COMPARING SHARE VALUATION MODELS IN BOOM AND RECESSION CONDITIONS: A SOUTH AFRICAN STUDY

by

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ABSTRACT

Comparing share valuation models in boom and recession conditions: a South African study

by

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The study's main concern was the extent to which the price earnings (P/E) valuation model and constant growth dividend discount valuation model (DDM) can estimate the intrinsic value of a share. The context within which the concern was addressed is the boom and recession conditions of South Africa during the period 1994–1999.

The study used the following descriptive statistics to make a comparison of the performance of each model:

- Theil's inequality coefficient;
- coefficient of variation;
- percentage improvement in the inter-quartile range (%IMP); and
- the Wilcoxon test and the Kruskal-Wallis test.

The study found that:

- the DDM is more efficient in estimating the intrinsic value in the boom period compared to the recession period.
- P/E is more efficient in estimating the intrinsic value in the recession period than the boom period.
- When the business cycle changed from a boom to a recession the %IMP increased for the DDM and the P/E model showing that there was no improvement in

performance. Instead, it showed an increase in the IQR of each model. The increase in the DDM was smaller than that of the P/E model.

- The difference between the absolute valuation errors of the DDM across the two phases of the business cycle (boom and recession) was not statistically significant while those of the P/E were significant.

Keywords: price earnings model, dividend discount model, intrinsic value, business cycles, boom, recession, valuation performance.

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Table 1: Abbreviations and acronyms used in this document

Abbreviation	Meaning
AVE	Absolute valuation error
DCF	Discounted cash flow
DDM	Dividend discount model
EPS	Earnings per share
GAAP	Generally accepted accounting standards
IQR	Inter-quartile range
%IMP	Percentage improvement inter-quartile range
MAPE	Mean absolute valuation error
OLS	Ordinary least squares
P/B model	Price book model
P/CF model	Price to cash flow model
P/E model	Price earnings model
P/S model	Price sales model
RIVM	Residual income valuation model
ROE	Return on equity
SARB	South African Reserve Bank
SVE	Signed valuation error
WACC	Weighted average cost of capital

1 INTRODUCTION AND BACKGROUND

Share valuation refers to the process of finding the intrinsic value of a share (Marx, 2010:61). The intrinsic value is the investor's or analyst's view of the true economic value of a share, given the investor or analyst has a hypothetical complete understanding of the share's investment characteristics (Pinto, Henry, Robinson, & Stowe, 2010:2).

There are two mainstream approaches to approximating the intrinsic value, namely the discounted cash-flow-based approach and the multiples-based approach.

In the discounted cash-flow-based approach, the intrinsic value of a share is equal to the sum of the present values of all expected future cash flows associated with the share. These cash flows can be classified as dividends, free cash flow or residual income. The discounted cash flow-based approach comprises of three discounted cash flow valuation (DCF) models, namely dividend discount model (DDM), free cash flow model and residual income valuation model (RIVM).

The multiples-based approach is based on the idea that shares cannot be valued in isolation; thus, this approach approximates the intrinsic value of a share by comparing it to a set of shares that are similar to the one being valued. The most common multiples-based approaches are ratios of price earnings (P/E), price to book value (P/B) and price to sales (P/S) (de Paula Neto, 2008:2).

No single theory can explain everything in all places at all times (Wacker in Kotzé, 2011:19) and no single technique can conclusively be the most accurate and precise in all situations (Yee, 2004:23). The same should apply to share valuation models across different phases of the business cycle. The South African Reserve Bank (SARB) defines business cycles as follows based on Burns & Mitchell, 1946:3:

> Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organise their work in business enterprises. A cycle consists of expansions occurring at about the same time in many economic activities, followed by similar general recessions, contractions, and revivals which merge into the expansions phase of the next cycle. This sequence of

change is recurrent but not periodic; in duration, business cycles vary from one year to ten years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

A boom is the upturn and recession the downturn in the economy. Most shares will perform well when there is an upturn in the economy and suffer when there is a downturn, but good shares will usually manage to produce increased earnings in the depth of a recession (Slater, 2008:165). The question is whether valuation models perform in the same pattern as the share, and whether it will it perform better in an upturn and suffer in a downturn.

Valuation models are evaluated by comparing observed market prices with the estimated intrinsic value based on valuation models (Penman & Sougiannis, 1998:34). Valuation performance refers to how close valuations based on valuation models are to the market price (Liu, Nissim & Thomas, 2007:1). According to equity valuation theory, all valuation models are expected to arrive at the same valuation estimates (de Paula Neto, 2008:2). Consequently, valuation models should perform equally in different market conditions if compared to each other; therefore, in theory no one valuation model should outperform the other.

Contrary to this, some researchers show that P/E outperforms DCF. A study on international equity valuation using multiples that included South Africa found that share valuation using multiples-based on earnings performed better compared to those based on sales, dividends and free cash flow (Liu, Nissim & Thomas, 2002b:3). Sehgal and Pandey (2010:86) found that price to earnings does a better job for share valuation in the case of emerging markets such as Brazil and South Africa. While James & Koller (2000:80) preferred the use of DCF for emerging markets, in their study the focus was on Asian emerging markets, and an extra level of risk taken by an investor in these markets was incorporated into the DCF valuation model. Although there are studies of share valuation models, there is a need for academics and industry practitioners to determine suitable share valuation models for an emerging market such as South Africa (Nel, 2009:117).

In uncertain economic times, like that of the 2008/2009 global financial crisis and the 2011 Euro debt crisis, information and extensive knowledge on shares and their characteristics become important to investors and industry practitioners. Questions related to the impact of business cycles on valuation models also gain importance.

1.1 PROBLEM STATEMENT

Research has been done in order to determine which share valuation model performs best, when multiple-based valuation approaches are compared to the discounted cash-flow-based valuation approaches. Such studies include those by Hickman and Petry (1990), Francis, Olsson and Oswald (2000), Berkman, Bradbury and Ferguson (2000) as well as de Paula Neto (2008). The literature review indicated limited studies on comparing the performance of share valuation models in different phases of the business cycle in South Africa.

1.2 PURPOSE STATEMENT

The purpose of the study was to compare the performance of the price earnings model (P/E model) and the dividend discount model (DDM) during different phases of the business cycle in South Africa according to the SARB classification. The periods of study were the 1994–1996 boom phase and the 1997–1999 recession phase.

1.3 RESEARCH OBJECTIVES

The following objectives guided the study:

- to evaluate and describe the performance of the P/E model in estimating the intrinsic value of JSE-listed shares during the South African economic boom phase of 1994–1996 and economic recession phase of 1997–1999;
- to evaluate and describe the performance of the DDM in estimating the intrinsic value of JSE-listed shares during the South African economic boom phase of 1994–1996 and economic recession phase of 1997–1999; and

- to draw a comparison between the performance of the two valuation models during the two phases of the business cycle in South Africa.

1.4 ACADEMIC VALUE AND CONTRIBUTION OF THE CURRENT STUDY

There is a need for academics and industry practitioners to determine suitable share valuation models for an emerging market such as South Africa (Nel, 2009:117). This is also emphasised by Bruner, Conroy, Estrada, Kitzman and Li (2002:319) who stress the need for academia and practitioners to agree on mainstream valuation practices, a trend that exists in developed countries. Studies need to be done to assist academia in converging on (or creating a trend of) mainstream valuation models. More research is needed with regard to the performance of current valuation models in emerging markets in order to assist academics in selecting and/or developing valuation models most appropriate for emerging markets conditions.

The importance of the area of valuation performance is increasing and investors are becoming more sophisticated and need as much information as possible to make investment decisions (Farooq, Ullah, Alam & Shah, 2010:157). The current study intended to increase literature on the area of valuation performance in South Africa, specifically performance in different phases of the business cycle.

1.5 DEFINITION OF KEY TERMS

The key concepts of this study were *intrinsic value*, *dividend discount model*, *price earnings model*, *valuation performance*, *business cycles*, *recession* and *boom*. The list below briefly defines the concepts, which were discussed further in the literature review.

Boom: “a recurring of slow growth in total output, income, employment and trade, usually lasting a year or more” (Taylor, 1998:15).

Business cycles: “a type of fluctuation found in the aggregate economic activity of nations that organise their work in business enterprises. A cycle consists of expansions occurring at about the same time in many economic activities, followed by similar general recessions, contractions, and revivals which merge into the expansions phase of the next cycle. This sequence of change is recurrent but not periodic; in duration business cycles vary from one year to ten years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own" (Burns & Mitchell, 1946:3).

Dividend discount model: "a valuation model that determines a firm's intrinsic value by finding the present value of the firm's stream of future cash dividends" (Hooke, 2010:199). For this study, the discount model used was the Gordon constant growth model, which assumes constant growth rate.

Intrinsic value: the investor's or analyst's view of the true economic value of a share, given the investor or analyst has a hypothetical complete understanding of the share's investment characteristics (Pinto *et al.*, 2010:2).

Price earnings model: a valuation model that determines a firm's intrinsic value by multiplying the firm's future earnings with the harmonic mean industry P/E. The ratio is found by taking the inverse average of a set of comparable firms excluding the target firm in a specific industry (Liu *et al.*, 2007:2).

Recession: "a recurring period of absolute decline in total output, income, employment and trade, usually lasting six months to a year and marked by widespread contractions in many sectors of the economy" (Moore & Zarnowitz, 1984:5).

Valuation performance: describes how close valuations based on valuation models are to the observed market price (Liu, Nissim & Thomas, 2007:1).

1.6 STRUCTURE OF THE MINI-DISSERTATION

The study comprises of five chapters subdivided as follows:

Chapter 1: Introduction

This chapter introduces the study. It provides a background to the research problem, definitions of keywords and a list of delimitations and assumptions of the study.

Furthermore, the chapter provides a discussion of the problem statement and research objectives as well the academic value and contribution of the study.

Chapter 2: Literature review

This chapter provides a detailed discussion about the DDM and the P/E model, comparing the performance of valuation models and business cycles.

Chapter 3: Research design and methods

This chapter outlines the research methodology applied in the study and discusses the process and tools used in analysing the data.

Chapter 4: Results and discussion of results

This chapter reports on and discusses the results from the data analysis.

Chapter 5: Conclusion and recommendation

This chapter summarises the study and provides a brief conclusion and some recommendations.

2 LITERATURE REVIEW

The literature review provides a discussion on how the DDM and the P/E model are used to estimate the intrinsic value of a share. It reviews past studies that focused on comparing the performance of valuation models after which the business cycle is defined and a description of South African business cycles during the period 1994 to 1999 is given in order to set the context of the study.

2.1 DIVIDEND DISCOUNT AND PRICE EARNINGS MODEL

The intrinsic value is the investor's or analyst's view of the true economic value of a share, given that the investor or analyst has a hypothetical complete understanding of the share's investment characteristics (Pinto *et al.,* 2010:2). It is the fair value or theoretical value of the share (Fabozzi & Markowitz, 2002:298).

The intrinsic value can be determined using two types of share valuation models, namely discounted cash-flow-based and multiples-based valuation models. The study chose to use the DDM as its discounted cash-flow-based model and the P/E model as the multiples-based model. The performance of these two models was evaluated and described across two business cycles namely the boom and the recession. This section aims to define, discuss and describe the DDM and the P/E model.

2.1.1 <u>Dividend discount model</u>

The DDM states that the intrinsic value of a share is equal to the present value of future expected dividends[1] (Fabozzi & Markowitz, 2002:298). The pure form of the DDM can be expressed as a mathematical equation:

$$V_0 = \frac{D_1}{(1+r_1)^1} + \frac{D_2}{(1+r_2)^2} + \ldots + \frac{D_n}{(1+r_n)^n}$$

[1] Some literature debates this by asking if earnings should be used instead of dividends but (Williams, 1964:57) debates this issue and summaries it saying that earnings and dividends should give the same answer. For if earnings not paid out as dividends are reinvested for the benefit of the shareholder, they would produce dividends later.

Where

V_0 = the intrinsic value (also known as the theoretical price of the share)

D = the expected dividend at year 1 to *n*

r = the rate of return earned on the share

The dividend discount model is based on the assumption that the firm pays annual dividends (Williams & Findlay, 1974:188) and that these are expected to be paid out forever (Fabozzi & Markowitz, 2002:298).

To use the DDM in its pure form is not practical as it is based on an infinite flow of dividends. Literature tells us that:

- "infinite dividends are impossible in a finite world" (Williams,1964:87);
- "no share exists whose dividends increase without limit" (Williams, 1964:87); and
- "no individual or institution can differentiate between short-term growth forecasts in the distant future" (Elton, Gruber, Brown & Goetzmann, 2003:447).

Therefore, it is simpler to use the constant growth model, which assumes that dividends will grow at the same rate (*g)* into an indefinite future (Elton *et al.,* 2003:447). This can be express mathematically as: $V_0 = \frac{D_1}{r-g}$

Where

V_0 = the intrinsic value (also known as the theoretical price of the share)

D_1 = next year's expected dividends

r = the rate of return earned on the share

g = expected long-term growth rate

The long-term growth rate *(g)* is the sustainable growth rate at which dividends can be sustained at a given level. It is calculated as the earnings retention rate multiplied by the return on equity, and is expressed mathematically as follows: $g = b \times ROE$ where b is the firm's earnings retention rate and ROE is the firms return on equity.

The rate of return earned on the share is the minimum level of expected return an investor requires in order to invest in the asset over a specified period, given the assets risk (Pinto *et al.,* 2010:39). It usually calculated using the capital asset pricing model (CAPM), which states that the required rate of return is equal to the risk-free rate plus a premium related to the asset's sensitivity to market returns. This is calculated as follows:

$$E(R) = RFR + \beta(R_m - RFR)$$

Where

$E(R)$ = the expected return of an asset

RFR = the risk-free rate

β = the assets sensitivity to market changes

R_m = return of the market

This study used the simpler form of the DDM, which is used by the McGregor BFA database, from which the intrinsic value of the share based on the DDM was downloaded. The following section discuses the P/E model.

2.1.2 Price earnings model

The P/E model is a valuation model that determines a firm's intrinsic value by multiplying the firm's future, present or past earnings with the harmonic mean industry P/E ratio. The harmonic mean industry P/E ratio is found by taking the inverse average P/E ratio of a set of comparable firms excluding the target firm in a specific industry (Liu *et al.,* 2007:2). It is based on the assumptions that the target firm and the set of comparable firms have proportional future earnings and risk expectations, and the performance measure (earnings) is proportional to value (Kaplan & Ruback, 1994:10). The intrinsic value can be expressed mathematically as: $V_0 = \frac{P}{E}t \times EPS_t$

Where

V_0 = the intrinsic value (also known as the theoretical price of the share)

$\frac{P}{E}t$ = harmonic industry mean P/E ratio at time *t*

EPS_t = forecasted earnings per share for time *t*

The P/E valuation model can also be derived from the DDM as follows: $\frac{P}{E}=\frac{P_0}{E_0}=\frac{D_0(1+g)/(r-g)}{D_0/payout}=\frac{(1+g)payout}{r-g}$. Thus it captures the growth of earnings, the dividend payout and required rate of return (de Paula Neto, 2008:6). This quality makes the models more comparable.

Most studies use the industry P/E ratio to estimate a firm-specific intrinsic value. They justify the use of an industry P/E ratio based on studies like that of Alford (1992:107), which explored the definitions of comparable firms and found that industry membership constitutes the major element that captures cross-sectional differences compared to size and return on equity (ROE). Studies similar to that by de Paula Neto (2008) define the industry P/E ratio as the P/E ratio of a set of comparable firms. Alternatively, the industry P/E ration can be define as the benchmark P/E ratio.

Cheng and McNamara (2000:349) referred to the benchmark P/E ratio and further stated that the benchmark P/E valuation model estimates the intrinsic value of a firm by taking the product of a firm's earnings and the benchmark P/E ratio of a set of comparable firms. De Paula Neto (2008:5) referred to a industry P/E ratio and described the P/E valuation model as a model that takes a set of comparable firms as a proxy for growth in order to estimate the intrinsic value of a specific firm. He estimated the intrinsic value, by taking the product of the industry P/E ratio mean and the firm earnings.

In Liu *et al.* (2007:2), a harmonic mean P/E ratio is used because the average P/E ratio may be skewed upwards or downwards by P/E ratios that are extremely higher or lower than the bulk of the industry P/E ratio. The harmonic mean P/E ratio provides a way to mitigate the effect of high or low on the mean P/E ratio. In finding the harmonic mean P/E ratio, the target firm's P/E is removed from the average to avoid contamination. An earlier study by Hickman and Petry (1990:79) made use of the median industry P/E. The current study preferred the use of a harmonic mean P/E ratio for its ability to reduce skewness.

2.2 METHODS OF EVALUATING AND DESCRIBING PERFORMANCE OF EQUITY VALUATION MODELS

The DDM assumes that the observed share price is equal to the present value of expected cash flow, that is, $P_{i,t}$ *(observed share price)* = $V_{i,t}$ *(estimated intrinsic value)*. This is not true in the real world, where deviations occur because of noise trading[2] and uniformed trading. The extent of the deviation of the intrinsic value from the observed share price is the valuation error (Lee, Meyers & Swaminathan, 1999:1697). This error is used in most studies to evaluate the performance of valuation models. *Valuation performance* refers to how close valuations based on valuation models are to the market share price (Liu, Nissim & Thomas, 2007:1). Valuation performance can be measured in terms of accuracy, bias and explainability. *Accuracy* describes the closeness of the estimated intrinsic value to the observed share price. The absolute valuation error is used to evaluate the level of accuracy for a specific valuation model. The absolute valuation error is calculated by dividing the difference between the intrinsic value and the observed share price by the observed share price.

Figure 1 below demonstrates the deviation of the intrinsic value from market price. The distance between the intrinsic value line (blue line) and the market price line (pink line) is the valuation error.

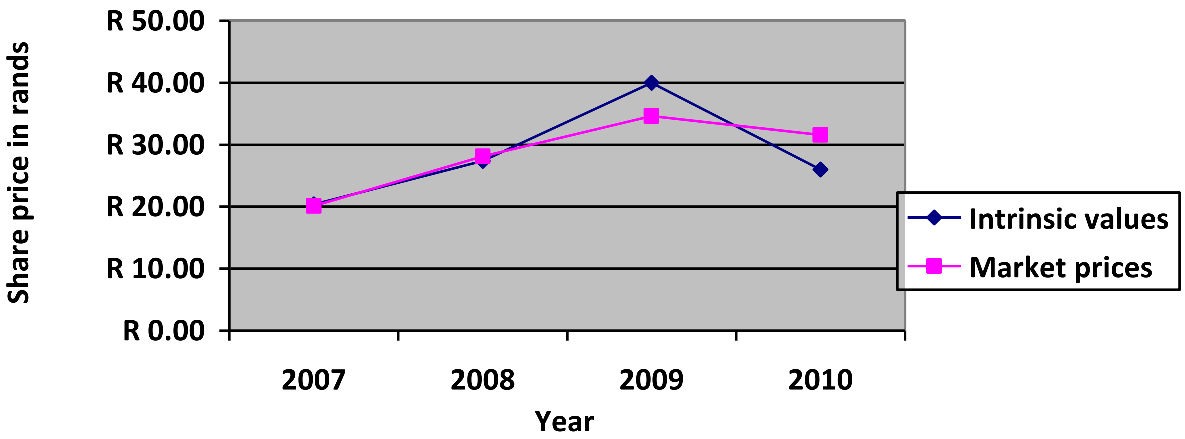

Figure 1: Line graph of intrinsics value and market prices

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[2] "Uniformed investors buying and selling financial securities at irrational prices, thus creating noise (strange movements) in the price of securities" (London Southeast Financial Glossary, 2011).

The closer the valuation error is to zero, the more accurate the estimated intrinsic value. *Bias* is defined as the signed valuation error found by dividing the difference between the intrinsic value and the observed share price by the observed share price. A negative error equates to a negative bias, while a positive error equates to a positive bias and a zero error equates to no bias. *Explainability* refers to how well the valuation model used explains the observed price, and this is described by R-squared[3] (Francis *et al.*, 2001:1). Most researchers use descriptive statistics, while other use parametric or nonparametric[4] measures to make inference about the accuracy and bias of the valuation models. This is discussed further in the review.

All valuation models are expected to arrive at the same valuation estimates (De Paula Neto, 2008:2); Francis *et al.* (2000:28) agreed with this statement and added that valuation models should theoretically provide the same intrinsic value estimate. Since this is not the case, several studies have been done on measuring the performance or accuracy of valuation models.

As a point of departure, to review performance measures used by past researchers of valuation models, the study consulted pre-2000 studies, after which post-2000 studies are discussed in detail. Malkiel and Cragg (1980) studied intrinsic value estimations by financial institutions, and compared these to the observed values of the share. The results of their study revealed that the assumption that all valuation models will predict the same intrinsic values is invalid. Their study examined the accuracy of the intrinsic value estimations made by the financial institutions by first converting the intrinsic and observed share values into percentage changes from the values as of the date the prediction was made in order to remove the scale effect from the figures. The study then considered the correlation between the intrinsic value and the realised share price as well as Theil's inequality coefficient.[5] With regard to the correlation, their used simple correlation,[6] Spearman ranks correlation coefficient[7] and Kendall's coefficient of concordance.[8]

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[3] R-squared is a measure of goodness fit of a regression. R-squared lies between 0 and 1. The closer to 1 the better the fit or the more the dependent variable is explained by the independent variables (Gujarati & Porter, 2009:493).
[4] For a non-parametric test, data is not required to have a normal distribution (Rubin, 2007:291–292).
[5] Theil's inequality coefficient describes how well the model estimated the intrinsic value. Theil's inequality coefficient lies between 0 and 1. If the Theil's coefficient is zero, then the model estimated the intrinsic value perfectly (Malkiel and Cragg, 1980:10).

Hickman and Petry (1990) compared the DDM and the P/E model by finding mean absolute errors, their study defined as the absolute value of the difference between observed and estimated prices divided by the observed price. Their study chose to use this variable, as it trusted that the variable reflected the "total" error. Their study found that the P/E valuation provides relatively reliable estimates of the intrinsic value (Hickman & Petry, 1990:81, 84).

Alford (1992) measured the effect of comparable firm selection on the accuracy of the P/E model and used the Friedman test[9] as nonparametric test. Their study analysed the absolute valuation error to measure accuracy and the signed error for bias and examined whether accuracy improves when the set of comparable firms is chosen differently. The parametric measures the study used to describe performance were the median (the middle value in a ranked distribution of values) and inter-quartile range (IQR, or the range for the middle 50% of values in a rank-ordered distribution). The study observed the changes in the estimated intrinsic value when the set of comparable firms used to calculate the median P/E ratio was selected on the basis of industry, risk (measured by firm size), and earnings, both individually and in pairs. The results of the study were consistent with existing literature that states, "much of the cross-sectional variation in the P/E ratio that is explained by risk and earnings growth are explained in industry" (Alford, 1992:107). The study thus concluded that other criteria of choosing comparable firms do not improve accuracy and that industry is a good criterion for comparable firm selection.

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[6] Simple correlation coefficient depicts the strength of the correlation between two variables. It ranges between +1 and -1, where +1 is the perfect positive correlation and -1 is the perfect negative correlation (Rubin, 2007:289).

[7] Spearman ranks correlation coefficient is used to calculate the correlation for variables that are at ordinal level of measurement, or interval or ratio-level data that are not distributed normally. The correlation lies between +1 and -1 and has the same meaning as the simple correlation (Rubin, 2007:294).

[8] Kendall's coefficient of concordance is used to calculate the correlation for variables that are at ordinal level of measurement, or interval or ratio-level data that are not distributed normally. The correlation lies between +1 and -1 and has the same meaning as the simple correlation. It is preferred to the Spearman ranks correlation when there are many ties in the rank ordering (Rubin, 2007:290).

[9] "The Friedman test is a nonparametric test that allows multiple comparisons of several related samples. For each firm, the absolute prediction errors for the various methods of selecting comparable firms are ranked from 1 (smallest) to K (highest), where K is the number of different methods of selecting comparable firms. The t-statistic between pairs of methods is based on the ranks for each method over the sample of firms. A composite t-statistic is then computed by averaging the individual year t-statistics over the three years. Note that averaging t-statistics assumes the tests in each year are independent" (Alford, 1992:101).

Kaplan and Ruback (1994) compared cash flow valuation to price multiples valuation. Their study compared the performance of the two valuation models by using the log valuation error (which is calculated as the log of the ratio of the estimated value to the market value). Their study used this method as it found that it would be easier to compare percentages. Their study used the constant growth DDM and EBITDA(earnings before interest, depreciation and amortisation) as a value driver for the price multiple models to estimate the intrinsic value of the shares. In order to comment on the performance of the valuation models, their study used descriptive statistics, such as:

- the median valuation error;
- mean valuation error (the summed of all the valuation errors divided by the number of the summed valuation errors);
- standard deviation of the valuation error (measures how far the valuation errors in a distribution are deviating from the mean on average);
- mean absolute valuation error (the summed of all the absolute valuation errors divided by the number of the absolute valuation errors summed) and the mean squared error (measures the average of the squared valuation errors).

Their study found that the DCF provided reliable estimates of the intrinsic value and that DCF performed as well as price multiples valuation but they should be used in conjunction to provide better estimates.

Penman and Sougiannis (1998) compared the DDM, discounted free-cash flow and P/E models. Their study evaluated the performance of the valuation models by interpreting the mean valuation errors and variation of the valuation errors. Its focus was on the effect of forecasting accounting accrual earnings based on GAAP (generally accepted accounting practices) on valuation models' ability to estimate the intrinsic value. The valuation errors of accruals-based model are compared to those of a model that forecasts free cash flows or dividends. Their study found that accrual accounting provides correction to discounted cash flow valuation. The correction involves accounting for expected investment and the recognition of non-cash value charges.

Kim and Ritter (1999) focus on estimating the value of an initial price offering using the multiple-based approaches. Their study compares the performance of the P/E model to

P/B model, P/S model, enterprise value-to-sale model and enterprise value-to-operating cash flows ratios model. Their study defined *enterprise* as the market value of equity plus the book value of debt minus cash. Their study compared the models based on historical numbers and forecasted numbers and found that, when forecasted earnings are used, the accuracy of the models improves.

The current study based the description and discussion of valuation performance on the statistical properties of absolute valuation errors.

Valuation errors are well explained in De Paula Neto (2008:8). His study evaluated the performance of P/B, P/E and RIVM (residual income valuation model) in USA-regulated companies. His study separated performance into two categories, with the first being bias and the second being accuracy. His study measured bias using the price-scaled signed valuation errors, which were used to determine if the intrinsic value was negatively biased, positively biased or unbiased. This is shown by the formula $SVE_{i,t} = \frac{(V_{i,t} - P_{i,t})}{P_{i,t}}$

Where:

$SVE_{i,t}$ = the signed valuation error for firm *i* at time *t*

$V_{i,t}$ = the estimated intrinsic value for firm *i* at time *t*

$P_{i,t}$ = the observed share value for firm *i* at time *t*

To measure accuracy De Paula Neto looked at the absolute valuation errors to determine how close to zero the valuation errors were or similarly how accurate the intrinsic value was. De Paula Neto used the same formula as the signed valuation error but found its absolute value as follows: $AVE_{i,y} = \frac{|V_{i,t} - P_{i,t}|}{P_{i,t}}$ where $AVE_{i,t}$ = the absolute valuation error for firm *i* at time t.

His study evaluated whether the regulation of industry affects the performance of the valuation model in the manufacturing industry and utilities industry. To describe the relationship, De Paula Neto regressed the intrinsic value against the observed prices as follows: $P_{i,t} = \beta_0 + \beta_1 V_1 \times IND_i + \varepsilon_i$

The regression states the observed share price is explained by three intercepts, a dummy variable IND that represents the industries, the intrinsic value and an error term. De Paula Neto then described how well the valuation models explained the intrinsic value by using R-squared. Other statistical measures that were considered were the t-stat,[10] z-stat[11] and Wilcoxon-test.[12] De Paula Neto found that the three valuation models tend to overestimate the intrinsic value and the P/E is the best performer when it comes to accuracy at a 1% significance level.

A similar study was done in 2007 by Liu *et al.* This study compared discounted cash flow valuation to the price earnings valuation model. In their study, Liu *et al.* (2007) compared the performance of price multiples and discounted cash flow models across industry and country. Their study used the valuation error, which describes how close to the observed price the intrinsic value is. This is the same as the bias calculated by de Paula Neto (2008). In a previous study (Liu *et al.*, 2002a; 2002b), a harmonic mean P/E ratio was used to determine the country industry-specific monthly intrinsic values[13] and the valuation error is termed the *pricing error*. To evaluate the performance, measures of dispersion such as the IQR were used in their study. The IQR is the middle 50% of values in a ranked distribution that falls between the first and third quartile (Q1 and Q3); therefore, IQR = Q3-Q1. Where: $Q_1 = \frac{1}{4}(1+n)$ and $Q_3 = \frac{3}{4}(1+n)$.

Their study used IQR 1 (the inter-quartile range for context A) and IQR 2 (the inter-quartile range for context B) to describe how similar the pricing errors of one price-multiple valuation model are across different countries. In their study they first compared the IQR to each other, and then used a measure called the *relative percentage improvement in performance* (%IMP), to measure the improved performance, by calculating the percentage decrease in the quartile range, where $\%IMP = 100\% \times (IQR1 - IQR2) / IQR1$.

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[10] T-state is the ratio of departure of an estimated value from its actual value, examines whether two population means are different (Investopedia, 2011).
[11] Used to determine whether two population means are different when their variances are known and the sample size is large (Investopedia 2011)
[12] A nonparametric test that compares two related samples to determine if their ranked mean differs. Also known as either the Wilcoxon ranked sum test or signed rank test (Investopedia, 2011).
[13] Liu *et al.* (2002b) define price multiple valuation as a method that estimates the intrinsic value of a firm by multiplying the firm's value driver observed (beign earnings per share, dividends per share, and cash flow per share or sales per share).

The %IMP of the valuation model X in context A is compared to the %IMP of valuation model X in context B. For example, their study looked at the country industry-specific monthly P/E ratio (context A), when the industry characteristic is removed from the P/E ratio calculation and a country-specific monthly P/E ratio (context B) is found. Their study then measured how the performance of the valuation model improved from the use of context A to the use of context B. Liu *et al.*'s (2002a, 2002b &2007) studies had a common finding, namely that the P/E ratio provides more accurate estimations of the intrinsic value when compared to other price multiples valuation models and DCF models.

Sehgal and Pandey (2010:81) referred to valuation errors and evaluated the performance of the model by looking at the root mean squared error (root MSE-standardised general standard deviation of valuation errors) and Theil's inequality coefficient of the series of pricing errors over the study period. Their study focused on the performance of price multiples valuation models in BRICKS[14] countries. The root MSE was used to compare the intrinsic value for the same series across different models. The smaller the error of the model the better the model was at finding the intrinsic value. The root MSE is calculated as follows: $\sqrt{\frac{\sum (P_{i,t} - V_{i,t})^2}{n}}$

Where

$P_{i,t}$ = observed share price

$V_{i,t}$ = forecasted value (intrinsic value)

n = number of observations

Theil's inequality coefficient lies between 0 and 1 and describes how well the model estimated the intrinsic value. If Theil's inequality coefficient is 0, then the model estimated the intrinsic value perfectly. If it is 1, then there is perfect inequality or negative proportionality between the observed share price and the intrinsic value (Leuthold, 1975:344). Negative proportionality can also be referred to as a naive prediction. It is possible for the inequality coefficient to be higher than 1, in which case the prediction is worse than the naive prediction (Malkiel and Cragg, 1980:10).

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[14] A group of emerging countries comprising of Brazil, Russia, India, China, South Korea and South Africa (Investopedia, 2011).

Theil's inequality coefficient can be calculated as follows: $\frac{\sqrt{\sum (P_{i,t} - V_{i,t})^2}}{\sqrt{\sum P_{i,t}^{\ 2}} + \sqrt{\sum V_{i,t}^{\ 2}}}$

Through these two measures, Sehgal and Pandey (2010:81) were able to evaluate the performance of the different price multiples valuation model in BRICKS countries and determine which valuation model was most efficient. Their efficiency criterion was the minimisation criteria. The valuation model for which both measures were the smallest number was deemed most efficient when determining intrinsic values.

Park and Lee (2003) studied the accuracy of price multiple models across industries, of Japanese listed companies during the bull market and the bear market. They first considered performance of the price multiples by industry for the period 1990–1998, then the performance by the market periods: the bull market period (1992–1993, 1995 and 1998) and the bear market period (1990–1991, 1994, 1996 and 1997). Earnings, cash flow, sales and book value were used as value drivers in investigating the effectiveness of price multiples model in estimating accurate intrinsic values. The valuation errors of the various price multiples were analysed and compared using the mean absolute percentage valuation error. This error is the average ability of a price multiple valuation model to estimate the intrinsic value and is calculated as follows: $MAPE_{ji} = \sum_{i=1}^{nj} [(\frac{|V_{it} - P_{it}|}{P_{it}}) / n_j]$

where

$MAPE_{ji}$ = the mean absolute percentage valuation error of industry *j* at time *t*

V_{it} = the estimated intrinsic value for firm *i* at time *t*

P_{it} = the observed share price for firm *i* at time *t*

n_j = the number of firms in industry *j*

Their study went on to consider its result at a 10%, 5% and 1 % significance level and found that the valuation errors in the bull market are generally smaller than those in the bear market. Throughout the whole period, the P/B model gave the least valuation errors within the industry. The P/E was reasonably superior to the other price multiples in the bear market period although the P/S model was marginally better in estimating intrinsic values of the textile industry in the bear market. The price cash flow (P/CF) model estimated the intrinsic value in the food and beverage industry in the bear market period slightly better than the other price multiples. The P/CF model was also a good estimator in the bull market in the textile, food and beverage and the communication industry.

Other studies done related to accuracy and the performance of valuation models are for instance that by Cheng and McNamara (2000), who studied the valuation accuracy of the P/E and P/B models. In that study, it is stated that the performance of a price multiple model depends on the selection of comparable firms. These researchers used nonparametric and parametric accuracy tests based on the statistical descriptors used by Alford (1992).

Berkman *et al.* (2000) also based their study on work done by Alford (1992) as well as Kaplan and Ruback (1994) and Kim and Ritter (1999). In order to evaluate performance, Berkman *et al.* (2000) looked at accuracy and bias. Their study discussed the median, mean and IQR percentages of the valuation signed errors and absolute valuation errors. Their study compared estimates of the intrinsic value of initial price offerings in New Zealand based on traditional DCF and P/E models. The P/E ratio was based on industry-comparable firms, market-comparable firms and transaction-comparable firms. The transaction ratio was based on the median of the last five recent initial price offerings. It found that market-based DCF valuations and P/E model valuations produce lower valuation errors than industry-based methods.

Francis *et al.* (2000) compared the reliability of the estimated intrinsic values from the DDM, discounted free cash flow and abnormal P/E valuation models. In their study, a regression analysis was used as well as the median and mean of signed valuation errors and absolute valuation errors. The ordinary least squares (OLS) R-squared were used to describe how much of the observed price is explained by the valuation models. It was found that the abnormal P/E valuation model was more accurate than the DDM and discounted free cash flow model in estimating the intrinsic value.

Francis *et al.* (2001) contrasted the performance of the mechanical earnings and residual income forecasts in estimating the intrinsic value. They compared the signed valuation errors of each model to measure accuracy, where the valuation error was calculated as the intrinsic value less the observed share price divided by the observed share prices at the end of the financial year for a specific company. Their study described the accuracy using the mean, standard error and median of the signed valuation error as well as the skewness of the valuation error. To measure reliability, they compared the ability of each valuation model to explain the variation in the estimated intrinsic value. This was captured using R-squared in a regression.

Courteau, Kao and Richardson (2001) compared the performance of the DCF model and the RIVM. They tested two hypotheses; the literature review will only discuss one of the hypotheses, as it is the most relevant to the researcher. The hypothesis stated that "across the versions of DCF and RIVM models that employ Value Line[15] forecasted prices in the terminal value expression, there is no difference in prediction errors" (Courteau *et al.,* 2001:636). The hypothesis was tested using the Wilcoxon signed rank test. This test is used to test the difference between the median and signed/absolute valuation errors at a 1% and 5% significance level. The hypothesis was rejected at a 1% significance level; thus, it could be said that at a 1% significance level there are differences in valuation errors for the DCF and RIVM versions that employ value line forecasted prices. This is relevant to the current study as it further confirms previous research that found that valuation models do not all perform the same.

Plennborg (2002) studied the effect of simplifying assumptions made in carrying out a valuation in a practical situation on the DDM and RIVM. His study considered assumptions about growth, weighted average cost of capital (WACC) and constant costs of equity and debt as well as the adjusted cost of equity and debt. He found that RIVM estimates intrinsic values more accurate in some cases and that it is more attractive than the DDM.

Yoo (2006) also used the mean absolute valuation error (MAVE) to analyse accuracy. His study was more comprehensive as it also looked at the IQR used by Liu *et al.* (2002a) and whose percentage valuation error was below 15%. His study deemed the valuation model with valuations errors that where below 15% to be more accurate in estimating the intrinsic value than those with errors above 15%. His study considered all three measures simultaneously because each measure has its shortcomings when the valuation error

[15] Value line is an American financial information database (Investopedia, 2011).

distribution has extreme values or skewness. What is important to note is that even though Yoo (2006) used the harmonic mean P/E ratio, his study still pre-empted the presence of skewness, whilst Liu *et al.* (2007:2) say that the use of a harmonic mean removes P/E ratio skewness.

The results of the valuation measures are tested by a t-stat to see if the differences between them are statistically significant. In his study, Yoo (2006) compared the intrinsic value found using a simple price multiple valuation model (where the intrinsic value is based on one value driver) to the intrinsic value found by combining the outcomes of several price-multiple models. He found that combining simple price-multiple models to estimate the intrinsic value may be able to improve accuracy.

Tseng and Lee (2007) evaluated the performance of equity valuation models in estimating the intrinsic value of shares from Taiwan's commercial banking industry. They compared the P/E model, P/B model, P/S model and the Black-Scholes model. With regard to the Black-Scholes model, they viewed the equity value as the call option, where the call option is the option to buy an asset at a certain price (Tseng & Lee, 2007:125). The researchers used Theil's inequality coefficient to compare the difference of each valuation model with respect to forecasting capability. The researchers found that the P/S model was the best model in estimating the intrinsic value of shares from the commercial banking sector in Taiwan.

Farooq *et al.* (2010) compared the overall performance of the RIVM, P/E, enterprise-value/sales and enterprise-value/earnings before interest tax depreciation and amortisation models in companies that had high intangible assets to those that had low intangible assets. Their study rejected the following three null hypothesises at a 5% level of significance:

- hypothesis one: "the mean value of paired valuation models is the same in both high and low intangible firms" (Farooq *et al.,* 2010:154).
- hypothesis two: "mean in absolute valuation error between the valuation models for high and low intangible firms are the same" (Farooq *et al.,* 2010:155).
- hypothesis three: "median in absolute valuation error between the valuation models for high and low intangible firms are the same" (Farooq *et al.,* 2010:156).

Farooq *et al.* (2010) concluded that RIVM gave more accurate intrinsic values for high intangible firms than the other models and that it explained around 65% of the observed share prices for high-intangible firms and 54% for low-intangible firms. The R-squared of the other valuations models were found too low for both high and low intangibles.

In conclusion, valuation models have different levels of accuracy, when compared to each other in different circumstances. The importance of the area of valuation performance is increasing and investors are getting more sophisticated and need as much information as possible to make investment decisions (Farooq *et al.,* 2010:157). The next sections look at business cycles as this is the context within which the current study aimed to compare the valuation models.

2.3 BUSINESS CYCLES

Studies have been done to compare valuation models and to examine their accuracy across countries (Liu *et al.,* 2002b), in a specific time period (Francis *et al.,* 2000), across industries in a certain market (Hickman & Petry, 1990; de Paula Neto, 2008), in emerging markets (Sehgal & Pandey, 2010; Bruner *et al.,* 2002), at initial price offering (Berkman *et al.,* 2000) and across stock exchanges (Alford, 1992; Lee *et al.,* 1999; Park & Lee, 2003).

In the Introduction, business cycles have been defined, and this is illustrated graphically in Figure 2 below and, although this is the definition used in the rest of the document, it is necessary to review what other researchers say about business cycles.

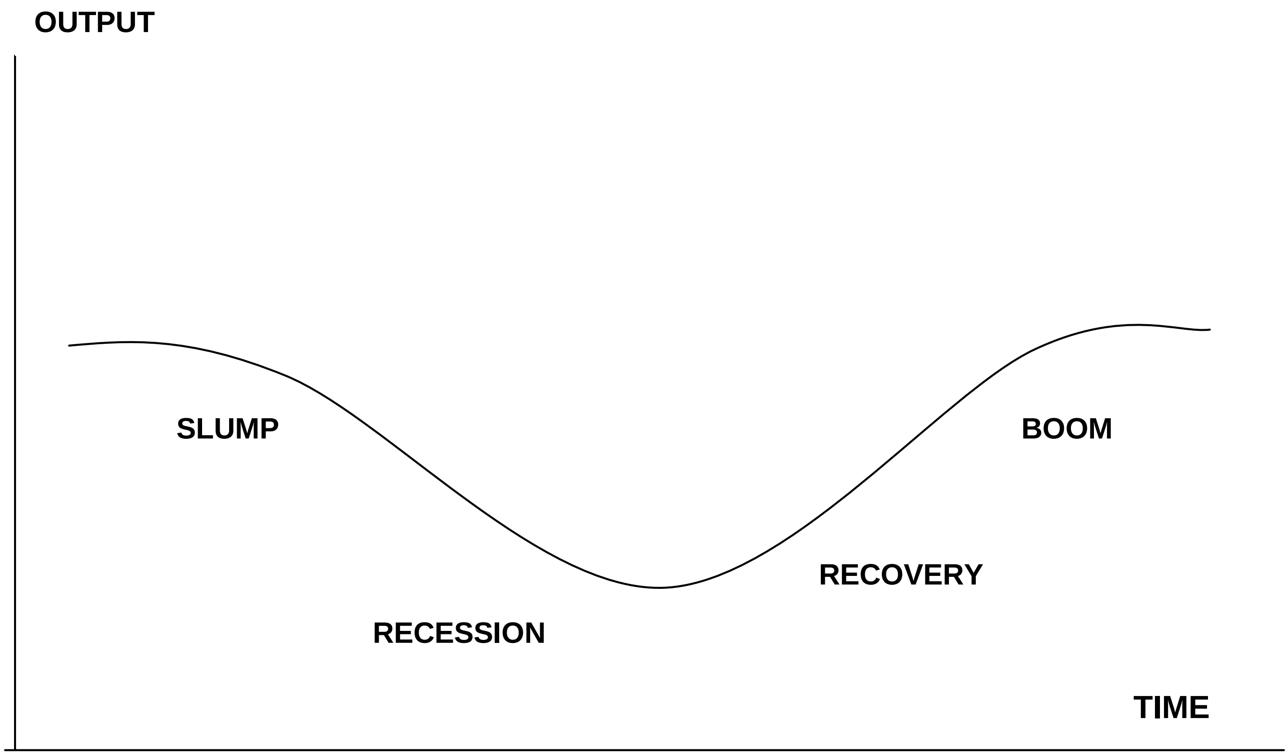

Figure 2: A graphical illustration of the business cycle

In Moore and Zarnowitz (1984:1–5), *business cycles* is defined as "recurrent sequences of expansions, downturns, contractions and upturns in a great number of diverse economic activity". These cycles are non-periodic, unsystematic (haphazard and lacking arrangement or method or organisation) and varying in duration and scope, and more than a year to ten or twelve years in duration. *Recession* is defined as "a recurring period of absolute decline in total output, income, employment and trade, usually lasting six months to a year and marked by widespread contractions in many sectors of the economy" and *boom* as "a recurring of slow growth in total output, income, employment and trade, usually lasting a year or more" (Taylor, 1998:15). Zarnowitz (1984:3) added that business cycles can be national and international in scope.

Prescott (1986:2) preferred to use a definition that states: "business cycles are the recurring fluctuation of output trend and the co-movement of other aggregate time series". Taylor (1998:1) defined it as the "evolution of the economy through time" and continued to subdivide the business cycle into four phases. The first phase is economic expansion, which is followed by economic growth above a sustainable noninflationary level. The third phase is a cyclical peak in growth, and the fourth is the trough (where growth falls). The researcher further went on to say that different types of assets perform differently during the different business cycles, for example, equity (shares) performs best during the second and fourth phases.

Johnson (1999:95) expanded on the definitions of a recession and a boom by saying that they are characterised by low growth rates and high growth rates respectively. A more recent study done in South Africa by Akinboade and Makina (2009:477) defined business cycles as recurring patterns of recession (economic downturn) and recovery (economic growth), measured by gross domestic product lasting three to five years.

Most literature on equity and business cycles deals with the selection of equity, investment timing and prediction of return. Firstly, business cycle variables are said to be able to predict stock return and variables such as the dividend yield, default spread and term spread (Lee *et al.,* 1999:1713). Fama and French (1989:48) studied the variation of expected return on stock and its negative relation to the long-term and short-term variation in business cycles. Johnson (1999) investigated the relationship of stock returns and earnings with business cycle.

Arnott and Copeland (1985) looked at how business cycles affect the effectiveness of share selection models. These are models used to estimate return, and the estimated return is then used to determine if a share should be bought or not. Their study subdivided the models into value-oriented models,[16] growth-oriented models[17] and other models (capitalisation and EPS variability models). To describe if the effectiveness of these models was affected by business cycles, the researchers looked at the information coefficient as a measure of the effectiveness of the model. The information coefficient was defined as the correlation between the estimated return and the observed return. A regression test was performed to determine which measure of the business cycle was useful in predicting the effectiveness of the models. The dependent variable was the effectiveness (information coefficient) of a share selection model at time *t* and the

[16] DDM rate of return, earnings retention rate, dividend yield and P/B ratio.
[17] Return on equity change (five year), sales growth change (five year) and EPS momentum.

independent variable, the economic measure of seasonality of available in *t*. In most of the models, effectiveness was not influenced by the business cycles.

Jensen, Mercer and Johnson (1995) observed that the variation in business cycles accounts for some change in stock returns, and the return an investor can expect from a share is pushed higher or lower as business cycles change. Choe, Masulis and Nanda (1993) observed that equity offerings across the business cycles and booms are associated with greater volumes of equity issues as well as lower undesirable selection costs, and that the opposite applies in a recession.

Lastly, Perez-Quiros and Timmermann (2001) looked at business cycles and stock returns using single-economic state and two-economic state specifications. They found that during the recession, the single-state model underestimates the size of the correlation between stock returns and business cycle variables (short-term interest and default premium). The opposite applies for a boom.

2.4 BUSINESS CYCLES IN SOUTH AFRICA DURING THE PERIOD 1994–1999

The SARB is responsible for determining the turning points of the business cycles; it has been doing this since 1946. They define business cycles based on Burns and Mitchell (1946:3) a business cycle is –

> a type of fluctuation found in the aggregate economic activity of nations that organise their work in business enterprises. A cycle consists of expansions occurring at about the same time in many economic activities, followed by similar general recessions, contractions, and revivals which merge into the expansions phase of the next cycle. This sequence of change is recurrent but not periodic; in duration business cycles vary from one year to ten years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.

Figure 3 is a graph from the SARB depicting the business cycles in South Africa between 1990 and 2004.

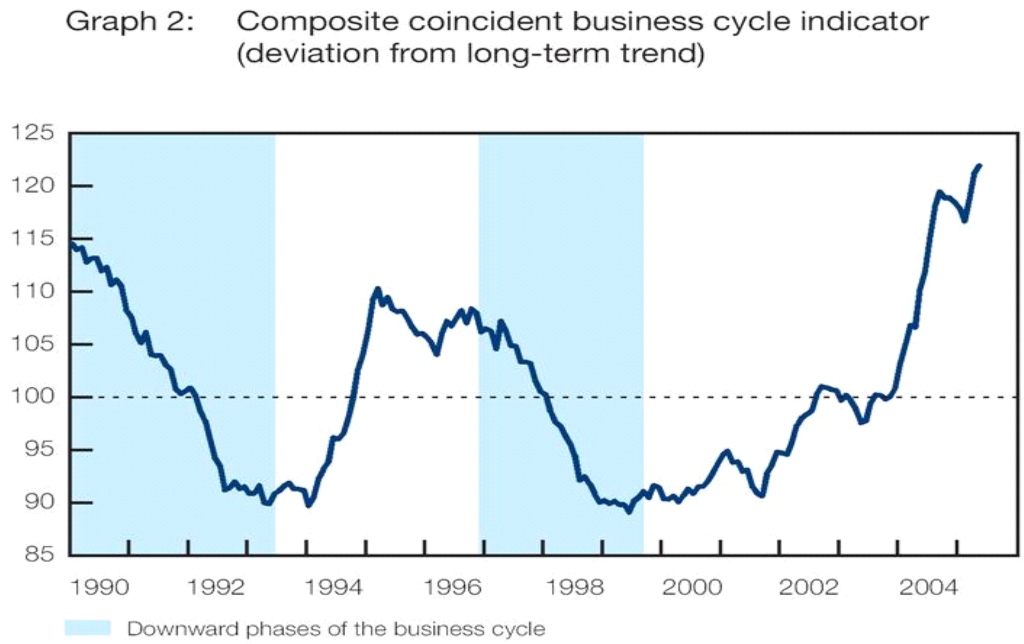

Figure 3: Graph from the SARB depicting the business cycles in South Africa between 1990 and 2004

Source: SARB 2005

In South Africa, the year 1994 marked a successful and peaceful political transition, which this was accompanied by a drop in systematic risk due to social and political factors (Du Plessis, Smit & Sturzenegger, 2007:5). As a result of the removal of trade and financial sanctions against South Africa after 1994, South Africa experienced a boom in the economy from June 1993 to November 1996. This boom was further stimulated by the slowdown in inflation and relaxation of exchange controls that improved the financial stability of the country (Pretorius, Venter & Weideman, 1999:3).

From December 1996 to August 1999, South Africa experienced a recession, which was characterised more by the deceleration in aggregate domestic demand and high levels of indebtedness. The Asian financial markets crisis and turmoil in October 1997, March 1998 and May 1998 was a contributing factor as well (Venter & Pretorius, 2001:5).

2.5 SUMMARY

The literature review discussed the definition of the DDM and the P/E model. It showed that, according to the DDM, the intrinsic value of a share is the present value of its future cash flow and also that the simpler form of the model is the constant growth model. The constant growth model is the one that was applied in this study. When discussing the P/E model, it was found that intrinsic value of a share is equal to the firm's future earning multiplied by the harmonic mean industry P/E ratio.

The discussion of the valuation models was followed by a review of methods used in describing and evaluating the performance of valuation models when estimating the intrinsic value. The review found that past researchers have used the IQR, Theil's inequality coefficient, root mean squared, the t-test, z-test, Wilcoxon test, and OLS regression analysis amongst others to describe the performance of the valuation models in terms of accuracy, explainability and bias. Comparisons were done across industries, countries stock exchanges, emerging markets and at initial price offerings.

The literature review found that studies were done on business cycles and variation in stock returns and stock selection and prediction of return and not on business cycles and valuation models that estimate the intrinsic value.

Lastly, the business cycles of South Africa during the period of 1994 to 1999 were described in terms of a boom or recession, and a graphical representation of the business cycle was given.

3 RESEARCH DESIGN AND METHODS

This chapter outlines and discusses the research methodology applied in the study. Firstly, a description of the inquiry strategy is given, followed by a discussion of the units of analysis and population. Lastly, the sampling, data collection and data analysis processes are described.

3.1 DESCRIPTION OF INQUIRY STRATEGY AND BROAD RESEARCH DESIGN

The empirical research for this study took the form of a quantitative, comparative, cross-sectional case study based on secondary data analysis. Descriptive statistics were used to report the findings of the study.

The study was quantitative by nature as it used numeric data and data analysis procedures such as graphs or statistics (Saunders, Lewis & Thornhill, 2009:151). The intrinsic values of the firm, the market price as well as the absolute valuation errors are numeric or quantitative by nature. The properties of the valuation errors were reported using descriptive statistics in order to draw inferences on the performance of the valuation models.

A comparative study focuses on the similarities and differences between two units of analysis (Mouton, 2001:154). This is in line with one of the objectives of the study, which was to draw a comparison between the performances of the two valuation models during the two phases of the business cycles (recession and boom) in South Africa. The units of analysis were the intrinsic values determined by the two valuation models, the P/E model and the DDM.

The current study took the form of a cross-sectional study as it aimed to study particular phenomena at a particular time. It therefore represented the state of those phenomena at a specific time (Saunders *et al.,* 2009:155). The study compared the performance of valuation models during the South African recession period of 1997 to 1999 and the boom period of 1994 to 1996.

A case study investigates the phenomena in their real-life context, highlighting the importance of context (Saunders *et al.,* 2009:146). This was evident in the current study because the study looked specifically at the case of South Africa and not at a global or multi-country situation.

Secondary data analysis uses existing data that has already been collected for another purpose (Saunders *et al.,* 2009:256). The researcher collected published firm share price data from McGregor BFA research domain.

3.2 UNITS OF ANALYSIS

The units of analysis in this study were the intrinsic values, while the sampling units were firms listed on the JSE throughout the period 1994 to 1999. The years 1994 to 1999 were the years during which South Africa experienced a three-year boom and a three-year recession. The intrinsic values for this study were determined using the P/E model and the DDM. The intrinsic values based on the DDM were downloaded from McGregor BFA and the P/E model intrinsic values were calculated by the researcher. This is further discussed in the data collection section.

3.3 TARGET POPULATION

The target population for this study were all firms listed on the JSE throughout the period 1994 to 1999 with positive P/E ratios thought the period of study. The study excluded firms with negative P/E from the population, as it wanted to ensure that the firms in the population would have at least one positive intrinsic value.

3.4 SAMPLING AND DATA COLLECTION PROCESS

This section discusses the sampling and data collection process. This process is subdivided into three phases. The first phase involves determining the size of the target population, the second phase deals with determining the number of firms in each industry to be included in the sample, and lastly, the third phase comprises of determining the specific firms to be included in the sample.

Sampling is the process of selecting and collecting particular data sources (Leedy & Ormrod, 2010:146). The study used stratified random sampling and generated a sample size of 30 firms. Stratified random sampling is a "modification of random sampling in which the study divides the population into two or more relevant and significant strata based on one or a number of attributes" (Saunders et *al.,* 2009:228). A sample of 30 firms should yield meaningful statistical results (Saunders *et al.,* 2009:218).

The secondary numeric data was collected from the internet research databases of McGregor BFA. The data collection time frame was two days. The following firm share data was collected from McGregor BFA: observed share prices, Gordon constant growth model intrinsic values, sustainable growth rates, earnings per share for 1993 and P/E ratios for the period 1994 to 1999.

The study began with collecting the DDM intrinsic values. During the data collection of these values, it was found that some of the values were negative. This was noted as one of the limitations of the study. Other obstacles encountered were that some companies had no dividends and this resulted in intrinsic values of zero. Such companies were not included in the final sample.

There were no obstacles encountered in the data collection process of EPS, P/E ratios and sustainable growth rate. The data collection process is elaborated on in phase three.

Phase 1

Phase 1 involved determining the number of firms in the target population. At first, the study found the number of firms listed on the JSE from 1994 to 1999 to be 109. These firms were then filtered to the number of firms listed on the JSE from 1994 to 1999 with positive P/E ratio during this period. This resulted in a final target population of 85 firms. Any statistical inference drawn from the study would only be related to this targeted population. The firms were then divided into eight main industries as shown in Table 2.

Table 2: Breakdown of target population into industry groups

	Industry	**Number of firms**
1	Basic material	18
2	Consumer goods	13
3	Consumer services	14
4	Financials	17
5	Health care	1
6	Industrials	20
7	Oils and gases	1
8	Telecommunication	1
	TOTAL	85

Phase 2

Phase 2 involved determining the number of firms from each category to include in the sample of 30 firms. Some of the industries were grouped together. The first grouping was that of the consumer goods and consumer services. These two industries were grouped together as **Consumers** because they were closely related (their industry performance is dependent on consumer behaviour). The second grouping was that of all the industries with a low number of firms, which were grouped together as **Other**. This is shown in Table 3.

Table 3: Grouping of Industry groups

	Industry	**Number of firms**
1	Basic materials	18
2	Financials	17
3	Consumers (consumer goods 13 + consumer services 14)	27
4	Industrials	20
5	Other (health care 1 + telecommunications 1 + oils and gases 1)	3
	TOTAL	85

This resulted in the study having only five industries to work with instead of eight. The study then determined what percent of the sample each industry should represent by finding the industry percentage representation in the target population, as shown in Table

4. After this, the number of firms that each industry should have in the sample was determined by multiplying the percentage representation by 30, as shown in Table 4.

Table 4: Number of firms in each industry to be included in the sample

Industry	Number of firms in target population	Percentage representation	Number of firms in sample
Basic materials	18	21%	6
Financials	17	20%	6
Consumers	27	32%	10
Industrials	20	24%	7
Other	3	3%	1
TOTAL	85	100%	30

Phase 3

Phase 3 involved determining which specific firms would be included in the sample. The following sampling criterion was used. Firms in the sample had to have:

- positive P/E ratios for the period 1994 to 1999;
- DDM intrinsic values from McGregor BFA for the period 1994 to 1999;
- EPS in 1993;
- observed share price from McGregor BFA for the period 1994 to 1999; and
- sustainable growth rates for the period 1994 to 1999.

Excel random sampling was used to find the sample of 30 firms. The steps followed to determine the final 30 firms were as follows:

- The firms were listed in alphabetical order and each firm was allocated a number between 1 and 85, Excel random sampling tool was used to sample 30 random numbers between 1 and 85. The first attempt produced 30 numbers. Within these 30 numbers, 5 numbers were repeating.
- The numbers were translated back into firms and the firms were then categorised into their specific industries. The results are reported in Table 5. Table 5 also shows what additional action was required to get the number of firms to the correct sample size of 30.

Table 5: The results of the 1st run of Excel random sampling tool

Industry	Number of firms produced by Excel	Action required
Basic material	6	None
Consumers	8	Run again to produce 2 additional firms
Financials	0	Run the excel tool again to produce 6
Industrials	10	Run sample tool on 10 firms to produce 7
Other	1	None
Total	25	

- Because the first run of the Excel sampling tool had only produced 25 firms, it was necessary to do a second and third run of the Excel random sampling to produce the required number of firms, namely 30 (this is shown in detail in Appendix A). The third run resulted in the preliminary sample of 30 firms that would be used for data collection.
- Table 6 below summarises the data collection process and the exclusion of some firms from the sample because of missing data. This is shown in detail in Appendix A.

Table 6: Summary of the data collection process

Industry	Number of firms produced by Excel	Obstacles	Action required	Result
Basic material	6	*	4 #	✓
Consumers	10	*	5 #	✓
Financials	6	*	3 #	✓
Industrials	7	*	1 #	✓
Other	1	N/A	N/A	✓
Total	30			✓

The explanations of the notation used in this table follow below.

Explanation

***** Firms did not have dividends for the years under observation (1994–1999), and McGregor was unable to estimate DDM intrinsic value.

\# Run Excel random sampling tool on the industry to replace the number of firms affected (N = 1-5).

(N = 1-5) # The number of firms that need to be replaced by an additional run of the excel random sampling tool.

✓ Firms replaced; no further action required.

N/A Not applicable.

3.5 DATA ANALYSIS

The extent of the deviation of the intrinsic value from the observed share price is the valuation error (Lee *et al.*, 1999:1697). This error is used in most studies to evaluate the performance of valuation models. Valuation performance refers to how close valuations based on valuation models are to the market share price (Liu *et al.,* 1997:1). Absolute valuation errors measure how close to zero the valuation based on the valuation model is without taking into account whether the deviation was positive or negative (de Paula Neto, 2008:8). The current study evaluated and described the performance of the valuation models by analysing the statistical qualities and characteristics of the absolute valuation errors of each model across the two phases of the business cycle (boom and recession).

3.5.1 Absolute valuation errors

To illustrate how accurate the intrinsic value estimates are, indicating how close to zero the error is, the absolute valuation error was used. The absolute valuation error was found as follows: $AVE_{i,y} = \frac{\left|V_{i,t} - P_{i,t}\right|}{P_{i,t}}$

where

$AVE_{i,t}$ = the absolute valuation error for firm *i* at time *t*

$V_{i,t}$ = the estimated intrinsic value for firm *i* at time *t*

$P_{i,t}$ = The observed share value for firm *i* at time

To determine the input figures ($V_{i,t}$ and $P_{i,t}$) needed to calculate absolute valuation errors the researcher followed the following steps:

- Downloaded observed prices from McGregor BFA database. The observed price was defined as the closing price of the share in December of that year, which as denoted as $P_{i,t}$ in the study. The yearly closing price was used because past research also used the closing price. Alford (1992:99) used the closing price at the end of April. Park and Lee (2003:333) used the average daily closing price. Sehgal and Pandey (2010) used the closing price. Berkman *et al.* (2000:74), who evaluated the accuracy of the DDM and the P/E model when valuing an initial price offering, used the closing price on the day of the offering. The closing dates for the 1994–1999 are listed in Table 7 below.

Table 7: The closing date of the JSE

Year	Closing date
1994	30 December
1995	29 December
1996	31 December
1997	31 December
1998	31 December
1999	29 December

- Downloaded intrinsic values for the DDM, from McGregor BFA database were denoted as: $V_{i,t}$. The intrinsic value based on DDM were downloaded on the 21st and 23rd of November 2011. These intrinsic values were assumed to be a reasonable reflection of the intrinsic value according to the DDM.

- Calculated intrinsic values for the P/E model were as follows: $V_{i,t} = \frac{P}{E} t \times EPS_t$

where

$V_{i,t}$ = the intrinsic value (also known as the theoretical price of the share)

$\frac{P}{E}t$ = harmonic mean industry P/E ratio at time *t*

EPS_t = forecasted earnings per share for time *t*

- The harmonic mean industry P/E ratio was calculated as follows:

$$\frac{1}{\frac{1}{n}\times\sum_{j=1}^{n}\frac{P}{E}j}$$

where: $\frac{P}{E}j$ = the P/E ratio for company j in a specific industry

n = the number of companies in industry j

- Forecasted earnings were calculated as follows: $EPS_t = EPS_{t-1}\times(1+g)$

where: g = the growth rate in time *t*

EPS_t = following year's earnings per share

EPS_{t-1} = previous year's earnings per share

3.5.1.1 *Outliers*

Once the absolute valuation errors had been found, the study discovered some outliers. Outliers are data points that are far outside the norm for a variable or population, in other words, data points that arouse suspicion or are questionable to the eye (Osborne, 2004:1).

Outliers include erroneous and extreme data points. Researchers may correct the mistake if the outlier was caused by an error. If the data point is an extreme value but not technically wrong, the researcher may accommodate or remove the outlier. If the outlier is accommodated, then the impact of that data point is reduced. It is however much simpler for the researcher to simply remove the outlier from consideration (George, 1995:175).

Due to the size of this study (mini-dissertation), the researcher simply decided to remove the outliers. Table 8 below shows the exclusion criteria for each valuation model. Appendix B gives a complete list of the valuation errors affected and also indicates from which industry, year and company they were.

Table 8: Outliers in the data set and the exclusion criteria of data points

Valuation model	Exclusion criteria	Number of affected data points in the period of study 1994–1999
P/E model	All valuation errors above 2	17 of 180
DDM	All valuation errors above 10	8 of 180

The outliers in the study were distorting the descriptive statistics and were making some of them unacceptably high. Most of the outliers for the P/E model were in the recession period (1997–1999), and for the DDM they were in the boom period 1994–1996. The highest outlier of 798 was from the basic material group in the DDM.

Only unacceptably high data points were removed as outliers from the data sets (absolute valuation errors of the P/E model and the DDM).

3.5.2 Statistical analysis

Once the absolute valuation errors had been determined, the following main descriptive statistics of each valuation model were calculated using excel and SPSS.[18] This is presented and discussed in Chapter 4. Several descriptive statistics were used as they measure the magnitude of the valuation error differently. The use of several descriptive statistics simultaneously is beneficial because each measure has its shortcomings when the valuation error distribution has extreme values or skewness (Yoo, 2006:115).

The dispersion and central tendency of the valuation errors of each model are described. To compare the dispersion of the valuation models to each other, the coefficient of variation is used. The percentage improvement of the IQR of the absolute valuation errors across valuation models is discussed and compared. The difference between the absolute valuation errors across business cycles is tested for statistical significance using the Wilcoxon test and Kruskal-Wallis test. Lastly, the Theil inequality coefficient is calculated and used to describe the efficiency of the valuation model in estimating the intrinsic value.

[18] Statistical Package for the Social Sciences (SPSS) is a statistical computer program.

- **Coefficient of variation**

Coefficient of variation is a measure of relative dispersion. It is used in this study to describe which valuation model has the least dispersed absolute valuation errors. It is calculated as the standard deviation divided by the mean: $CV = \frac{s}{x}$ (Diamantopoulos & Schlegelmilch, 1997:104).

- **Percentage improvement in the inter-quartile range (% IMP)**

%IMP is the percentage decrease in the inter-quartile range (Liu *et al.,* 2002b:9). It is calculated as follows: $\%IMP = 100\% \times (IQR1 - IQR2) / IQR1$

where: IQR 1 = IQR of ranked absolute valuation errors for the DDM or P/E in a boom

IQR 2 = IQR of ranked absolute valuation errors for the DDM or P/E in a recession.

The current research used this value to illustrate whether the performance of a valuation model improves when the business cycles changes from a boom to a recession or whether it does not improve. A decrease in the %IMP was classified as an improvement and an increase as a lack of improvement.

- **Wilcoxon test and Kruskal-Wallis test**

A test for normality was conducted to determine if non-parametric or parametric test statistics had to be used to test the null hypothesis. Table 9 shows the results of the test of normality for both valuation models. The null hypothesis for the DDM was "the distribution of the absolute valuation errors of the DDM with the mean of 1.66 and the standard deviation of 1.76 is normal". This was rejected at a 5% level of significance. The null hypothesis for the P/E model was "the distribution of the absolute valuation errors of the P/E model with the mean of 0.79 and the standard deviation of 0.26 is normal". This was also rejected at a 5% level of significance. The conclusion of the test was that the absolute valuation errors of the DDM and the P/E model were not normally distributed.

Table 9: The results of the test for normality: DDM and P/E model

DDM model

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of pe is normal with mean 0.79 and standard deviation 0.26.	One-Sample Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

P/E model

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of ddm is normal with mean 1.66 and standard deviation 1.76.	One-Sample Kolmogorov-Smirnov Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Once it was determined that none of the data set was not normally distributed, two nonparametric tests were used, namely the Wilcoxon test and Kruskal-Wallis to test whether the difference between the absolute valuation errors of the valuation model (DDM or P/E) across the two phases of the business cycle (boom and recessions) were statistically significant. The null hypothesis was not rejected or rejected at a 5% level of significance. The Wilcoxon test, Kruskal-Wallis test and the null hypothesis for both tests are discussed below.

- **<u>Wilcoxon test</u>**

The Wilcoxon test is a non-parametric test that provides an alternative to the t-test when data is not normally distributed. It compares the differences between two groups according to their rank-ordered values and does not require the data sets to have the same number of observations (Rubin, 2007:254). It tests whether the two samples have identical distributions and whether the difference in the ranks between the two groups is statistically significant. If the result is significant then the samples are different from each other (Miller & Miller, 2004:529).

- **Kruskal-Wallis test**

The Kruskal-Wallis test is an alternative test to the one-way variance test. It is a non-parametric test that tests whether *k* samples are from an identical distribution. This test, like the Wilcoxon test, does not assume that the sample is normally distributed. If the result is significant then the samples are different from each other (Miller & Miller, 2004:533).

- **Null hypothesis**

The null hypothesis for the study across the Wilcoxon test and Kruskal-Wallis test is: The difference between the absolute valuation errors of the valuation model (DDM or P/E) across the two business cycles (boom and recessions) is not statistically significant.

The null hypothesis could rejected or not rejected at a 5% level of significance. The study chose to reject the null hypothesis, and found that there was a statistical difference between the absolute valuation errors of valuation models across business cycles.

- **Theil's inequality coefficient**

Theil's inequality coefficient lies between 0 and 1, and describes how well the model estimated the intrinsic value. If Theil's inequality coefficient is 0, then the model estimated the intrinsic value perfectly, if it is 1 then there is perfect inequality or negative proportionality between the observed share price and the intrinsic value (Leuthold, 1975:344). It is calculated as follows: $\frac{\sqrt{\sum (P_{i,t} - V_{i,t})^2}}{\sqrt{\sum P_{i,t}^{\ 2}} + \sqrt{\sum V_{i,t}^{\ 2}}}$

where: $V_{i,t}$ = the intrinsic value (also known as the theoretical price of the share)

$P_{i,t}$ = the observed share price

The researcher wanted to minimise the coefficient. The valuation model with the lower coefficient was therefore regarded as the valuation model that explains the intrinsic value more efficiently than the other.

3.6 ASSUMPTIONS AND LIMITATIONS

3.6.1 Assumptions

The research was based on the following set of assumptions:

- the intrinsic values based on the DDM downloaded from McGregor BFA are assumed to be correct and reflecting the true intrinsic value for this valuation model;
- the markets are efficient; and
- the closing price (observed price) of a share on the JSE at close in December is comparable to its intrinsic value estimated by the DDM and P/E model.

3.6.2 Limitations

Limitations applicable to the research and the possible effects thereof on the interpretation of the results were:

- Firstly, the study only considered South African firms listed on the JSE during the period 1994 to 1999 with positive P/E ratios as the target population.
- Secondly, all assumptions made by McGregor BFA in calculating the intrinsic value became the assumptions of this study.
  - These were assumptions on:
    - Market return
      - market return of 6% was used for all the intrinsic value calculations.
    - Sustainable growth
      - was calculated as the return on equity (ROE) multiplied by the retention rate.
    - Required rate of return
      - was calculated using the R157 bond return rate on the day of data collection as the risk-free rate; and
      - was kept constant for each company over the years 1994–1999.
- Some of the intrinsic values based DDM downloaded from McGregor were negative.
- The study only removed unacceptably high data points as outliers from the valuation errors. It further accepted that low valuation errors do not arouse suspicion because a small valuation error can be interpreted as a small deviation of

the intrinsic value from the observed price. In addition, the valuation model's ability to estimate the intrinsic value can be seen as being close to accurate (a valuation error is the extent of the deviation of the intrinsic value from the observed price and is used to measure accuracy, bias and explainability (Lee *et al.,* 1999:1967).

- The P/E model data set was negatively skewed. Not removing the low absolute valuation errors would affect the calculation of the %IMP. The %IMP would be fairly large as the difference in Q3 and Q1 is large, and this would affect the comparison of the %IMP of the models.
- The results of this study cannot be used to create a general opinion about the valuation model's performance across:
  - the whole JSE;
  - shares not included in the target population; and
  - years not included in the study.

3.7 ASSESSING AND DEMONSTRATING THE QUALITY AND RIGOUR OF THE RESEARCH DESIGN

Data quality issues regarding the use of secondary data from an internet source can be related to validity and reliability (Saunders *et al.,* 2009:273). Reliability and validity are ways of showing the rigour and trustworthiness of the research process and findings (Roberts & Priest, 2006:41). Reliability is the ability of a measurement tool to measure consistently, yielding a similar measurement in a similar situation (Winter, 2000:2), while validity is the ability of a tool to provide relevant information needed to answer the research question (Saunders *et al.,* 2009:273).

The reliability and validity concerns of the study are attributed to secondary data and the result of the method of data collection and the source of the data. The secondary data of the study was collected from McGregor BFA research database, which is unlikely to contain bias and measurement error. McGregor BFA prides itself in the integrity of its data and its data is used by academic and corporate markets at large (McGregor BFA, 2010). Measurement bias can occur for two reasons, namely intentional distortion of data and changes in the way data is collected (Saunders *et al.,* 2009:277). According to Saunders *et al.* (2009:274), the reputation and continuous existence of a database/organisation is dependent on the credibility of its data, McGregor BFA was founded in 1986 and its continuous existence and the fact that it is widely used make it a credible source of secondary data.

3.8 SUMMARY

This chapter dealt with the research methodology of the study. It started with the description of the method of inquiry and broad research design. The target population and units of analysis where defined. The sampling and data process was explained. This involved three main phases.

Phase 1 involved determining the size of the target population, Phase 2 determined the number of firms in each industry to be included in the sample and, lastly, Phase 3 determined the specific firms to be included in the sample. Some firms had to be excluded from the sample because of missing data, such as dividends, making it impossible to find the intrinsic value using the DDM. These firms were removed and replaced by firms from the same industry. Further elaboration is given in Appendix A.

In the data analysis section, the absolute valuation errors were explained. The input values used to determine the absolute valuation errors were also explained. These input values were the observed price (defined as the closing price) and the intrinsic values from the DDM and the P/E model. This section also provided a discussion of how the intrinsic values of the P/E model were calculated and how those of the DDM were downloaded from McGregor database. Once the absolute valuation errors were calculated, it was found that the data sets had outliers. An exclusion criterion for the outliers in the DDM and the P/E model was therefore established, and the outliers were removed from the data set.

The statistical analysis section described and explained the descriptive statistics that was used to reach a conclusion on the performance of the valuation models. These included the %IMP, coefficient of variation, the Wilcoxon test, Kruskal-Wallis test and Theil's inequality coefficient. Chapter 4 will summarise and discuss the empirical results of the study.

4 RESULTS AND DISCUSSION OF RESULTS

The purpose of this chapter is to report on and discuss the results of the data analysis. The results of the DDM are discussed, followed by the results of the P/E model, and lastly a comparison is made between the valuation performances of the two models.

4.1 DIVIDEND DISCOUNT MODEL

Table 10 contains the measures of dispersion and measures of central tendency as well as other sample descriptive statistics for the DDM. The respective statistics are grouped into the overall period of 1994–1999, the boom and the recession. The difference in boom and recession period sample size was caused by the removal of the outliers. The initial sample size was 90. As the data was positively skewed, the outliers were mainly in the right tail. The descriptive statistic of the DDM valuation model can be used to further justify that the absolute valuation errors were not normally distributed. The kurtosis[19] of a normal distribution is 3, while that of the DDM data set distribution was above 3 for the overall period, the boom and the recession. The skewness[20] of a normal distribution is 0, while that of all the periods for the DDM was larger than 0. When a data set is normally distributed the mean, mode and median are equal, which was not the case for the DDM absolute valuation errors.

The measures of the central tendency of absolute valuation errors of the boom and recession period were not far from each other. The median and mode of the recession period were less than those of the boom period, while the mean was larger. The absolute valuation errors of the recession period were more dispersed than those of the boom with a standard deviation of 1.82 for the recession period compared to 1.71 for the boom period. The recession period's absolute valuation errors had a lower range than those of

[19] The kurtosis of a distribution curve is the degree to which a distribution curve is relatively peaked or flat. This degree depends on the size of the distribution curve's standard deviation relative to its mean and its range. The kurtosis of a normal distribution is zero (Rubin, 2007:68).
[20] A skewed distribution is one that has values that fall more on one side than on the other side of the mean. The imbalance creates a difference between the mean and the median. A distribution can be negatively or positively skewed. A normal distribution is asymmetric giving it a skewness of zero (Rubin, 2007:64).

the boom, as well as a lower degree of kurtosis. Although both data sets were positively skewed, the recession period was less skewed than the boom.

Table 10: DDM descriptive statistics

Descriptive statistic	Overall	Recession	Boom
Mean	1.659998	1.716996	1.602330
Standard error	0.134645	0.196211	0.185253
Median	1.000000	0.998716	1.001449
Mode	0.526056	0.526056	0.672727
Standard deviation	1.760718	1.819583	1.707946
Sample variance	3.100128	3.310881	2.917081
Kurtosis	5.295546	3.788515	7.676641
Skewness	2.253449	2.030613	2.557697
Range	9.604507	8.257374	9.538089
Minimum	0.018182	0.018182	0.084600
Maximum	9.622689	8.275556	9.622689
Sum	283.8597	147.6617	136.1981
Count (N)	171	86	85

Theil's inequality coefficient shown in Table 11 for the DDM lay between 0 and 1 for the overall period, the boom and the recession periods. The DDM was most efficient in forecasting intrinsic values in the boom period. There was an increase in the IQR from the boom to the recession period. This is shown by the positive %IMP in Table 12. From this it can be deduce that DDM valuation performance did not improve when business cycles changed from boom to recession although the difference was low.

Table 11: DDM Theil's inequality coefficient

Statistic	Overall	Recession	Boom
Theil's inequality coefficient	0.9838	0.9902	0.8008

Table 12: DDM %IMP

	Recession	Boom
Q3	2.1124	1.932494
Q1	0.623451	0.643975
IQR	1.488949	1.288519
%IMP	13.46%	

Once it was found that the DDM absolute valuation errors data set was not normally distributed, the Wilcoxon and Kruskal-Wallis test were used to test whether the difference between the absolute valuation errors of the DDM across the two phases of the business cycle (boom and recessions) was statistically significant at a 5% level. Table 13 summarises the hypothesis used for the Wilcoxon and Kruskal-Wallis test for the DDM, as well as other test notation.

Table 13: The Wilcoxon test and Kruskal-Wallis test hypothesis for the DDM and other test notations

Notations

Period 1	Boom
Period 2	Recession
Data sets-	Absolute valuation errors of each model

Hypotheses

Null: The difference between the absolute valuation errors of the DDM across the two phases of the business cycle (boom and recessions) is not statistically significant.

Alternative: The difference between the absolute valuation errors of the DDM across the two phases of the business cycle (boom and recessions) is statistically significant.

Both the Wilcoxon test and Kruskal-Wallis test found that differences between the absolute valuation errors of the DDM across the two phases of the business cycle (boom and recessions) were not statistically significant at a 5% level. The null hypothesis could therefore not be rejected. The results of the Wilcoxon test and Kruskal-Wallis test are shown in Tables 14 and 15.

Table 14: DDM Wilcoxon test results

Ranks

Period	N	Mean rank	Sum of ranks
1	85	85.21	7243
2	86	86.78	7463
Total	171		

Test statistics[a]

Wilcoxon W	7243
Z	-0.207
Asymp. Sig. (2-tailed)	0.836
a. Grouping variable: Period	

Table 15: DDM Kruskal-Wallis test results

Ranks

Period	N	Mean rank
1	85	85.21
2	86	86.78
Total	171	

Test statistics[a,b]

Chi-square	0.043
df	1
Asymp. Sig.	0.836
a. Kruskal Wallis test	
b. Grouping variable: Period	

There was no statistical difference between the absolute valuation error of the DDM and the %IMP was 13.46%. It was concluded that the DDM provides similar absolute valuation errors across the two business cycles (boom and recession). According to Theil's inequality coefficient, the DDM is more efficient in estimating the intrinsic value in the boom period. The absolute valuation errors of the boom period were less dispersed than those of the recession period. Furthermore, they had a lower IQR and mean compared to the recession period. In the next section, the results of the P/E model are discussed.

4.2 PRICE EARNINGS MODEL

Table 16 contains the measures of dispersion and measures of central tendency as well as other sample descriptive statistics for the P/E model. The grouping of results is identical to that of the DDM, and the results are grouped into the overall period, the boom and the recession periods. Since both data sets (DDM data set and P/E model data set) were found to be not normal it is necessary to state for the P/E model also that its kurtosis, skewness and the relationship between the mean, mode and median reaffirm this finding. The kurtosis of the P/E model was below 3 for the overall period and the recession while it was above 3 for the boom. The overall period and the boom period were negatively skewed, while the recession was positively skewed. None of the data sets for the overall period, the boom and the recession had mode, while the median and mean of all the periods were not equal. Although the outliers of the P/E model for the overall period were mainly in the left tail, the study only removed outliers that were unacceptably high (this was stated as a potential limitation of the study). The outliers that were unacceptably high were found mainly in the recession period.

The absolute valuation errors of the recession period were more dispersed than those of the boom period. The range of the absolute valuation errors for the recession period was larger than that of the boom period. While the recession period had a positively skewed data set, the boom period had a negatively skewed data set and a higher kurtosis.

Table 16: P/E model descriptive statistics

Descriptive statistic	Overall	Recession	Boom
Mean	0.793764183	0.696486729	0.874647
Standard error	0.020499732	0.037906268	0.016188
Median	0.868916736	0.670695618	0.943062
Mode	#N/A	#N/A	#N/A
Standard deviation	0.26172306	0.326082044	0.152714
Sample variance	0.06849896	0.106329499	0.023321
Kurtosis	1.989321318	1.744128984	3.249839
Skewness	-0.249644566	0.666724703	-1.85984
Range	1.7116	1.7116	0.731953

Minimum	0.0636	0.0636	0.268735
Maximum	1.7752	1.7752	1.000688
Sum	129.3835618	51.54001798	77.84354
Count	163	74	89

Theil's inequality coefficient for the P/E model in Table 17 lay between 0 and 1 for the overall period, the boom and the recession periods. The P/E model was most efficient in forecasting intrinsic values in the recession period. There was an increase in the IQR from the boom to the recession. This is showed by the positive %IMP in Table 18. From this it can be deduced that the P/E model's valuation performance did not improve when estimating intrinsic values in recession from a boom, and that the difference between the two coefficients was significant.

Table 17: P/E model Theil's inequality coefficients

Statistic	**Overall**	**Recession**	**Boom**
Theil's coefficient	0.6227	0.5844	0.8841

Table 18: P/E model %IMP

	Recession	**Boom**
Q3	0.8597	0.9732
Q1	0.5122	0.8560
IQR	0.3475	0.1172
%IMP	66.28%	

The Wilcoxon test and Kruskal-Wallis test to test whether the difference between the absolute valuation errors of the valuation model across the two business cycles (boom and recessions) was statistically significant at a 5% level were also conducted on the P/E model data set. Both test found that the difference was statistically significant. The null hypothesis was thus rejected at a 5% level of significance. Table 19 shows the test hypothesis for both the Wilcoxon test and Kruskal-Wallis test and Tables 20 and 21 show the results of the Wilcoxon test and Kruskal-Wallis test respectively.

Table 19: The Wilcoxon test and Kruskal-Wallis test hypothesis for the P/E model and other test notations

Notations

Period 1	Boom
Period 2	Recession
Data sets-	Absolute valuation errors of each model

Hypothesis

Null: The difference between the absolute valuation errors of the P/E model across the two phases of the business cycle (boom and recessions) is not statistically significant.

Alternative: The difference between the absolute valuation errors of the P/E model across the two phases of the business cycle (boom and recessions) is statistically significant.

Table 20: P/E model Wilcoxon test results

Ranks

Period	N	Mean rank	Sum of ranks
1	89	100.63	8956.00
2	74	59.59	4410.00
Total			

Test statistics[a]

Wilcoxon W	4410
Z	-5.526
Asymp. Sig. (2-tailed)	0.000
a. Grouping variable: Period	

Table 21: P/E model Kruskal-Wallis test results

Ranks

Period	N	Mean rank
1	89	100.63
2	74	59.59
Total	163	

Test statistics[a,b]

Chi-square	30.541
df	1
Asymp. Sig.	0.000
a. Kruskal Wallis Test	
b. Grouping variable: period	

There was a statistical difference between the absolute valuation errors of the P/E model, and the %IMP had a high value of 66.28%. According to Theil's inequality coefficient, the P/E model is more efficient in estimating the intrinsic value in the recession period than the boom period. In the research reported here, the absolute valuation errors of the boom period were less dispersed. They had a lower IQR and mean compared to the recession period. It was therefore concluded that the absolute valuation errors of the P/E model were different across the business cycle (boom and recession) and that its ability to estimate the intrinsic value was not the same across business cycles.

In the last two sections, the performance of each individual model is discussed. In the section to follow the study draws a comparison of the valuation models.

4.3 COMPARISON OF THE PERFORMANCE OF THE DDM AND P/E MODEL

Table 22 forms the introduction for the comparison of the two valuation models. It contains the Wilcoxon test, which was used to test whether the difference between the absolute valuation errors of the DDM and the P/E model for the overall period under study was statistically significant at a 5% level. From the test, it was found that the difference between the valuation errors of the two models was statistically significant. It is important to note that there was considerable difference between the sample sizes. This was the result of removing outliers.

The individual Wilcoxon test and Kruskal-Wallis test of each model found that the difference between the absolute valuation errors of the DDM across the two phases of the business cycle (boom and recession) was not statistically significant while that of the P/E was significant.

Table 22: The Wilcoxon test – testing the difference between the absolute valuation errors between the DDM and P/E model

Valuation model	N	Mean rank	Sum of ranks
DDM	171	193.12	33023
P/E	163	140.63	22922
Total	334		

Test statistics[a]

	value
Mann-Whitney U	9556
Wilcoxon W	22922
Z	-4.966
Asymp. Sig. (2-tailed)	0

a. Grouping variable: DDM or P/E

When looking at the %IMP, it was found that there was no improvement of performance by either model when the economic condition changed from boom to recession. Instead, there was an increase in the IQR, resulting in a positive %IMP of 13.46% for the DDM and 66.28% for the P/E model. The low %IMP of the DDM is an indication that the difference in the absolute valuation errors of the DDM was low across business cycles. This is in line with the statistical result of the difference not being statistically significant. The opposite can be said about the P/E model, namely that the difference between the absolute valuation errors was high at 66.28% and was statically significant.

According to Theil's inequality coefficient, the DDM was more efficient in estimating the intrinsic values in the boom period than in its estimation in the recession period. The P/E model was more efficient in the recession period than in its boom period. Overall it was found that Theil's inequality coefficient was 0.9838 and 0.6227 for the DDM and the P/E model respectively. From this we can conclude that the P/E model is more efficient than the DDM overall. The difference between the P/E model's Theil's inequality coefficients was larger than that of the DDM. In the recession period, the coefficient for the P/E model was 0.55844 and in the boom, it was 0.8841, while it was 0.9902 and 0.8008 respectively for the DDM.

Since it is challenging to compare the means and standard deviations to each other, the study preferred to use the coefficient of variation (CV) as shown in Table 23. The absolute valuation errors of the P/E model were less variable and dispersed than those of the DDM. The level of dispersion of the P/E model increased by a large margin when the business cycles changed from boom to recession, while those of the DDM decreased by a very small margin.

Table 23: Comparative descriptive statistics of the valuation models

Valuation model	Descriptive statistics	Overall	Recession	Boom
DDM	Coefficient of variation	1.060675	1.059748	1.065914
P/E model	Coefficient of variation	0.329723947	0.468181274	0.1746

It is interesting to note that for both valuation models, the recession period had a higher standard deviation than the boom period and higher mean.

In the next section, a conclusion is formulated as to which model performed best, after which recommendations are made.

5 CONCLUSION AND RECOMMENDATION

The performance of the valuation models was described and evaluated in this study, after which the performance of the models was compared.

The study found that there was little difference in the way the DDM performs across the two business cycles. The measures of central tendency were not far from each other and the valuation errors during both periods were positively skewed. The %IMP was 13.62%, which indicated that there was no improvement in performance when business cycles changed. The change was small, and according to the Wilcoxon test and Kruskal-Wallis test, it was also not statically significant. It can be concluded that the DDM did not perform any better in different business cycles.

For the P/E model, absolute valuation errors for the two business cycles had distinctly different characteristics. The mean and the median of the boom were higher than those during the recession, while the range, the IQR and the standard deviation of the boom were lower than those of the recession period. The absolute valuation errors for the recession period were more dispersed than those of the boom period. The %IMP was 66.28%, which is fairly high. This showed that there was a large change in the IQR when business cycles changed. The difference between the absolute valuation errors of the P/E model across the two business cycles was statically significant. From this, it can be concluded that performance of the P/E model changes with business cycles. In terms of Theil's inequality coefficient, the P/E model was more efficient in estimating the intrinsic value in the recession period compared to the boom period.

The Wilcoxon test found that there was a statistical difference between the absolute valuation errors of the P/E model compared to those of the DDM. Furthermore, the DDM model was found to be more dispersed than the P/E model and less efficient in estimating the intrinsic value.

The study recommends that future research be done to investigate and measure the business cycle's ability to explain the intrinsic value.

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6 APPENDICES

APPENDIX A

Table 24: The sampling and data collection process

Sampling and data collection process

PHASE 1

Phase 1 involved determining the number of firms in the target population. The study first found the number of firms listed on the JSE from 1994 to 1999 as 109. These firms were then filtered to the number of firms listed on the JSE from 1994 to 1999 with positive a P/E ratio during this period. This resulted in a final population of 85. It was decided that the target population was 85 and any statistical inference drawn from the study would only relate to this targeted population.

Initial target population firms listed on the JSE for the period (1994–1999)		109
Firms with a positive P/E ratio for whole period (TOTAL)	Industry	85
	Basic material	18
	Consumer goods	13
	Consumer services	14
	Financials	17
	Health care	1
	Industrials	20
	Oils and gases	1
	Telecommunication	1

PHASE 2

Phase 2 involved determining the number of firms from each category to include in the sample of 30 firms. The study first combined some of the industries. Consumer goods and consumer services were grouped together as **Consumers** because they were closely related. All the industries with a low number of firms were grouped together as **Other**.

Therefore the industry groups were as follows	Basic materials	18
	Financials	17
	Consumers (consumer goods and consumer services)	27
	Industrials	20
	Other (health care, oils and gases, telecommunications)r	3
		85

This resulted in the study having only five categories to work with instead of eight. The next step was to determine what percent of the sample each industry should represent. This was done by finding the industry percentage representation in the target population. Following this, the number of firms that each industry had to have in the sample was determined by multiplying the percentage representation by 30.

	Number of firms in targeted population	Sampling percentage	Number of firms in sample
Basic materials	18	21	6
Financials	17	20	6
Consumer goods and consumer services	27	32	10
Industrials	20	24	7
Health care, oils and gases, telecommunications and other	3	4	1
	85	100	30

PHASE 3

Phase 3 involved determining which specific firms would be included in the sample. The following sampling criterion was used: firms in the sample must have:

- Positive P/E ratios for the period 1994 to 1999
- DDM intrinsic values from McGregor BFA
- EPS in 1993
- Observed share price from McGregor BFA
- Sustainable growth rates

Excel random sampling was used to find the sample of 30 firms. The steps below were followed to get to the final 30 firms:

- The firms were listed in alphabetical order and each firm was allocated a number between 1 and 85. The Excel random sampling tool was used to sample 30 firms. This produced 30 firms. Some firms were repeating and were therefore removed. The sample ended up with 25 firms.

1st sample run from population

The 1st random sample run produced six Basic material firms, which was the number needed by the sample. No financial firm was produced, so the sampling tool needed to be run gain. Eight Consumers were produced, so the tool had to be run again to produce an additional two firms. Ten Industrial companies were produced and the study only needed weven. The sample tool was run on the ten firms to produce seven. The first run on the ten Industrial firms produced four firms and the second run produced three.

2nd sample run from population

The second run produced five Financial firms, but the study needed six so a 3rd run was necessary to produce one additional firm for the Financials group. In the Consumers group,

	11 firms were produced and the study needed two, so the sample of 11 was taken and two random firms were found.
3rd sample run from population	The sample produced five Financial firms from which another random sample was run to produce one firm.

After the sampling process with 30 firms, the data collection process was started. The study started collecting the DDM intrinsic values. During this process, it was discovered that some firms did not have complete data for essential figures such as dividends and sustainable growth (G), and thus McGregor BFA was unable to calculate the DDM intrinsic values. These firms were excluded from the sample and replaced. No obstacles were found in the data collection of the group Other.

In replacing disqualified firms, the study randomly sampled the number of firms needed from the industry population group and not the full population. This can be viewed as a limitation of the study.

Colour category	Key
Red	Firms in initial sample
Yellow	Firms produced to replace disqualified firms from initial sample
Green	Firms produced to replace yellow category firms
Blue	Firms produced to replace green category firms

	INDUSTRY	FIRM	REASON FOR EXCLUSION	REPLACED BY
1	BASIC MATERIAL	AECI LIMITED		
2	BASIC MATERIAL	AFRICAN OXYGEN LIMITED		
3	BASIC MATERIAL	AFRICAN RAINBOW LIMITED		
4	BASIC MATERIAL	ANGLOPLAT	NO DIVIDENDS	GREEN
5	BASIC MATERIAL	ANGLO		
6	BASIC MATERIAL	ANGGOLD	NO DIVIDENDS	YELLOW
7	BASIC MATERIAL	ARCELORMITTAL SA LTD		
8	BASIC MATERIAL	DELTA EMD LTD		
9	BASIC MATERIAL	EVRAZ HIGHVELD STEEL AND VANADIUM LTD		
10	BASIC MATERIAL	HWANGE COLLIERY COMPANY LTD		
11	BASIC MATERIAL	IMPALA PLATINUM HD LTD		
12	BASIC MATERIAL	LONMIN PLC	NO DIVIDENDS	YELLOW
13	BASIC MATERIAL	OMNIA HLDS LTD		
14	BASIC MATERIAL	PALABORA MINING COMPANY LTD		
15	BASIC MATERIAL	PETMIN LD		
16	BASIC MATERIAL	LTD		

17	BASIC MATERIAL	TARN HEX GRP LTD		
18	BASIC MATERIAL	SAPPI	NO DIVIDENDS	YELLOW
19				
1	FINANCIALS	ABSA GROUP LIMITED		
2	FINANCIALS	CAPITAL PROPERTY FUND		
3	FINANCIALS	FIRSTRAND LTD		
4	FINANCIALS	FOUNTAINHEAD PROPERTY TRUST	NO DIVIDENDS	YELLOW
5	FINANCIALS	HYPROP INVES LTD		
6	FINANCIALS	INVESTEC LTD		
7	FINANCIALS	LIBERTY HLD LTD		
8	FINANCIALS	NEDBANK GRP LTD		
9	FINANCIALS	OCTEDA INV LTD		
10	FINANCIALS	PUTPROP LTD		
11	FINANCIALS	RMB HLD LTS	NO DIVIDENDS	YELLOW
12	FINANCIALS	SAAMBOU HLD LTD		
13	FINANCIALS	SANTAM LTD		
14	FINANCIALS	SASFIN HLD LTD		
15	FINANCIALS	STANDARD BANK GROUP LTD		
16	FINANCIALS	SYCOM PROPERTY FUND	NO DIVIDENDS	YELLOW
17	FINANCIALS	ZURICH SA (December)		

1	INDUSTRIALS	ALLIED ELECTRONICS LIMITED		
2	INDUSTRIALS	BARLOWORLD LTD		
3	INDUSTRIALS	BOWLER METCALF LTD		
4	INDUSTRIALS	CARGO CARRIERS LTD		
5	INDUSTRIALS	CEREMIC INDUSTRIES LTD	NO DIVIDENDS	GREEN
6	INDUSTRIALS	CONTROL INSTRUMENT GRP LTD		
7	INDUSTRIALS	ELB GRP LTD		
8	INDUSTRIALS	GROUP FIVE LTD		
9	INDUSTRIALS	HUDACO INDUSTRIES LTD		
10	INDUSTRIALS	IMPERIAL HLD LTD		
11	INDUSTRIALS	JASCO ELECTRONICS HLD LTD		
12	INDUSTRIALS	MOBILE INDUSTRIES LTD		
13	INDUSTRIALS	NAMPAK LTD		
14	INDUSTRIALS	PRETORIA PORTLAND CEMENT COMPANY LTD		
15	INDUSTRIALS	REUNERT LTD		
16	INDUSTRIALS	TRENCOR LTD		
17	INDUSTRIALS	WILSON BAYLY HOLMES-EVCON LTD		
18	INDUSTRIALS	ADCORP LTD		
19	INDUSTRIALS	WINHOLD (September)	NO DIVIDENDS	YELLOW
20	INDUSTRIALS	THE BIDVEST GRP LTD		
1	CONSUMER GOODS	AVI LTD		
2	CONSUMER GOODS	CAPEVIN INVESTMENTS LTD		
3	CONSUMER SERVICES	CASHBUILD LTD	NO DIVIDENDS	BLUE

	4	CONSUMER SERVICES	CAXTON CPT PUBLISHERS AND PRINTERS		
	5	CONSUMER SERVICES	CITY LODGE HOTELS LTD		
	6	CONSUMER SERVICES	COMBINED MOTOR HOLDINGS		
	7	CONSUMER GOODS	COMPAGNIE FIN RICHEMONT	NO DIVIDENDS	YELLOW
	8	CONSUMER GOODS	CROOKES BROTHERS LTD		
	9	CONSUMER GOODS	DISTELL GRP LTD		
	10	CONSUMER SERVICES	ILLOVO SUGAR LTD		
	11	CONSUMER SERVICES	ITALTILE LTD	NO DIVIDENDS	GREEN
	12	CONSUMER SERVICES	JD GRP LTD		
	13	CONSUMER GOODS	METAIR INV LTD		
	14	CONSUMER GOODS	MR PRICE GRP LTD		
	15	CONSUMER SERVICES	NEW AFRICA INV LTD		
	16	CONSUMER GOODS	NU-WORLD HLD LTD		
	17	CONSUMER GOODS	OCEANA GRP LTD		
	18	CONSUMER SERVICES	PICK N PAY HLD LTD	NO GROWTH	YELLOW
	19	CONSUMER SERVICES	PICK N PAY STORES LTD		
	20	CONSUMER SERVICES	REX TRUFORM CLOTHING COMPANY LTD	NO GROWTH	GREEN
	21	CONSUMER	SABMILLER PLC		

	GOODS			
22	CONSUMER GOODS	SEARDEL INV CORP LTD		
23	CONSUMER SERVICES	HLD LTD		
24	CONSUMER SERVICES	SUN INTERNA LTD		
25	CONSUMER SERVICES	THE FOSCHINI GRP LTD	NO DIVIDENDS	YELLOW
26	CONSUMER GOODS	TIGER BRANDS LTD		
27	CONSUMER GOODS	HULETT LTD	NO DIVIDENDS	YELLOW

FINAL SAMPLE (with complete data)		
HWANGE COLLIERY COMPANY LIMITED (HWA)	6	BASIC MATERIALS
AFRICAN OXYGEN LIMITED (AFX)		BASIC MATERIALS
AFRICAN RAINBOW MINERALS LIMITED (ARI)		BASIC MATERIALS
IMPALA PLATINUM HOLDINGS LIMITED (IMP)		BASIC MATERIALS
OMNIA HOLDINGS LIMITED (OMNI)		BASIC MATERIALS
EVRAZ HIGHVELD STEEL AND VANADIUM LIMITED (EHS)		BASIC MATERIALS
SUN INTERNATIONAL LIMITED [SUI]	10	CONSUMERS
TIGER BRANDS LIMITED [TBS]		CONSUMERS
SEARDEL INVESTMENT CORPORATION		CONSUMERS

LIMITED [SER]		
AVI LIMITED [AVI]		CONSUMERS
CAXTON CTP PUBLISHERS AND PRINTERS [CAT]		CONSUMERS
ILLOVO SUGAR LIMITED [ILV]		CONSUMERS
CITY LODGE HOTELS LIMITED [CLH]		CONSUMERS
JD GROUP LIMITED [JDG]		CONSUMERS
SHOPRITE HOLDINGS LIMITED [SHP]		CONSUMERS
NU-WORLD HOLDINGS LIMITED [NWL]		CONSUMERS
INVESTEC LIMITED [INL]	6	FINANCIALS
ABSA GROUP LIMITED [ASA]		FINANCIALS
STANDARD BANK GROUP LIMITED [SBK]		FINANCIALS
HYPROP INVESTMENTS LIMITED [HYP]		FINANCIALS
FIRSTRAND LIMITED [FSR]		FINANCIALS
SAAMBOU HOLDINGS LIMITED [SBO]		FINANCIALS
SASOL LIMITED [SOL]	1	OTHER
CARGO CARRIERS LIMITED [CRG]	7	INDUSTRIALS
GROUP FIVE LIMITED [GRF]		INDUSTRIALS
ELB GROUP LIMITED [ELR]		INDUSTRIALS
MOBILE INDUSTRIES LIMITED [MOB]		INDUSTRIALS
JASCO ELECTRONICS HOLDINGS LIMITED [JSC]		INDUSTRIALS
TRENCOR LIMITED [TRE]		INDUSTRIALS
ADCORP HOLDINGS LIMITED [ADR]		INDUSTRIALS

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APPENDIX B

Absolute valuation errors and outliers for each model

Table 25 shows the list of the absolute valuation errors of the P/E model and highlighted in yellow are the outliers.

Table 25: Absolute valuation errors and outliers for the P/E model

	ABSOLUTE VALUATION ERRORS					
	Recession			Boom		
	1999	1998	1997	1996	1995	1994
Basic materials	1.2372	1.5037	2.1358	0.705889	0.695698	0.863816
	1.6777	0.144819	0.159575	0.958191	0.964547	0.986937
	0.605217	0.780941	0.272617	0.940126	0.962582	0.993206
	6.343	2.7842	3.0378	0.697731	0.268735	0.764592
	0.185392	0.3818	4.7516	0.36984	0.561931	0.911812
	0.289668	0.909607	0.515898	0.932714	0.915726	0.968318
Consumers	11.95734	4.979653	11.81546	5.13696	0.538912	0.838982
	0.957671	0.457098	39.70611	0.725954	0.616394	0.757336
	0.59141	0.675557	0.611508	0.974505	0.982599	0.990923
	0.64586	0.77259	0.612617	0.954984	0.947071	0.984545
	0.838256	0.815193	0.616775	0.942928	0.94825	0.976117
	0.928078	0.951348	0.952456	0.989581	0.983114	0.989571
	1.006481	0.72577	2.567888	0.57078	0.731309	0.979683
	0.580206	0.793902	0.28743	0.858703	0.855101	0.94531
	0.366975	0.506084	0.126746	0.942067	0.947274	0.982914
	0.75957	0.932767	0.649439	0.957635	0.959248	0.983663
Financials	0.665834	0.811213	0.527402	0.93811	0.931652	0.963404
	0.743189	0.728334	0.42473	0.872038	0.817989	0.919052
	0.501521	0.568411	0.0636	0.894231	0.908398	0.970522
	0.773954	0.804424	0.479676	0.924865	0.87613	0.953432
	0.868917	0.918065	0.818351	0.96271	0.955594	0.972818
	1.0406	0.6223	2.506	0.586093	0.547406	0.788534
Industrial	1.137965	0.970054	0.91006	0.984898	0.957325	0.973058

	5.4316	1.7752	5.0965	0.510736	0.629685	0.853446
	0.626794	0.650633	0.537707	0.943655	0.95211	0.994492
	0.867898	0.856919	0.553797	0.992326	0.988314	1.000688
	0.1195	0.841057	0.2088	0.893546	0.885447	0.965804
	18.5982	4.1932	6.9114	0.794307	0.721335	0.902528
	0.810123	0.946755	0.933113	0.99332	0.992683	0.99763
Other	0.635319	0.514202	0.457677	0.943062	0.899131	0.973195

Table 26 shows the list of the absolute valuation errors of the DDM and highlighted in yellow are the outliers.

Table 26: Absolute valuation errors and outliers for the DDM

	ABSOLUTE VALUATION ERRORS					
	recession			boom		
	1999	1998	1997	1996	1995	1994
Basic materials	17.6278	3.1671	0.2076	3.331875	17.97667	26.2195
	0.921642	0.724444	0.329672	0.658633	0.819744	0.763864
	0.725	0.2848	0.371028	0.522819	5.296735	0.125185
	0.926829	0.5	2.2857	1.1857	5.6941	0.6
	798.4745	6.533	1.58	1.0668	2.4332	0.3448
	0.092282	0.026846	8.275556	4.930233	1.385818	2.7172
Consumers	4.219298	6.739234	1.096364	3.086	1.90411	2.77619
	2.024731	2.185185	1.582014	1.210744	1.110857	1.205
	1.657143	2.1616	3.00241	2.017647	1.110857	0.1914
	1.428113	3.014615	0.35563	0.402273	0.0846	0.9
	0.712353	0.344828	0.983571	0.875556	0.758182	0.690909
	0.965714	0.790909	0.647059	0.426829	0.328889	0.93
	0.965934	0.980488	0.95	0.672727	0.672727	0.8
	5.810204	1.802228	7.627451	4.953216	2.768043	25.4272
	0.526056	0.978966	0.502083	2.4905	0.515397	0.4042
	0.526056	0.978966	0.502083	2.4905	0.515397	0.4042
Financials	2.5681	3.0326	1.6779	1.5142	2.1380	10.2905
	0.9580	0.6417	0.0182	8.2234	5.8000	1.2250

	0.9974	0.9943	1.2982	0.9967	0.9929	0.9955
	0.5231	0.2785	0.2615	0.7345	0.3399	0.1957
	0.5686	0.8700	1.3882	0.5949	1.3360	0.2042
	11.2262	0.3878	3.4163	2.9754	24.5680	9.6227
Industrials	1.0076	1.1056	1.0200	1.0567	0.2933	0.8000
	4.4412	4.0889	0.3200	0.7048	2.3893	0.9048
	0.1500	1.4378	0.0627	1.1114	1.0428	0.8404
	0.9216	0.8595	1.0920	0.9791	0.9221	1.0014
	2.363158	1.094118	0.309091	0.573529	1.324138	1.246667
	7.418605	1	2.213333	1.510703	3.017582	0.333333
	1.5076	1.424186	1.3635	1.179149	2.11	0.544928
Other	2.096	5.2674	2.231569	1.41027	1.476717	2.96237