

The property market is subject to constant fluctuations in supply and demand, which directly affect the price of real estate. The causes of the fluctuations in supply and demand were researched extensively, while more emphasis was placed on the demand side of the market. The fluctuations were divided into four components: a trend component, a cyclical component, a seasonal component and a random component (Crook and Reekie 1975:92). This research focused on cycle influences on the house price market in order to predict recurring growth fluctuations.

Cycle influences are visible throughout the world, whether it is seasons or the economy. The real estate cycle is related to the economic cycle and to a lesser to seasonal cycles. The business cycle is the standard reference of economic fluctuations and it is commonly measured by gross domestic product (GDP). The business cycle encompasses all economic activity in a country, including real estate activity; therefore an analysis of the business cycle was undertaken (Born, Phyr and Roulac: 1999).

Business cycles follow a sine-wave pattern, which provided the point of departure for this research which could be divided into four phases: recovery, expansion, contraction and recession. Here the recovery and expansion formed the upswing phase of the cycle and the contraction and recession the downswing phase of the cycle (Cloete 1990:11-12). Since the business cycle is represented by fluctuations in the cumulative economic activity, changes in the

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variables that influence the business cycle also cause changes in the house price cycle (Case & Fair 1999:510-511).

A comparison between the economic conditions prevailing during the four phases of the business cycle and the aggregate real estate cycle with specific reference to indicators that influence the real estate cycle was compiled. During the recovery phase of the business cycle there is an initial increase in economic activity which leads to an increase in capital expenditure (including expenditure on construction) for firms (Estey 1956:87). There is also an increase in income because of the increase in production (Estey 1956:87).

During the recovery phase of the real estate cycle there is no initial construction activity and the activity slowly increases towards the end of the phase (Hoyt: 1947 and Mueller: 2002). This corresponds with the recovery phase of the business cycle. The business cycle recovery is characterised by low interest rates, while the recovery phase in the real estate cycle is flooded with foreclosed properties. The decrease in property prices also makes it easier to qualify for a mortgage loan (Trass 2004:87). The economic conditions for the recovery phases of the business cycle and the real estate cycle indicate that the phases should coincide.

The expansion phases of both the cycles are characterised by high levels of construction and an increase in the disposable income of households (Cloete 1990:26, Hoyt: 1947 and Leland Consulting Group: 1999). The availability of finance decreases during the expansion phase of the business cycle because of the excess capital expenditure of firms and this is coupled to increase in interest rates (Cloete 1990:26). There appears to be no reference to the state of the mortgage market during the expansion phase of the real estate cycle, but mortgages are still readily available during the hypersupply phase, making it safe to assume that finance availability has not decreased

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during the expansion phase (Trass 2004:100). This shows the first discrepancy between the timing of the real estate cycle and the business cycle. It seems as if the upswing phase of the property cycle is longer than that of the business cycle.

During the recession phase of the business cycle incomes decrease, construction activity continues at a slower pace and there is an increase in interest rates (Cloete 1990:28). On the other hand the real estate cycle hypersupply (recession) phase shows stable incomes, high construction levels and readily available mortgages (Leland Consulting Group: 1999 and Trass 2004:100). Here again the real estate cycle lags the business cycle, indicating a longer real estate cycle.

The contraction phase of the business cycle is divided into two concurrent segments: a continuation of the recession and the start of recovery. The recession shows a decrease in income and an increase in mortgage delinquencies and foreclosures (Cloete 1990:28 and Dokko, Edelstein, Lacayo and Lee: 1999). The start of the recovery is characterised by a decrease in interest rates, an increase in mortgage demand and an increase in residential construction (Achinstein 1950: 236 and Cloete 1990:24). The real estate recession (contraction) shows no new construction and most construction comes to a halt at the end of the cycle (Leland Consulting Group 1999).

A comparison between the economic conditions/indicators of the business cycle and the aggregate real estate cycle shows that the business cycle moves faster than the aggregate real estate cycle, making the duration of the property cycle longer than that of the business cycle. The causes of this occurrence may be numerous, but the most likely is the construction lag present in the real estate cycle.

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The construction lag refers to the delay in construction activity relative to economic activity (Dokko: 1999). Construction in itself is also subject to cycle theory: it is traditionally described as an $18 \frac{1}{3}$ year cycle for the classical cycle and $3 \frac{1}{2}$ years for the growth cycle (Hoyt: 1933 and Jaffe and Rosen: 1979). The aggregate growth construction cycle is mainly influenced by changes in the supply of credit and interest rates and should correlate with business cycles, whereas the residential construction cycle appears to move counter-cyclically to the business cycle (Grebler and Burns: 1982, Guttentag: 1961 and Leland Consulting Group: 1999). Traditionally, residential construction leads the business cycle which implies that residential investment is a cause of GDP growth (Green: 1997).

The house price cycle lags the business cycle (as is the case with the aggregate real estate cycle), which indicates that prices of real estate adjust more slowly than those of equity markets, such as shares etc. (OECD 2004: 130). Fluctuations in the residential real estate cycle are also more stable than in the other sectors of the property market, since the key driver of the residential cycle is population growth (Guttentag: 1961).

Growth cycles could be analysed by means of indicator analysis where the indicators may be divided into leading, coincident and lagging indicators. Trass (2004) identified a set of indicators that are applicable to the residential real estate cycle in New Zealand and tested their position in the cycle. He divided the indicators into leading, lagging and coincident indicators for the different phases of the cycle. The indicators for the recovery phase can be seen as the indicators of the beginning of the growth cycle.

The leading indicators for the recovery phase are property construction levels, vacancy rates, employment levels, return on investment, average rents, GDP and property sales. The coincident indicators are population change,

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property construction, average incomes and property sales volume. The lagging indicators of the recovery phase are the number of people per household and affordability of property. The indicator series confirms that GDP, thus the business cycle, leads changes in house prices, but GDP coincides with property sales volume and construction levels.

6.1.2 Indicator Analysis for House Prices

The indicators for house price growth (residential real estate growth cycle) may be divided into four categories: demand and supply indicators and absolute and relative performance measures. The demand and supply indicators are seen as direct influences on the house price cycle, whereas the performance measures are seen as indirect influences.

Demand indicators are population growth, interest rate, credit availability, inflation, income, capital gains tax and personal income tax and employment levels. Supply indicators are construction cost, the rental price level and occupancy rates.

Performance measures are divided into absolute and relative performance measures according to the nature of the indicator. An absolute performance measure is seen as an absolute value and a relative performance measure is a relationship between two or more indicators. The absolute measures are property sales volume, personal savings, GDP, household consumption and the stock market. Relative performance measures are the price-rent relationship, property affordability, debt measures and the exchange rate.

An analysis of all the indicators, supply and demand as well as the performance measures showed that each had a direct or indirect influence on

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house price growth. The causality of the influence was tested with the Granger Causality Test, but the test did not produce any conclusive results. The test is subject to controversy, with the result that a regression analysis was performed to analyse further the relationship between the indicators and the house price growth cycle.

6.1.3 The Development of a Model for prediction of growth in house prices

The indicators of the house price cycle were identified through an assessment of the literature and the relationship with house prices was analysed to specify which indicators may cause changes in the growth of house prices. The methodology employed to identify the indicators were as follows: firstly data on the relevant variables were collected and assessed. Secondly the time series data for each of the variables were evaluated for normality and correlation to understand the relationship. Thirdly all the applicable variables were used as input for a linear least square regression analysis. The model provided an indication of the importance of each variable and a selection was made for the following stage. Finally, the variables chosen during the latter assessment were used to develop a best subset regression model for the house price growth cycle.

During the first phase variables, such as income tax, were eliminated since they were not relevant to an assessment of the growth cycle of South African house prices. Variables were also eliminated because of the unavailability of data, such as sales volumes and the number of mortgage loans approved (mortgage availability). Other variables were removed because they were not available in the appropriate format (e.g. monthly versus annual). The variables finally considered and included in the least squares regression model were:

- The affordability index

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- The building cost index
- Building plans passed
- Consumer price inflation
- Disposable income
- Gross domestic product (GDP)
- Household consumption
- Household debt to disposable income
- Household savings
- The JSE All Share Index
- Interest Rates
- Growth in Interest Rates
- One-quarter lagged house prices and
- The Rand-Dollar exchange rate.

The variables were all subjected to two time lags (two quarterly lags) to test whether the current values of the dependent variable related to previous values of the independent variables (Dielman 1996:180-181). A strong relationship between the value of current house prices and previous house prices caused the inclusion of a lagged dependent variable (Case and Shiller: 1989 and Quigley: 1999). The time series data were evaluated over a 31 year time period from 1974 to 2004.

The least squares regression analysis was used to determine which set of variables would produce an appropriate predictive model of growth in the real estate cycle. The variables were divided into 10 sets according to their lags and the autoregressive error term. The number of variables per set varied between 14 and 28. It was necessary to conduct a least squares regression analysis, since best-subset regression analysis is complicated when using more than 14 variables (Dielman 1996:419 and Ott and Longnecker 2001:716).

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The least squares regression analysis showed that the one-quarter lagged variable set without any autoregressive error term produced the lowest RMSE within the confines of the best-subset regression restrictions. The RMSE related to the predictive ability of the model was 3.55 with a R^2 of 0.92 and an F-statistic of 82.36. The analyses identified eight variables with significance at the 95 percent confidence level. These variables are:

- Construction cost
- Consumption
- The debt to income relationship
- GDP
- Inflation
- Interest Rates
- JSE ALSI and
- Affordability

The R^2 and adjusted R^2 of 0.92 and 0.91 show that more than 90 percent of the changes in house prices can be explained by the combination of variables. Construction cost, consumption, debt/income, GDP, inflation, interest rates, the JSE ALSI and affordability are significant at the 95 percent confidence level which means that they have good predictive qualities.

6.1.3.1 The development and results of a regression model for the complete house price growth cycle

The best subset regression analysis was performed on the one-quarter lagged variables. The analysis performed regressions between the dependent variable and all possible subsets of independent variables. Each subset model was evaluated based on its coefficient of determination (R^2) (Dielman 1996:415). The model that produced the highest R^2 of 0.92 included the following explanatory variables one-quarter lagged house price growth, one-

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quarter lagged interest rate growth, one-quarter lagged rand/dollar exchange rate growth. It could be said that this combination of variables acts as a leading indicator of growth in house prices. All the variables are significant at the 95 percent confidence level suggesting that they have good predictive qualities. The data used for the development of the model covered the period from 1974 to 2000, while the predictive ability of the model was based on 2001 to 2004. The test period included one complete growth cycle.

A second best subset regression analysis was conducted on data from 1974 to 1995 to test whether the relationship between the variables and house prices remained relatively constant, or whether it changed constantly. The regression analysis identified lagged growth in house prices, GDP growth, growth in interest rates and building plans as the combination of variables that produced the highest R^2 of 0.90 and a RMSE of 4.36. It very closely matches the actual values from 1974 to 1995 obtained for growth in house prices. All the variables are significant at the 95 percent confidence level, based on the values of their t-statistics.

Of the variables used in the regression analysis conducted for the period 1974 to 1995, only the one-quarter lagged house prices were present in the analysis conducted from 1974 to 2000. This indicates that the relationship (interaction) between the independent variables, and the relationship between the dependent and independent variables changes constantly.

The cycle analysis conducted in Chapter 2 indicated that GDP, property sales, return on investment, average rents, employment levels and vacancy rates act as leading indicators for the house price growth cycle. The regression model for the complete cycle based on data from 1974 and 1995 identified growth in house prices, interest rates, growth in building plans passed and growth in GDP as indicators of growth in house prices. The regression

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analysis based on 1974 to 2000 identified house price growth, interest rate growth, the Rand/Dollar exchange rate growth and construction cost growth are indicators of growth in house prices.

A comparison between the literature study, the regression model based on 1974 to 1995 and the regression model based on 1974 to 2000 showed that one quarter lagged house prices were identified as leading indicators and contributors the predictive about of the model by both regression models. The literature indicated that growth in property sales was a leading indicator for the house price cycle. Property sales could be substituted (and may prove more accurate) for house prices as a measurement for the activity in the house price cycle. Thus activity in the residential market is shown as the most consistent indicator of house price growth.

One quarter lagged interest rates and one quarter lagged interest rate growth were indicated by the regression models to contribute to the prediction of the house price growth cycle. GDP and construction activity were also consistently indicated as measures that affected growth in house prices.

6.1.3.2 The development and results of a regression model developed for the upswing phase of the house price growth cycle

The house price growth cycle consists of four phases, but it is almost impossible to distinguish between the recovery and expansion phase and between the recession and contraction phase (Cloete 1990:11-12). Thus the analysis of house price growth was continued on the basis of separate regression models for the upswing and downswing phases of the cycles. The time series data were divided into upswing and downswing phases using the definition that a phase is two successive periods of growth in the same direction. This resulted in 11 upswing phases and 12 downswing phases.

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The methodology used for the analysis of the upswing and downswing phases was the same approach applied to assess the complete cycle. The variables included in the analysis were also the same. The best subset regression analysis performed on the one-quarter lagged variables during the upswing phases for the time period from 1974 to 2000 identified one-quarter lagged house price growth, one-quarter lagged interest rates, one-quarter lagged household savings, one-quarter lagged consumption, one-quarter lagged JSE Alsi Index and the one-quarter lagged Rand-Dollar Exchange rate.

The combination of variables produced a coefficient of determination (R^2) of 0.97 and a root mean square error (RMSE) of 1.6392. The variables could explain 97 percent of the variation in the growth of house prices during the upswing phase of a house price growth cycle. As in the case of the full cycle, a second analysis was performed to determine whether the variables could consistently predict growth in house prices. This analysis was performed on data from 1974 to 1995 and identified two models with similar coefficients of determination (R^2) of 0.97 and 0.98 respectively. The first model identified one-quarter lagged house prices and one-quarter lagged building plans passed as the variables that could assist in the prediction of growth in house price. The second regression analysis identified one-quarter lagged house prices, one-quarter lagged inflation, one-quarter lagged household savings, one-quarter lagged consumption, one-quarter lagged construction cost and one-quarter lagged building plans passed. The two models had only one quarter-lagged house prices and building plans passed in common.

A comparison of the three models produced by the best subset regression analysis showed that house prices are prevalent in all three models. The model based on 1974 to 2000 and the six variable model based on 1974 to 1995 also had household savings and consumption in common, whereas the

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two models based on 1974 to 1995 both identified building plans passed as an indicator of the upswing cycle.

The theoretical research indicated construction levels and mortgage availability as leading indicator of the upswing phase of growth in house prices. A comparison between the regression models and the literature identified a change in construction as a leading indicator of growth in house prices during the upswing phase.

6.1.3.3 The development and results of a regression model for the downswing phase of the house price growth cycle

The methodology employed for the development of the complete house price growth cycle and the upswing phase of the house price cycle were repeated for the development of a downswing regression model. The results produced by the best subset regression analysis produced a model with a R^2 of 0.96 and a RMSE of 1.65. The model identified one-quarter lagged house prices, one-quarter lagged interest rates growth, one-quarter lagged household savings and one-quarter lagged construction cost as the variables that would best predict house price growth. All the variables are significant at the 95 percent confidence level.

In common with the regression analysis for the complete house price growth cycle and the upswing phase, a second regression analysis was performed on data from 1974 to 1995. This regression showed one-quarter lagged house prices, one-quarter lagged interest rate growth and one-quarter lagged construction cost as indicators of house price growth. All the variables are significant at the 95 percent confidence level.

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The two regression models had all the variables in common, with the exception of household savings. This shows that the leading indicators of the downswing phase of the house price growth cycle were consistent for the two sample periods. The results from the regression model were compared with the theoretical research of Chapter 2 and 3 and the theoretical study had activity in the construction market in common with the empirical models.

6.2 Conclusion

For the first time since 1984 house prices in South Africa have registered significant increase in values since the beginning of 2000. This sparked a marked interest in the real estate market with both investors and home owners entering the market. This raised some questions regarding the sustainability of the increased activity. The hypotheses of the study were twofold: firstly that different macro determinants and performance measures of the real estate cycle are active during the upturn and downturn of the cycle, and secondly that a combination of macro determinants and performance measures assist in the prediction of growth in house prices.

6.2.1 Complete assessment period 1974 to 2000

This study was conducted to determine whether it was possible to predict the movement in house prices and the following results were obtained:

- Changes in the full house price growth cycle may consistently be predicted by a combination of the following variables:
- Changes in house prices,
- Changes in interest rates or the mortgage market,
- Changes in overall economic activity measured by GDP and
- Changes in the construction market measured by construction cost or activity.

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6.2.2 Complete assessment of the upswing phase for the period 1974 to 2000

The upswing phase of growth in the residential real estate market can be predicted by a combination of the following variables:

- Positive changes in house prices,
- Changes in the construction market measured by construction levels,
- Changes in household savings,
- Changes in the consumption of households and
- Changes in the mortgage market measured by either interest rates or mortgage activity.

6.2.3 Complete assessment of the downswing phase for the period 1974 to 2000

The downswing phase of the house price growth cycle can be predicted by a combination of the following variables:

- Changes in the growth of house prices,
- Changes in the construction market mainly measured by construction cost and
- Changes in the mortgage market mainly measured by changes in interest rates.

The first hypothesis only proved to be true in part, since the three variables influencing the upswing phase of the market, also affect the downswing phase of the cycle, but it was established that the upswing phase had two additional variables. The second hypothesis was proven true, since the best subset regression analysis showed that a combination of macro determinants could predict the growth in house prices with more than 90 percent accuracy.

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6.3 Recommendations

All recommendations are based on analysis of the house price *growth* cycle and not the house price *classical* cycle.

6.3.1 Data related aspects

- During the course of the research limitations to the study specific to data were encountered. These gave rise to recommendations for further research.
- It is necessary to obtain data on all the possible indicators of house price growth to eliminate serial correlation between the residuals during the regression analysis and to obtain more accurate results. This could only be done if the values are recorded personally. Some of the data, such as population growth, would not enable a researcher to compile the data without an extraordinary amount of effort.
- More accurate results could be obtained by compiling the data of house price growth and the variables on a monthly basis.

6.3.2 Recommendations related to the analysis

- The analysis was performed on the upswing and downswing phase of the house price growth cycle using year-on-year growth in house prices as computed by the Absa house price index. The recommendations for analysis in future research are:

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- The growth cycle consists of an upswing and downswing phase, but it is divided into four sequential phases. During the research it was indicated that it is difficult to distinguish between the two phases in the upswing phase and the two phases in the downswing phase. This limited the study empirical study to upswing and downswing phase regression models. For future empirical studies it is recommended that the growth cycle be divided into four phases.
- The house price cycle is traditionally analysed through a house price index, but house prices adjust slowly to economic conditions, whereas occupancy rates and sale volumes adjust faster. Although occupancy rates are not applicable for a country with high home-ownership, it may prove to be worthwhile to measure the property cycle by means of the application of sales volume.
- It is recommended that the regression analysis be conducted on a three-yearly basis to remain assured of the continuous relationship between the variables and house price growth. A three-yearly basis is recommended, because it is the average length of the house price growth cycle.

6.3.3 Recommendations on use and decision-making relating to findings

- The findings of the study lend themselves to the following applications for persons active in the housing market:
- The analysis of the variables that are active during the phases of the cycle is useful for determining whether the market is in an upswing or in a downswing phase.

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- Changes in the variables active during the cycles may be employed to predict changes in the direction of growth in house prices.
- The results from the best subset regression analysis conducted on the South African housing market could be used to determine the optimum timing when to enter the housing market. This applies both to investors and to home-buyers. For example: it may well be advantageous to enter the market at the beginning of an upswing phase rather than at the end of this phase when the market is overheated. The best time thus determined to enter the market may lead to a reduction in the price and maximise the capital growth of a property.

6.3.4 Recommendations related to the practical use of the findings by industry specialists:

6.3.4.1 Estate agents

- The house price growth regression model can assist estate agents with determining whether a market is nearing an upswing or a downswing. If the residential real estate market is approaching or entering an upswing, it could aid the agency by providing it sufficient time to prepare for an upswing by, for example, appointing and training new staff, opening new branches and actively acquiring new properties.

6.3.4.2 Development companies

- The results could be applied by development companies through planning new developments to be released during an upswing phase of the house price growth cycle. Consequently a development company

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could provide housing, or plans for housing, when demand for housing is high.

- During the downswing phase of the house price cycle construction prices are lower than during the rest of the cycle. A company involved in development activities could well coincide its contract for upcoming building activities with the end of the downswing phase and should thereby be able to increase its profit margin.

6.3.4.3 Investment specialists

- The analysis of the interaction between the business cycle and the real estate cycle, and the interaction between the general real estate cycle and the residential real estate cycle, could assist in the allocation of investment between commercial, industrial and residential real estate and between real estate and other investment vehicles for fund managers.
- The results of the regression model are useful for the prediction of changes in the state of the house price market. This could assist investment specialists with the timing of entering the market with a view to possibly maximising their profit.

6.3.4.4 Construction Sector

- Construction price fluctuate along with the real estate market, leading to construction companies adding premiums to their prices when demand for construction is high, and allowing discounts when demand for construction is low. A study of the demand for housing may assist the construction company with adding premiums earlier in the upswing

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phase and minimising discounts by introducing them later during the downswing phase and removing them again earlier in the upswing phase.

6.4 Further Research

- During the regression analysis certain variables identified by the theoretical study were excluded because of the lack of availability of the relevant data. The accuracy of the variables identified by the regression analysis could be improved by compiling all the relevant data over a period of several years and performing the regression analysis on the data. As a minimum criterion the data should be available or compiled in a quarterly format to improve the accuracy of the current findings.
- The residential real estate cycle is divided into four phases in the literature study. During the empirical study only the upswing phase and the downswing phase of the house price growth cycle were analysed because of data limitations. By using monthly data the recovery and expansion phase in the upswing cycle and the hypersupply and recession phase during the downswing phase could be distinguished more clearly. This would allow for empirical studies to be conducted on all four phases, which would in turn contribute to the accuracy of prediction of directionality and timing of changes in house price growth.
- The regression analysis should be conducted at regular intervals - at least every few years - because of continuous changes in the interaction between the variables that influence house prices.
- An analysis of the variables that influence the classical growth cycle may contribute to a further understanding of the residential real estate market.

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This analysis was not performed during the study because of insufficient data.

- A study comparing the intensity of firstly a downswing growth phase coinciding with a downswing in the classical cycle, and secondly the downswing growth phase coinciding with an upswing in the classical cycle, could well shed further light on which variables are of most consequence during a downswing. The same data would be applicable for the upswing phase.

- A detailed analysis of the growth in the different sectors of the real estate market could assist in predicting growth for these sectors. It is possible that one of the sectors could consistently act as a leading indicator for the others, thereby enabling some early identification of changes in the sectors.

- A mapping of the changes in variables during every growth cycle for the data period would provide a more comprehensive understanding of the interaction between the variables, rather than the understanding provided by the theoretical study.

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