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Empirical testing of implied cost of equity in the capital asset pricing model using JSE listed companies

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Abstract

The capital asset pricing model (CAPM) has for half a century been considered a pillar of modern finance in describing the relationship that is deemed to exist between the risk of owning an asset and the expected future returns from that asset. The model has however been subject to criticisms and attacks in the literature and some doubt remains about the validity and successful application of the model. This research builds on previous empirical testing of the CAPM with a specific focus on the cost of equity of companies listed on the Johannesburg Stock Exchange.

The approach of this research was to use market values, as indicated by the share price of a listed company and discounted free cash-flow valuations to determine both an estimated and implied cost of equity. The aim was to test the validity of the CAPM empirically and potentially find an accurate, implied cost of equity for the South African equity market, by comparing the different rates and looking for statistical correlation between them. While no correlation could be found, this study did provide evidence that the cost of equity and the market risk premium in South Africa is potentially higher than previously thought.

Keywords

Cost of equity, CAPM, JSE, Empirical testing, Valuations

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Paul Kempff

11 November 2013

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and friend a man could ever hope for.

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1. Introduction to the research problem

1.1 Research title

Empirical testing of implied cost of equity in the capital asset pricing model using JSE listed companies.

1.2 Research problem definition

On October 14th 2013, it was announced that the 2013 Nobel Prize in Economic Sciences was awarded jointly to Eugene F. Fama, Robert J. Shiller and Lars Peter Hansen "for their empirical analysis of asset prices" (Nobel Media AB, 2013). These three American economists had in the course of their illustrious careers produced sometimes conflicting research on how financial markets work and formed an interesting, yet somewhat contradictory group. (Miller, Zambrun, & Magnusson, 2013) Fama had been recognized for his empirical studies that led to the development of the efficient-market hypothesis while Shiller had been one of the biggest critics of this theory, regularly knocking holes in it with his own theories and empirical testing. Hansen became famous for his development of statistical techniques using empirical data to test theories of asset pricing. (Miller et al., 2013).

This recognition by the Nobel committee in 2013, bestowed on three respected academics in the economic and financial fields for their decades of work on asset pricing, provided appropriate affirmation that the chosen research problem of this study was still relevant and worthy of further empirical testing. The framework for the study of the dynamics of asset prices, developed by many researchers around the world for half a century was still robust, but evidently open to further scrutiny.

The capital asset pricing model (CAPM) is central to modern finance theory (Bodie, Kane, & Marcus, 2011) and despite failing a number of empirical tests in the past (Fama & French, 2004) it is still widely employed to explain the apparent relationship between the risk and the return of an asset. This relationship offers the benefit that it allows users to develop a benchmark against which the return of different assets or investments can be evaluated. Such a benchmark can then be used to determine, for example, if a listed share is trading at a price that represents a fair return, given its inherent risk. The CAPM

is primarily used in listed companies but the relationship it describes can easily be applied to determining an approximate value for an unlisted company by analysing expected returns (Bodie et al., 2011).

Knowing what a listed share or company is worth and how to accurately value a business or part thereof is of significant value to shareholders, investors, directors, employees and analysts. Companies use valuations for a variety of reasons including selling shares to obtain capital, share incentive schemes, mergers and acquisitions (Reilly, 2012). Unfortunately there are a number of different techniques used to do company valuations that often result in widely varying results and consequently give rise to a myriad of question marks around the validity and accuracy of these valuations (Karsh, 2012). The accuracy problem is further compounded by the fact that most models make use of either variables that are derived from historic results, forecasts or even worse, estimations with limited empirical testing of the underlying variables (Fama & French, 2004a).

A widely used and accepted valuation method in accounting and finance is the discounted cash-flow model (DCF) that discounts expected future cash-flows of a company by an appropriate discount rate that takes into account the different types of capital – debt and equity – used by a company (Firer, Ross, Westerfield, & Jordan, 2012). Such a risk-adjusted discount rate is called the weighted average cost of capital (WACC). One of the components of the WACC is a company's cost of equity (referred to as the cost of capital in some literature) that can be calculated using the CAPM equation.

The use of cost of equity as a discount rate is not limited to valuation purposes only. The performance of portfolio managers are often evaluated using average rates of return relative to the security market line (SML) and in regulated companies expected returns relative to risk is used by regulatory authorities to determine the cost of equity. Cost of equity does also feature strongly as a discount rate or hurdle rate in many companies for capital budgeting decisions (Correia & Cramer, 2008).

Despite the apparent acceptance and regular use of the CAPM and cost of equity theory in the academic world and business environment, it is still based on a number of variables that are often not much more than educated guesswork. The components of the cost of equity equation are beta, as an indication of systemic risk, a risk-free rate and a market risk premium. Beta gives a description of the sensitivity of the excess returns an asset will

earn in relation to the expected market returns (Ward & Muller, 2012). While the first two components of the cost of equity equation can be calculated with a reasonable amount of accuracy and certainty, the market risk premium does warrant further investigation.

1.3 Research motivation

The CAPM has been under attack from many different angles and disciplines for a number of decades. These attacks are theoretical, empirical academic and lately even behavioural psychological, casting doubt on the validity of the entire model (Levy, 2011). Furthermore, the assumption of an arbitrary market risk premium in the determination of cost of equity exposes these types of calculations to interpretation and possible manipulation. The principal motivation for this study was to determine an implied cost of equity based on empirical evidence. It furthermore aims to determine if the estimations of the cost of equity commonly used in South Africa until now were reasonably accurate given the expectation that such rates in South Africa and in other emerging markets may well be higher than in developed markets.

The expected return of an asset as determined by the CAPM equation forms the basis of valuation theory and is therefore fundamental to corporate finance and investment decisions in any company. The apparent positive, linear relationship between risk and return of the CAPM theory has been widely employed and taught for many years. Despite these endorsements, there have been numerous studies that has shown this relationship to be weak or even non-existent (Fama & French, 2002, 2004; Montier, 1997; Van Rensburg & Robinson, 2003) with limited empirical research supporting the CAPM theory (Ward & Muller, 2012).

An understanding of company valuations based on earnings forecasts and how it relates to the market value of a company as measured by the listed share price of that company, is an important aspect of equity analysis (Gode & Mohanram, 2003). The expected return on the company's equity or the cost of equity, serves as a valuable link between the valuation of a company and the actual earnings and/or forecast of the earnings of the company by analysts.

Due to the unobservable nature of the cost of equity (Ashton & Wang, 2013) it is necessary to use proxies when using it as an input in valuation models. The two most

common proxies used, are an estimate of the implied cost of equity based on past realised returns or *ex post* returns and an estimate of the implied cost of equity calculated from the forecasts of earnings by analysts or *ex ante* earnings (Ashton & Wang, 2013). Unfortunately neither of these proxies provides a very accurate measure of the cost of equity due to the different assumptions made and models used in its estimation.

One of the problems with the CAPM is that theoretical underpinnings of the models used require an expected or *ex ante* beta while the actual betas used in the calculations are realised betas or *ex post* betas (Borgman & Strong, 2006). Using realised share market returns as a proxy has proven to be notoriously imprecise (Chen, Jorgensen, & Koo, 2004) and other, more precise methods of estimating the cost of equity could be valuable when performing valuations. In this study the use of different proxies for earnings was continued in an attempt to estimate a more accurate implied cost of equity and thereby try and find empirical evidence that supports the CAPM theory.

This study builds on a recently published research paper by Mike Ward and Chris Muller of the Gordon Institute of Business Science, University of Pretoria where they did empirical testing of the CAPM on the JSE (Ward & Muller, 2012) as well as a working paper compiled by them on implied growth rates and the use thereof in forecasting terminal growth rates in discounted free cash-flow valuation models (Ward & Muller, 2010). In the aforementioned two papers two future opportunities for research were identified: the estimation of the implied cost of equity and the estimation of implied beta. Extensive research has been done on implied beta, for example the study by Borgman and Strong *"*Growth rate and implied Beta: Interactions of cost of capital models" (Borgman & Strong, 2006). Limited empirical research has however been found on implied cost of equity, especially in a South African or emerging market context.

The majority of prior studies on the subject of the CAPM are confined to share returns of companies in the United Stated of America (USA). Some studies have expanded the research to other countries as well (Chen et al., 2004), but most of the data and evidence available is still based on companies in the USA and to a lesser extent, other developed countries. One study done by Hail and Leuz (2006) discussed international differences in the cost of capital in 40 different countries including South Africa, but the focus of that study was the effect of legal institutions and securities regulations on the cost of equity. This research report focussed on listed companies in South Africa with the aim to develop

an estimation model that can potentially be applied to other emerging economies with similar characteristics to that of the South African economy.

One of the characteristics of the South African market that could potentially make this study different from that of the traditional developed markets studies is the heavy weighting to resource shares in our stock exchange. Previous studies have shown that there are specific industry differences in the estimation of cost of equity (Wen, Martin, Lai, & O'Brien, 2008) which implies that the cost of equity for South African equities could vary extensively from that of developed markets given our unique weightings. Furthermore, the value of shares traded on the JSE is highly concentrated with the largest 160 companies representing 99% of the total market capitalization on the JSE (appendix 1). This concentration of value does however make it possible to limit the study to a relatively smaller number of companies and yet obtain a highly representative result.

1.4 Research aim and purpose

The aim of this study was to determine the implied cost of equity of an appropriately large number of the most valuable listed companies on the Johannesburg Stock Exchange (JSE) based on market capitalization, by using financial statement data and share price data over a period of eight years from 2005 to 2012. The approach that was followed varies from that of most previous empirical research on the CAPM theory and specifically that of cost of equity. Instead of determining a value using cost of equity and some earnings proxy, the method that was employed was based on the assumption of the efficient market theory (Fama E. F., 1970) which suggests the market value of a company is a fair reflection of the true value of the company over the long term. The market value of a company was used to calculate the discount rate implied by that market value when compared to a valuation based on a combination of the actual earnings and forecasted earnings of that company.

In the first part of this study the traditional method of using the CAPM and a DCF valuation was applied to determine the value of a company and the resultant estimated cost of equity for each company in this study. This cost of equity rate was then used as the benchmark against which the implied cost of equity would be measured. In the second part of the study this calculated value for the company and a re-arranged CAPM equation was used to determine at what discount rate this calculated value would be equal to the

market value of the company as reflected by the share price of the company on a specific date. By determining this discount rate and applying the re-arranged CAPM equation it was possible to determine a cost of equity as implied by the actual financial data and market value of the company. Finally, in the third part of this study, the implied cost of equity data points were compared to the benchmark cost of equity data points to determine whether a significant difference existed that would create an opportunity to redefine the market risk premium used as a variable in the traditional determination of cost of equity in the South African equity market. Furthermore, the study endeavoured to find empirical evidence for the validity of the CAPM itself, with specific application to the South African equity market, through seeking a statistical correlation between an estimated cost of equity and an implied cost of equity.

1.5 Research project scope

At the outset of this research report the method and process of obtaining the data that was needed to fulfil the ambitious research aims of this project had to be determined. Firstly, the number of companies that was to be included in this study and the criteria for choosing these companies had to be defined. It was decided to use the 100 most valuable companies on the JSE All-share index (ALSI) on 31 January 2013 as measured by market capitalisation. The financial statement and share price/market value data of these 100 companies were obtained electronically.

Simultaneously a comprehensive literature review of theory and previous research done on the CAPM and more specifically, empirical testing on the cost of equity were conducted. Initially all relevant literature on the subject was considered but eventually the scope of the literature review was narrowed to focus on empirical testing of the cost of equity done in South Africa and other emerging economy countries.

The next step in the data collection process was to construct a Microsoft Excel spread sheet which made it possible to input the different variables that would ultimately result in the implied cost of equity data points needed for this study. Thereafter the statistical analysis of the data results was conducted with the aim of answering the research questions and hypotheses and ultimately reaching meaningful conclusions.

This research report was set out as follows: Chapter 1 gave an introduction of the research problem, focussing on defining the problem, highlighting the motivation behind conducting this research, the principal aim and purpose of the project and finally the scope of the research. Chapter 2 reviewed the theory on which this research endeavours to build and all relevant literature was discussed. Chapter 3 presented the research questions and research hypothesis and chapter 4 was devoted to the research methodology, describing the research design, data collection process, population and sampling used. Chapter 5 summarized the results of the research and the statistical analyses of the data and in chapter 6 the results were discussed in detail. Chapter 7 contained the conclusion to the research report and highlighted the recommendations for application of the findings and opportunities for future research.

Some of the data used and results obtained in this research project were impractical to include in this written report as they were contained in large spread sheets. There were, for example almost 100 spread sheets with detailed discounted free cash-flow valuations for the various companies used on this research report that would have added at least another 200 pages to this report. Where this was the case examples of the data and results were given in this report, some data were included in the appendices to this report and the rest of the data were submitted in electronic format.

2. Theory and literature review

2.1 Scope of the literature review

The literature reviewed in this research project falls into the category of literature that explores the theoretical relationship that exists between risk and return in financial markets. In broad terms this literature discusses the concept of risk and how that risk is rewarded in the market. It describes a model, referred to as the CAPM, which attempts to give a prediction of the relationship that can be observed between the risk of owning an asset and its expected return (Markowitz H., 2005). The review of the CAPM in general and more specifically the empirical testing of the CAPM over time are important as it will provide a framework for this research report and serve as an introduction to the next part of the literature review.

The CAPM is utilized to determine an appropriate discount rate, such as the WACC, that can be used to calculate the value of future cash flows in a company (Firer et al., 2012). The second part of the literature review focuses on the empirical tests that had been done in the past on one of the components of this discount rate, cost of equity.

2.2 History of the capital asset pricing model

In 1952 Harry Markowitz introduced the idea of an efficient risk versus return frontier in his work on portfolio selection (Markowitz H., 1952) and laid the foundations for the development of the CAPM in his mean-variance efficiency analysis. His work was expanded on by William Sharpe (Sharpe, 1964), John Lintner (Lintner, 1965) and Fischer Black (Black, Jensen, & Scholes, 1972) and would eventually lead to the development of the CAPM theory and the awarding of a Nobel prize to Markowitz and Sharpe for their contribution to financial economics (Levy, 2011).

The CAPM is a set of predictions that attempt to find the equilibrium expected returns on risky assets (Sharpe, 1964). It endeavours to describe a relationship between the risk of holding of an asset and the expected, forward-looking returns you can expect to receive from holding the asset over a period of time (Berger, 2011). The roots of these relationships and the CAPM are found in the work that Harry Markowitz conducted on portfolio choices based on certain expectations of the future performance of a portfolio

(Berger, 2011). His respected and often-cited paper on mean-variance efficiency (M-V) analysis formed the basis of many academic studies in the field of finance and economics and had a great impact on the field of corporate finance (Levy, 2011).

It is interesting to note that while all authors seem to agree that the work of Harry Markowitz was the foundation, different authors give credit for the development of the CAPM to different people. Bodie, Kane and Marcus (2011) give credit to Sharpe, Lintner and Jan Mossin (Mossin, 1966). Fama and French however talks primarily about the work of Sharpe and Lintner on the CAPM but mentions the work of Black in relation to the zero-beta model (Black, Jensen, & Scholes, 1972). Black as well as Ward and Muller also give credit for the CAPM to the work of Jack Treynor in two unpublished manuscripts from 1961 entitled “Market value, time and risk” and “Toward a theory of market value of risky assets” (French, 2003).

2.3 Explanations of concepts used in this research report

A brief explanation of certain concepts and terms used in this research report may be necessary before the review of the relevant literature is continued.

CAPM

An appropriate starting point to explain or define the equation of the CAPM is to consider the element of risk in an asset. A study of the risk of holding a share shows that risk can be divided into unsystematic risk and systematic risk. The responsiveness of the returns of a particular share in relation to the returns of the market as a whole is called the systematic risk and it is usually represented as a beta coefficient (Firer et al., 2012). This is the first component of the security market line (SML), an equation that results from the plotting of expected returns and beta coefficients of a share that describe the relationship between systematic risk and expected returns in financial markets. This relationship can be expressed in the CAPM equation as derived from the SML equation and it can be represented as a linear equation used to estimate the expected return on an asset based on its systematic risk, referred to as beta.

The different components of the SML or CAPM equation are:

- Re **– representing the expected returns of a share or the cost of equity for that share**
- Rf **– representing the risk-free rate in the market**
- Be **– representing beta or the systematic risk of the share relative to the market**
- $Rm - R$ **– representing the difference between the average expected returns of the market and the risk-free rate of the market, known as the market risk premium**

If the line that will be the result of the plotting of different return and beta coefficients is taken the result will be the SML equation and if the different components of this equation are rearranged slightly, the result is the CAPM equation (Firer et al., 2012), which is central to this research report:

$$\boldsymbol{Re = Rf + \beta e\,(Rm - Rf)}$$

This equation shows that the expected return of a share will depend on three key aspects (Firer et al., 2012):

1. The time value of money as measured by the risk-free rate.
2. The reward for taking on systematic risk as measured by the market risk premium.
3. The amount of systematic risk present in a specific asset relative to the risk of an average asset as measured by the beta coefficient.

Cost of capital

The analysis of the CAPM was initially conducted by studying beta as an indication of the risk inherent in an asset for a shareholder of that asset and the relationship between this risk and the expected return on the asset. This return that a shareholder of an asset receives for taking on the risk of investing in the asset is inversely the cost of that asset to the company that issued it (Firer et al., 2012). This cost is referred to as the cost of capital and it is divided into two components: the cost of debt and the cost of equity.

The cost of debt is the return that lenders to the company require on their borrowings to the company or, from the point of view of the company, the interest paid on the company's debt. This rate is usually relatively easily obtained from the financial statements of a

company or can be assumed from the prime interest rate applicable to the specific environment and period that the company operates in. This interest rate is taken and the effect of tax at the legislated rate is calculated to determine the cost of debt. This is done because of the tax deductibility of interest for a company and the resulting tax shield and the increased value of that company as a result of the debt (Firer et al., 2012).

The cost of equity can be determined in various ways including the dividend growth model approach and the SML approach (Correia & Cramer, 2008). For purposes of this report only the SML approach as explained above was considered. It is important to note that some literature refers to the cost of equity as the cost of capital (Hope, 2002, Borgman & Strong, 2006). These two terms are often used interchangeably. For purposes of this research report only the term cost of equity will be used. When the term cost of capital is used in this research report it will be in the context of a rate that is a combination of the cost of equity and the cost of debt as used in the WACC.

WACC

The combination of the cost of debt and the cost of equity of a company in a ratio equal to the amount of debt versus the amount of equity in the company provides (WACC). This WACC can then be used as an appropriate discount rate to determine the value of cash flows in a company. When doing a discounted free-cash-flow valuation on a company the WACC is the discount rate used most often in practice (PWC Corporate Finance, 2012).

Estimated versus implied

All cost of equity rates are estimations. This is because the underlying components of the cost of equity rate are based on assumptions that are very difficult to quantify accurately (Fama & French, 2004a). In this research report a distinction was however made between estimated and implied cost of equity. Estimated cost of equity will refer to the rate as determined by the CAPM equation from the three components – beta, a risk-free rate and a market risk premium. Implied cost of equity will refer to the rate as determined by the market value of the company and the rearranged CAPM equation, the methodology used in this research report.

2.4 Assumptions underlying the CAPM

The basic version of the CAPM is based on a number of assumptions that would lead to a simplified world (Bodie et al., 2011). These assumptions are in summary:

a. There are many investors and they are price-takers, meaning that share prices are not affected by their individual trades.
b. All investors plan for one identical holding period.
c. Investments are limited to a range of publicly traded financial instruments such as shares and bonds and that investors have unlimited access to borrowing at a fixed, risk-free rate.
d. No taxes on returns and no transaction costs.
e. All investors are rational mean-variance optimisers.
f. All investors analyse shares in the same way and share the same economic view of the world.

These assumptions create a hypothetical world that completely ignores the complexities that do exist in the real world and therefore requires further empirical testing to ensure the model does have application in the real world (Fama & French, The capital asset pricing model: theory and evidence, 2004a). Many of the studies and empirical tests done on the CAPM have changed some of these assumptions and updated the model in an attempt to make it more valid and applicable to real world scenarios (Leland, 1999).

2.5 CAPM literature

For purposes of this literature review a distinction was made between CAPM research literatures in general and then research literature focussed on the empirical testing of cost of equity, the latter being more closely related to the methodology of this research report. On the subject of the CAPM in general there are two recent studies and one slightly older but probably the most respected study, that focuses on the validity of the CAPM theory. Due to the vast amount of literature available on the CAPM the review will only be conducted in the context of these three studies with reference made to other literature.

Fama and French (2004)

The attacks and criticism that the CAPM has increasingly been subject too, resulted from a number of empirical studies in finance and economics where the results of these tests practically invalidate the CAPM (Fama & French, 2004a). Most of the recent studies of the CAPM refer to the survey of empirical results published by Fama and French in 2004 as the seminal work on the subject (Levy, 2011). Fama and French speculate that the empirical problems may first be as a result of theoretical failings because of the large number of assumptions used to simplify the model (as described above) and second because of the difficulties encountered when implementing valid tests of the model (Fama & French, The capital asset pricing model: theory and evidence, 2004a).

Some of the criticisms Fama and French highlighted in the study they conducted on the assumptions used in the CAPM model, are that unrestricted short-selling and risk-free borrowing is unrealistic and that all investors will always act in the same way and in complete agreement. This issue alone does not invalidate the CAPM as in the words of Fama and French (2004a): "…. all interesting models involve unrealistic simplifications, which are why they must be tested against data."

Fama and French continue to state that most tests of the CAPM are based on three implications derived from the relationship implied by the model between expected returns and risk. The first implication is that expected returns on all assets are directly related to their betas only and no other variables have any influence. The second implication is that the beta premium is positive; implying that the expected return from a market portfolio exceeds the expected return on assets whose returns are uncorrelated with the market return. The third implication as seen in the Sharpe-Lintner version of the CAPM (Lintner, 1965), is that assets uncorrelated with the market have expected returns equal to the risk-free interest rate and that the beta premium is then the expected market return minus the risk-free rate.

Most of the early tests of these models used either cross-section or time series regression. When tests were done on risk premiums, estimates for individual asset betas proved to be imprecise and to be causing measurement errors. Regression residuals also proved to have other sources of variation for example, the effects of specific industries on average returns (Wen et al., 2008). In an effort to improve the accuracy of estimated betas some

researchers started working with portfolios rather than individual securities (Blume & Friend, 1973, Black et al. 1972). This type of grouping did however lower the range of betas and reduced the statistical power of these tests.

Fama and Macbeth (1973) introduced a method to address the problems around the correlation of residuals. They used a time-series of month-by-month cross-section regressions of estimated monthly returns on betas instead of single estimations (Fama & MacBeth, 1973). Early empirical tests also rejected the Sharpe-Lintner version of the CAPM around an asset's excess returns showing that there was a positive relation between beta and average returns but this relation was too flat as confirmed in time-series tests (Black et al., 1972). This evidence was updated by Fama and French in 2004 by using 912 monthly returns on ten beta-sorted portfolios ranging from 1928 to 2003.

From the early tests observed by Fama and French they conclude that the Black version of the CAPM, that market betas are sufficient to explain expected returns and that the risk premium for beta is positive, seemed to hold. They concluded however that the Sharpe-Lintner CAPM which stated that the premium per unit of beta is the expected return less the risk-free interest rate is consistently rejected (Fama & French, 2004a). Empirical studies done in the late 1970's by Basu (1977) and Banz (1981) also challenges the Black version of the CAPM. Fama and French confirmed from these studies and others that size, earnings-price, debt-equity and book-to-market ratios as well as momentum add to the dynamics of the relationship between expected returns and beta.

Levy (2010)

In his journal article "The CAPM is alive and well: a review and synthesis" (2011), Levy looks at the CAPM from a behavioural economist and even psychologist point of view. He refers to a series of studies done by Kahneman and Tversky which shows that the typical investor is not always rational and an "efficient machine" (Kahneman & Tversky, 1979). This implies that some of the foundations of the CAPM are not valid and do not therefore have theoretical justification.

Levy continues by listing the main theoretical and empirical criticisms of the CAPM and then sets about overcoming each of these criticisms one by one. His approach to evaluating the CAPM is focused on the expected utility theory (EUT) of Von Neumann and

Morgenstern in 1953 which according to Levy is the theory from which the mean-variance (M-V) efficiency analysis of Markowitz and the CAPM is derived. He therefore extrapolates that criticism of the EUT casts doubt on the validity of the M-V rule and the CAPM itself (Levy, 2011).

Levy explains in detail how each of the criticisms listed is invalid or not applicable concluding that there is no absolute evidence that any of these criticisms renders the CAPM completely invalid. Levy claims further that the empirical results are inconclusive due to the fact that *ex post* parameters are used in the tests and that the CAPM theory is defined in terms of *ex ante* parameters. Due to the fact that there are differences between the *ex post* and *ex ante* parameters it can be shown that with small changes in the parameters the CAPM cannot be rejected. He even goes as far as taking the empirical tests of Fama and French in 2004 and showing how he can find positive relationships between variables where Fama and French found negative relationships by simply breaking the data down into different time periods (Levy, 2011).

Levy goes on to cite the study of Roll in 1977 in which he showed that the only relevant test of the CAPM is whether the employed market portfolio is M-V efficient (Roll, 1977). He again points out the differences between *ex post* and *ex ante* parameters and how with a slight manipulation of the parameters the observed, market portfolio is in fact M-V efficient which implies in turn that the CAPM is valid. Important for the methodology employed in this report, Roll uses a "reverse engineering" approach to the tests. He works from a given market proxy portfolio and then by making small adjustments to the parameters, positions the proxy portfolio on the M-V efficient frontier. He reached the conclusion in this study that only slight changes in the parameters are needed to achieve this and therefore market portfolio efficiency cannot be rejected and the CAPM remains valid.

Levy concludes his study by stating that the CAPM cannot be rejected in terms of behavioural economics and psychology as he had rejected all the criticisms against it. Furthermore the CAPM cannot be rejected on empirical grounds when *ex ante* parameters are used instead of *ex post* parameters. He goes as far as stating that the CAPM is strongly supported experimentally with *ex ante* parameters. He concedes that there is substantial difficulty in estimating the *ex ante* parameters but that this is the case in virtually all theoretical models (Levy, 2011).

Berger (2011)

Similar to the study of Levy, Berger states that the use of *ex post* returns in place of *ex ante* returns is problematic. This assumes that observed returns is always closely related to predictions of returns. He cites a number of studies that question the validity of using observed returns as a proxy for expected returns in asset-pricing models. Elton (1999) argues that periods of more than 10 years where stocks and bonds underperformed the risk-free rate confirms that realized returns cannot be used as a measure for *ex ante* expectations. Claus and Thomas (2001) studied equity premiums by relating current market values of companies to the forecasts of earnings of those companies by analysts and found a very low equity premium of about 3%. Other studies (Fama & French, 2002, Petkova & Zhang, 2005) continue to prove that rejecting the CAPM based on observed returns do not necessarily render the CAPM invalid and that studies based on expected returns does give strong support to the model.

Given all this evidence against realised or observed returns Berger analysed the performance of the CAPM based on an alternative proxy for expected returns. His focus was on the ability of CAPM betas to explain returns across size and book to market portfolios. In his study Berger looked at both observed returns and fundamental returns and as expected the results of the tests using observed returns showed a failure of the CAPM with significant abnormal performances in a large number of stock portfolios as well as a significant value premium that could not be explained by the model. There was also no evidence that portfolios with a high beta outperform portfolios with a low beta in terms of average returns. His tests using fundamental returns as supported by Fama and French (2002) does however give support to the CAPM showing that the high beta stocks perform better than their low beta counterparts in terms of average returns (Berger, 2011). Both observed and fundamental returns did however reveal a value premium that could not be explained by the CAPM.

2.6 Cost of equity empirical testing literature

The next phase of the literature review is more focussed on describing the empirical testing of cost equity that has been attempted in previous studies. The seminal work on the cost of equity (they use the term cost of capital) not considered to be directly related to the CAPM, is the paper of Modigliani and Miller published in 1958 in which they put

forward their now famous Proposition I and II (Livingston, 2013). Proposition I states that a company's market value and concomitantly its cost of capital are independent of its capital structure. Proposition II stated that the cost of equity of a company rises in direct proportion to a rise in its debt-to-equity ratio. These propositions made the assumption that there were no corporate income taxes.

In 1963 Modigliani and Miller revised their earlier paper and stated that a company with debt or a levered company has a higher value than a company with an equity only capital structure since the levered company benefited from a tax shield on their debt. Working from the work of Modigliani and Miller, Hamada (1972) first introduced the idea of an asset beta and a levered beta for valuation purposes to separate the operating risk of a company from the financing risk of a company. The betas developed by Hamada are often used to adjust the betas of different companies in the same industry to provide for the differences in leverage between the companies (Livingston, 2013). Further work on the effect of leverage on the cost of capital was done by Miles and Ezzell (1980) and Harris and Pringle (1985). They stated that the value of the debt shields in a company is driven by the debt rebalancing policy of the company.

When determining a cost of equity rate from empirical testing that rate is commonly referred to as implied cost of equity. In his book "Estimating the Cost of Capital Implied by Market Prices and Accounting data" Easton defined the implied cost of equity as the internal rate of return that equates price to the expected future payoff to shareholders (Easton P., 2007). Borgman and Strong (2006) defined implied cost of equity as the internal rate of return that equates the present value of future cash flows to the current stock price. In finance research and accounting the use of implied cost of capital is increasing with application being found in testing international asset pricing models, the inter-temporal risk-return relationship and the pricing of default risk. Easton also emphasised the empirical problems related to using realized returns as a proxy for expected returns, like many others in earlier studies (Berger, 2011).

In his study Easton made use of the DCF based valuation model to determine an implied cost of equity but used the residual income variation and the abnormal earnings variation valuation models. While admitting that the implied cost of equity rates based on his theory was flawed he submitted that these rates were based on better proxies for the market's expectations than realised returns and therefore potentially more accurate (Easton P.,

2007). Citing evidence from Gebhardt, Lee and Swaminithan (2001) as well as Frankel and Lee (1998), Easton stated that reasonable implied cost of equity estimates may be correlated with future returns, especially with certain small corrections or adjustments as we have seen in the empirical studies of the CAPM by Levy. One of the measurement errors, referred to in his book, that Easton considered to be problematic was the noise of the stock price itself and that this aspect of implied cost of equity certainly warranted further studies and tests.

Due to the directly unobservable nature of the concept of cost of equity it is necessary to utilise proxies to estimate it. The two most widely used proxies are a cost of equity based on past realised returns and a cost of equity based on analysts' forecast of expected returns (Ashton & Wang, 2013). The evidence against realized returns as an accurate measure is overwhelming (Elton, 1999) and therefore most empirical studies of cost of equity make use of an implied cost of equity based on expected returns.

The problem with this approach is the infinite series of future flows from an asset is invariably eliminated by using a terminal valuation. This means that the accuracy of the implied cost of capital is also dependent on the assumed rate of growth in perpetuity that is used as discount rate for the terminal value of the cash-flows (Ashton & Wang, 2013). A working paper on the implied growth rate in the South African equity market by Ward and Muller (2010) showed that the implied growth rate of the earnings of South African companies are significantly higher than expected and this further complicates the testing of implied cost of equity using DCF valuations. Most of the studies done on the subject of implied cost of equity take the growth rate used in the terminal value as an external parameter. It has only been in limited studies for example the ones done by Easton, Taylor, Shroff & Sougiannis (2002) and Easton (2004) that it was attempted to estimate the cost of equity and growth rate simultaneously.

Borgman and Strong (2006) calculated a forward looking cost of equity estimate using CAPM but with an implied beta calculated using analysts' forecasts of future growth in terms of both earnings and dividends in the hope of getting a more accurate cost of equity given the well-documented shortcomings of calculations based on historic data. In their study they calculated a WACC based on the no-arbitrage theories of Modigliani and Miller (1958, 1963) taking into account the cost of debt and equity weighted to the debt ratio of the company and adjusted for the tax deductibility of interest on debt.

In their efforts to calculate an implied beta, Borgman and Strong (2006) made an interesting observation regarding the use of growth rates in the CAPM and the calculation of cost of equity. They submitted that it made sense to use forecasts of growth rates (*ex ante*) rather than actual growth rate averages based on historic data (*ex post*). This assertion is based on findings that there is no persistence in long-term earnings growth beyond chance (Chan, Carceski, & Lakonishok, 2003) and that analysts' forecasts are generally better predictions of the future than historical growth rates (Van Der Weide & Carlton, 1988). Borgman and Strong also make the assumption that over the long-term companies will tend to earn only their cost of equity. If they earn less they will not survive and if they earn more their stock price will be bid up and the return on equity will decline (Damodaran, 1994, 1996, Copeland, Koller, & Murrin, 1995). This implies that in the long-term a company's expected return or cost of equity should be equal to its return on equity (ROE) (Borgman & Strong, 2006).

Borgman and Strong (2006) concluded their study by stating that growth rates and beta are related and that by combining the two most common methods of determining the cost of equity, the dividend discount model and the CAPM, it is possible to estimate an implied beta based on forward looking analyst growth estimates. They claimed these implied betas were better estimates to use in the calculation of cost of equity, especially for companies in transition or in changing industries.

The increasing use of concepts like shareholder value-added (SVA) as a management tool in companies is another opportunity to test the practical application of the CAPM and more specifically finding an accurate and appropriate cost of equity (Hope, 2002). SVA is created when earnings exceed the cost of equity factor and anything less than that destroys SVA. Cost of equity should drive decisions about risk management, resource allocation and capital management in a company but without a realistic measure of cost of equity all these decisions become incredibly difficult. Some researchers believe that the weakness of the CAPM lies in the difficulty of accurately determining the components of cost of equity – the risk-free rate of return, the equity risk premium and beta (Hope, 2002) – and therefore recommend an alternative approach. One such approach is to use internal measures of risk, estimates of earnings growth and expected leverage to determine a perpetuity value of the equity and to measure an appropriate risk-adjusted return (Hope, 2002). There are similarities between this recommended approach and the approach followed in the DCF valuations conducted in this research report.

Many studies have used cost of equity as the subject of their research but in most cases the purpose was to study the effect of a specific variable on the cost of equity calculation. Some of these variables include the effect of shareholder rights (Chen, Chen, & Wei, 2011), dividend taxes (Dhaliwal, Krul, Li, & Moser, 2005), earnings smoothness (McInnes, 2010) and options trading on the cost of equity. All these studies provided valuable insights into the calculations of cost of equity, the different assumptions and models used as well as the practical implications of cost of equity estimations, without really focusing on the shortcomings of the cost of equity estimation models and ultimately the CAPM.

Gebhardt et al. (2001) developed an approach to estimating the cost of equity that entails calculating the internal rate of return where share prices are equal to the intrinsic value of a company based on analyst earnings forecasts. They used the Edwards-Bell-Ohlson residual income valuation model to calculate an implied cost of equity. They also assume like others (Liu, Nissim, & Thomas, 2002) that from year four to twelve of a forecast horizon the company's return on investment reverts to the industry mean and then remains constant in perpetuity while the dividend pay-out ratio is assumed to be 100%. Gordon and Gordon (1997) on the other hand assumed that a company's return on equity converges to the cost of equity beyond the fourth year. Botosan and Plumlee (2002) as another example of alternative assumptions, assume that analysts and markets forecasts of terminal values are consistent.

Some evidence exists that the industry a company operates in, plays a role in the estimation of cost of equity and there has been some studies on for example the insurance industry that support this idea (Wen et al., 2008). In this study the researchers developed a variation on the CAPM based on asymmetrically distributed returns caused by an asymmetric claims process in these firms resulting in large errors when using the CAPM. This new model for the insurance industry based on work done by Rubinstein (1976) and Leland (1999) (Leland, 1999), called the RL model, took into account other elements of risk including skewness, kurtosis and higher moments. The use of an alternative model yielded some interesting results according to the researchers. Using the RL-model showed significant differences in the estimates of market risk for insurers with returns that strongly depart from a normal distribution as well as for small insurers. They concluded by stating that it would make more sense to use the alternative RL-model than the CAPM for these insurers with asymmetrical returns or when these insurers were smaller.

As already indicated in this literature review there are numerous difficulties in valuing companies when using the CAPM and cost of equity estimates. These difficulties are compounded when valuing private companies (Livingston, 2013). The illiquidity and lack of transparency of private companies only add to the complexity of the models used to determine an appropriate discount rate. In most cases investors in private companies will demand a premium for small size, the lack of a public market and the loss of diversification, leading to an increased cost of equity. The earlier discussion of levered and unlevered betas has limited application to public companies. For private companies it may be necessary to consider adjusting the CAPM-based approach for specific risk factors that are unique to private companies. It is however possible to use the betas of comparable public companies for the valuation of a private company by first adjusting for any differences in debt and then adjusting for factors like small size and illiquidity (Livingston, 2013).

A number of recent studies have investigated the reliability of cost of equity estimates (McInnes, 2010). All of these studies, for example Botosan and Plumlee (2005) and Easton and Monahan (2005) used different methods of determining the reliability of cost of equity. It is interesting to note that most studies were using expected returns in their calculations. It was only the paper of McInnes on the effect of earnings smoothness on implied cost of equity that recently used observed returns in his tests. In his study McInnes did not find any relation between earnings smoothness and average stock returns over a 30 year period which is in contradiction to the common notion that earnings smoothness will result in a lower cost of equity (McInnes, 2010).

The majority of the studies done on cost of equity are based on US data from US companies. One study investigating the cost of equity in a different country was the Gregory and Michou (2009) study “Industry cost of equity capital: UK evidence.” Their approach to evaluating the cost of equity in the UK was based on the Fama and French methodology for the analysis of US companies where they examined the static and rolling versions of the CAPM. They elaborate on this study and also review a number of alternative models including the Fama-French three-factor model (1993, 1995, 1996), the Cahart four-factor model (1997), conditional versions of the CAPM and three-factor model as well as a simple market adjusted returns model. According to Gregory and Michou (2009) the results of their study paints a bleak picture for the CAPM with large errors in estimating the cost of equity, irrespective of which alternative model is used. They do

however conclude the study by stating that despite the noisiness of the estimates all models investigated deliver a result significantly better than simply assuming that beta is equal to one for all firms. The study of Claus and Thomas (2001) also examined five other large stock markets from developed countries – Canada, France, Germany, Japan and the United Kingdom – but they found that their results were similar to what was found in the USA.

Although most studies of cost of equity has been based on US companies it might not necessarily detract from the international applicability of these studies. The increasing globalisation of capital markets and investment strategies indicated that different countries could use similar valuation models with small adjustments for factors unique to their country (Trombetta, 2004). In countries with a significantly large and important stock market the kind of training that financial analysts receive should be fairly similar around the world. Most studies on implied cost of equity across different countries show little differences between the valuation methods used in the different countries (Chen et al., 2004) although the choice of earnings-based valuation model used may depend on analysts' interpretation of their financial reporting environment.

2.7 Cost of equity empirical testing literature – South Africa

As we have highlighted previously, empirical testing on the JSE in South Africa has been limited and has provided limited support for the CAPM. Van Rensburg (2002) stated:

> "Amazingly, almost all prior South African finance research has been biased towards finding no relationship between JSE share returns and prescribed economic variables."

He goes on to conclude that the JSE All Share Index is not mean-variance efficient and that the CAPM therefore appears to be invalid for the South African equity market as well (Van Rensburg P., 2002). He recommends the use of a two-factor arbitrage pricing theory (APT) model. In a study the following year Van Rensburg and Robertson (2003) followed the Fama and French methodology in their empirical analysis of the JSE over the period 1990 to 2000 and found both a size and price to earnings effect but concluded that the results did again not support the CAPM (Ward & Muller, 2012). Strugnell, Gilbert and

Kruger (2011) did further research using JSE data from 1994 to 2007 and found similar results.

In 2007 Samouilhan published a paper that investigated the risk and return relationship of companies listed on the JSE. In his literature review he almost exclusively referred to international studies confirming again the lack of empirical testing done on the South African equity market. The methodology followed by Samouilhan was a two-factor intertemporal CAPM based on the work of Merton (1973) and he found that there was an historic reward for risk taken on the JSE providing some support to the CAPM theory (Samouilhan, 2007).

Ward and Muller (2012) on the other hand constructed five equal weighted portfolios based on the ranked beta methodology and analysed the data from the 160 biggest companies on the JSE from 1986 to 2011 and actually found an inverse relationship between beta and returns. According to these researchers their findings made the single factor CAPM "effectively redundant" for the South African equity market (Ward & Muller, 2012).

2.8 Summary and conclusion to the literature review

Given the differing models and assumptions found in the literature, it is not unexpected to find differences in the results of these varied studies with significant differences between the expected return on equity and the actual cost of equity (Ashton & Wang, 2013). This is even more evident when comparing findings based on historic returns with findings based on more recent returns or forecasts of earnings.

Perhaps the one study found that resembles the approach followed in this research project most closely, was the work of Claus and Thomas (2001): "Equity premia as low as three percent? Evidence from analysts' earnings forecasts for domestic and international stocks markets." In this study they described their aim as follows:

> "Our objective is to show empirically that eight percent is too high an estimate for the equity return in recent years. Rather than examine observed returns, we estimate for each year since 1985 the discount rate that equates US stock market valuations with the present value of prevailing forecasts of

future flows. Subtracting ten-year risk-free rates from these estimated discount rates suggests that the equity premium is only about three percent."

It is important to note that the equity premium referred to by Claus and Thomas in their study is the same as the market risk premium term used in this research project.

This literature review discussed all the aspects of the CAPM that this research report endeavoured to study. The literature on the subject over the last 60 years is incredibly diverse and it is impossible to include all studies. The aim was to include all the most important and most relevant studies to this specific research problem.

3. Research Questions and Hypotheses

The primary purpose of this research report was to determine an implied cost of equity through the empirical testing of financial and market data of JSE listed companies. This implied cost of equity could then be used to determine an implied market risk premium for the South African equity market that could be compared to the benchmark market risk premium commonly used in valuations in South Africa. The literature review concluded that this had been attempted before in numerous studies employing various methodologies but with inconclusive results and limited application to the South African equity market.

Although validity of the CAPM theory had been vehemently questioned and criticised in its 50 year existence, it still finds application in academic teachings and the business environment around the world. A secondary aim of the research project was to develop a method to test the validity of the CAPM by comparing the estimated cost of equity and the implied cost of equity rates for correlation. The intention of this study was to take a different approach to previous empirical studies and obtain answers to a number of research questions and hypotheses that would successfully address the stated primary and secondary purpose of the research project.

The research questions were as follows:

Research question 1:

> **"Can an implied cost of equity be determined for the South African equity market using market capitalisation values, discounted free cash-flow valuations and a rearranged CAPM equation?"**

Research question 2:

> **"Using the method described in research question 1, what was the average implied cost of equity for the South African equity market that was obtained from these results and did this figure make intuitive sense?"**

Research question 3:

"Did the implied cost of equity for the South African equity market change significantly annually and if it did, what can be cited as the underlying reasons for this change?"

Research question 4:

"What was the average implied market risk premium for the South African equity market that could be determined from the aforementioned implied cost of equity found in this research report and did this figure make intuitive sense?"

The method that was followed to obtain answers to the stated research questions was through viewing and comparing the different means calculated from the estimated and implied cost of equity rates of 100 JSE listed companies over a period of eight years.

The main hypothesis of this study questioned the validity of the implied cost of equity and by extension the CAPM by testing for a correlation to the estimated cost of equity using a simple linear regression on the two sets of data points. Furthermore, sub-hypotheses were formulated where the same correlation test could be done per year of the study and per company included in the study in an attempt to test further for correlation.

The null hypothesis for the main hypothesis and each sub-hypothesis stated that there was a correlation between the estimated cost of equity (est.Ke) and the implied cost of equity (imp.Ke). The alternative hypothesis stated that no correlation existed between the estimated cost of equity and the implied cost of equity. In these hypotheses the ≠ symbol implies no correlation and the = symbol implies correlation:

Hypothesis 1 – for the entire data set:

Null hypothesis (H_0): **est.Ke = imp.Ke**

Alternative hypothesis (H_A): **est.Ke ≠ imp.Ke**

Hypothesis 2 – per year:

Null hypothesis (H_0): **est.Ke = imp.Ke**

Alternative hypothesis (H_A): **est.Ke ≠ imp.Ke**

Hypothesis 3 – per company:

Null hypothesis (H_0): **est.Ke = imp.Ke**

Alternative hypothesis (H_A): **est.Ke ≠ imp.Ke**

The test for correlation to obtain an answer to the above hypotheses had to be repeated a number of times – once on the entire data set, once for each year of the study (8 repetitions) and once for each company in the study (approximately 100 repetitions). In the data points of the different companies where no valid data was available for a specific year or where less than three data points for each variable was available, no regression test could be performed.

4. Research methodology

4.1 Introduction

This research paper endeavoured to develop an empirical estimation of the cost of equity from the CAPM by using real market data. It further aimed to determine if a correlation existed between the cost of equity as estimated by the traditional CAPM equation and the cost of equity as implied by the market data. The ultimate aim was to design an alternative model that could provide a cost of equity solution for the South African equity market as a whole from which a more accurate market risk premium could be estimated for use in public as well as private company valuations.

Purely quantitative data was used and different types of research designs were applied throughout this research report. A descriptive research design (Saunders & Lewis, 2012) involving the collection of measurable, quantifiable data through the analysis of secondary data was used as a starting point. An explanatory research design was then applied in an attempt to find a causal relationship between two variables through statistical analysis. All information used in this research report was secondary data from JSE listed companies and therefore there was no need to design a primary data collection instrument. A secondary data collection instrument was used in the form of a template spread sheet.

The measurement scale that was applied was percentages which allowed for comparisons between varying data sets and for statistical tests to be performed (Zikmund, Babin, Carr, & Griffin, 2013). A number of assumptions had to be made in the analysis of the data to simplify the calculations. These assumptions will be explained in detail during each step of the research process in the discussion of the research methodology that was followed.

In the following sections the unit of analysis, the population, sample size, sample method and the research design that was applied in the collection of the relevant data points will be discussed. Finally, this will be followed by a breakdown of the process employed for the statistical data analysis and the limitations that were identified in this study.

4.2 Unit of analysis

The unit of analysis used in this study was 100 listed companies included in the JSE ALSI as at 31 January 2013. Quantitative data from the JSE including share prices, market capitalization and share betas as well as financial statement information from the annual reports of the listed companies were reviewed. The study was limited to information obtained in relation to the sample companies over a period of eight years between 2005 and 2012.

All information used in the study was taken in rand terms and the results of the research process were estimations of cost of equity and implied cost of equity expressed as a percentage.

4.3 Population, sampling size and sampling method

The population relevant to this study was any company in South Africa that produce financial statements from which specific data could be extracted that allowed for a DCF valuation to be conducted with a reasonable amount of accuracy. Due to fact that some of the variables used in the DCF valuation model and in the determination of the WACC (for example beta) was more easily or more appropriately applied to listed companies, only companies listed on the JSE at the time that we took the sample for this study was included. It therefore follows that the results of the study will be more applicable to listed companies. It is however submitted that with certain adjustments it may be possible to apply the outcome of this study to private companies as well.

Given that the study is limited to JSE listed companies it was possible to obtain a complete list of all members of the chosen population and therefore the sampling technique applied was probability sampling (Saunders & Lewis, 2012). On the date of the sample, 31 January 2013, 95.23% of the total market capitalization of the JSE was represented by the top 100 listed companies on the ALSI (appendix 1). It is submitted that this was a representative sample of the relevant population and therefore the study was limited to these 100 listed companies. It was noted that extreme or abnormal circumstances influencing the share price or financial statements of smaller companies over the short-term had a more significant effect on the data needed for the study and could skew the findings of the study. The effect that extreme or abnormal circumstances had on the data

of companies with a larger market capitalisation was less severe providing more support for limiting this study to these 100 companies..

4.4 Data collection and the research design

This study employed exclusively secondary data that was publicly available and qualified as non-human. Therefore no consent was required from the specific companies involved in the study. The majority of the information used was obtained from electronic databases that the Gordon Institute of Business Science (GIBS) had access to and the necessary permission to use. This data was supplemented where necessary by financial statement information from the annual reports of the specific companies studied. This information was obtained from the public websites of these companies and was primarily used for verification of certain information obtained from the databases.

The electronic databases used for the secondary data was:

- The McFas database providing comprehensive financial statement data for all JSE listed companies.
- The JSE Bulletin database providing share prices, market capitalization and beta scores for all JSE listed companies.

Both these databases were made available for this study by Professor Mike Ward and Chris Muller.

The process of data collection and the research design entailed a multi-stage, multi-step process. Each stage in the process will be discussed in detail in this chapter of the research report with specific findings at each stage and the simplifying assumptions made at each stage discussed in the next two chapters. The priority in which the different stages and steps were undertaken was determined by the results this study sought to obtain. The stages were shortly:

Stage 1: Determine sample of companies to be used.
- Step 1: Construct spread sheet
- Step 2: Populate date from JSE Bulletin database
- Step 3: Sort data

Stage 2: Free cash-flow valuations

Step 1: Design spread sheet

Step 2: Populate with data from McFas database

Step 3: Calculate WACC and WACC components

Step 4: Conduct DCF valuation

Step 5: Goal seek to implied cost of equity

Stage 3: Repeat stage 2 for all companies in the study

Step 1: Repeat process 100 times and transfer data points – estimated and implied cost of equity – to final results spread sheet

Step 2: Statistical analysis of data points

Stage 1

The first stage in the research process was to determine the sample of companies from the ALSI that were used in the study. This was done by means of constructing a Microsoft Excel spread sheet where the company codes and company names of all companies listed on the JSE could be entered using the JSE Bulletin database. Thereafter the JSE Bulletin functions were applied to determine the market capitalisation of each company on a chosen date, 31 January 2013. The final step in the first stage of the process was to sort the companies in descending order based on their market capitalisation and then identifying and highlighting in green, the top 100 companies to be used in the study. This spread sheet is included in appendix 1 of this research report and an example of the layout of the data with the top ten companies is given below for ease of reference.

Ward and Muller (2012) followed a similar approach in determining the companies included in their empirical testing of JSE companies. They chose the top 160 companies on the JSE ALSI at the time representing 99% of the market capitalisation of the JSE. In this study 100 companies representing 95% of the market capitalisation of the JSE were chosen.

Table 1: Sample of companies with market capitalisation

Company Code	Company Name	% of Total JSE Market Capitalization - 2013	Cumulative % of Total JSE Market Capitailization - 2013	Market Cap
BTI	British American Tob plc	11.67%	11.67%	R 940 512 379 891.68
SAB	SABMiller plc	9.13%	20.81%	R 735 963 642 323.80
BIL	BHP Billiton plc	8.15%	28.96%	R 657 026 560 086.78
CFR	Compagnie Fin Richemont	4.80%	33.76%	R 386 802 000 000.00
AGL	Anglo American plc	4.69%	38.45%	R 378 069 397 974.00
MTN	MTN Group Ltd	4.09%	42.54%	R 329 798 105 132.40
SOL	Sasol Limited	3.11%	45.65%	R 250 259 418 157.32
NPN	Naspers Ltd -N-	2.98%	48.63%	R 239 873 090 216.97
KIO	Kumba Iron Ore Ltd	2.41%	51.03%	R 193 937 262 200.32
SBK	Standard Bank Group Ltd	2.33%	53.36%	R 187 400 162 087.37

Stage 2

The second stage in the research process involved constructing a template spread sheet (included in the electronic submission accompanying this report) that could first determine an estimated WACC and all the components thereof as well as any other variables used in a traditional DCF valuation and secondly complete the relevant valuation. The spread sheet was based on the McFas database functions that could identify a share code and share name that could be changed for each company by simply entering a new share code for each company to be analysed. All relevant data in the spread sheet was linked to this share code which meant every time the share code was changed, the financial statement data in the spread sheet changed to that of the company being used. Once the spread sheet was completed it served as the template for repeating the second and third stages of the process 100 times for each company identified for this study.

The next step in this second stage was capturing the dates for the extraction of the data to be used. A McFas function was used again to obtain the latest date for which information was available and then the relevant date was used with a previous year function to provide the eight years from 2005 to 2012 that was needed for this study. All financial statement

information extracted from the database for each company was now available in a practical format for each year of the study. At this stage the variables and information needed for the calculations and the DCF valuations could be entered.

The following step in the collection process was conducting the DCF valuation, starting with calculating an appropriate WACC. The first component of the WACC was the cost of debt for which an appropriate interest rate for the debt of the company and an appropriate tax rate, were required. The average annual South African prime interest rate (Trading Economics, 2013) and the South African corporate tax rate for each year (Trading Economics, 2013) were used respectively in the following equation in the spread sheet to determine the cost of debt (Kd):

Kd = Interest Rate x (1 – Corporate Tax Rate)

An example of the first part of the template spread sheet is given below where the cost of debt for a company is determined and the share code, share name and the relevant dates are provided:

Table 2: Example of calculation of cost of debt as component of WACC

ACP	ACUCAP PROPERTIES LIMITED			
YEAR	FINANCIAL STATEMENTS YEAR END DATE	SA PRIME LENDING RATE - AVERAGE PER ANNUM	SA CORPORATE TAX RATE	COST OF DEBT (Kd)
2012	31 Mar 12	8.50%	28.00%	6.12%
2011	31 Mar 11	9.00%	28.00%	6.48%
2010	31 Mar 10	9.50%	28.00%	6.84%
2009	31 Mar 09	12.00%	28.00%	8.64%
2008	31 Mar 08	15.00%	28.00%	10.80%
2007	31 Mar 07	13.50%	29.00%	9.59%
2006	31 Mar 06	11.50%	29.00%	8.17%
2005	31 Mar 05	10.50%	29.00%	7.46%
2004	31 Mar 04	11.00%	30.00%	7.70%
2003	31 Mar 03	13.40%	30.00%	9.38%

The second component of the WACC that was required was the cost of equity for which an appropriate risk-free rate, the market risk premium and the beta for the specific company was needed. The South African R157 bond rate (Sharenet, 2013) was used as a risk-free rate and a market risk premium of 7.2% was chosen. The R157 bond rate is the most liquid and well traded bond in the South African market and it is used as a risk-free rate by 14% of valuation professionals in South Africa (PWC Corporate Finance, 2012). The market risk premium that was chosen was determined by collating the data from a number of studies on market risk premiums in South Africa. This data is discussed in more detail in chapter 7 of this research report. The rate used for the market risk premium in this research report was the applicable rate for South Africa from the 2012 edition of the Equity Risk Premium publication by the Stern School of Business in New York (Damodaran, 2012).

The beta that was used as input for this equation was a 60-month beta specific to the company being studied. The beta is obtained from a JSE Bulletin function based on the share code in the spread sheet. The beta for 2012 for each company was used for each year of the study as the betas calculated by the JSE Bulletin for each preceding year was increasingly smaller which made the determination of a meaningful cost of equity difficult.

The equation used to determine the cost of equity (Ke) with these variables was:

Ke = Risk-Free rate + (Market Risk Premium x Beta)

The last two variables included in the template spread sheet at this time, that were not unique to the specific company being analysed, was the long term growth rate used in the valuation of the terminal value of the company and the forecasted growth rate of free cash-flow in the specific company for the next five years. An example of the next part of the spread sheet providing the calculation of the cost of equity, long-term growth rate and forecasted free cash-flow growth rate is given below. The estimated cost of equity calculated based on the risk-free rate and the market risk premium was highlighted in yellow in the template spread sheet as this was the first important data point that was collected for the final analysis:

Table 3: Example of calculation of cost of equity and other assumptions

SA RISK FREE RATE - R157 BOND RATE (RFR)	SA MARKET RISK PREMIUM (MRP)	BETA	COST OF EQUITY (Ke) BASED ON ESTIMATES OF RFR AND MRP	LONG TERM GROWTH RATE USED FOR VALUATION OF TERMINAL VALUE	FORECASTED GROWTH RATE OF FREE CASH FLOW IN FIRST 5 YEARS OF VALUATION
6.00%	7.20%	0.26	7.89%	4%	10.00%
7.50%	7.20%	0.26	9.39%	4%	10.00%
8.03%	7.20%	0.26	9.92%	4%	10.00%
8.47%	7.20%	0.26	10.36%	4%	10.00%
10.72%	7.20%	0.26	12.61%	4%	10.00%
8.49%	7.20%	0.26	10.38%	4%	10.00%
8.65%	7.20%	0.26	10.54%	4%	10.00%
8.00%	7.20%	0.26	9.89%	4%	10.00%
10.20%	7.20%	0.26	12.09%	4%	10.00%
9.42%	7.20%	0.26	11.31%	4%	10.00%

The entire template spread sheet had been designed in such a way that any of the variables could be changed and the impact of such changes on both the estimated and implied cost of equity could be obtained without requiring further complicated calculations.

The final component needed for the determination of a WACC was the debt to total capital ratio of the company. This was determined next by using the McFas database functions to extract the total debt and total equity of the specific company and adding these two figures together to obtain a total capital figure for the company. The debt to capital ratio was then calculated by dividing the total debt by the total capital and presenting the result as a percentage.

Table 4: Example of calculation of debt to total capital ratio

DEBT	EQUITY	TOTAL CAPITAL	CASH AND NEAR CASH ON BALANCE SHEET	DEBT TO TOTAL CAPITAL RATIO
B022	B013		B037	
TOTAL LIABILITIES	Total Shareholders Interest		Cash & Near Cash	
R 5 560 126 000	R 3 777 372 000	R 9 337 498 000	R 8 399 000	59.55%
R 5 369 675 000	R 3 313 077 000	R 8 682 752 000	R 5 977 000	61.84%
R 4 888 604 000	R 2 489 553 000	R 7 378 157 000	R 37 912 000	66.26%
R 4 614 416 000	R 2 016 960 000	R 6 631 376 000	R 22 205 000	69.58%
R 4 543 422 000	R 2 110 213 000	R 6 653 635 000	R 13 110 000	68.28%
R 2 203 638 000	R 1 300 725 000	R 3 504 363 000	R 5 775 000	62.88%
R 1 706 220 000	R 775 640 000	R 2 481 860 000	R 682 000	68.75%
R 1 624 305 000	R 334 906 000	R 1 959 211 000	R 167 487 000	82.91%
R 1 117 836 000	R 82 137 000	R 1 199 973 000	R 117 959 000	93.16%
R 922 721 000	R 22 497 000	R 945 218 000	R 27 141 000	97.62%

At this stage it possible to determine a CAPM theory based WACC in the template spread sheet for each specific company using the following equation:

WACC = Kd x Debt/Total Capital + Ke x (1 – Debt/Total Capital)

After determining the WACC to be used in the free cash-flow valuation for each year of the study the free cash-flow available in the company for each year of the study had to be calculated. The different components of the free cash-flow calculation were:

- **Net operating profit after tax - NOPAT**
- **Depreciation – DEP**
- **Spend on capital expenditure – CAPEX**
- **Changes in net working capital - NWC**

Each of these components was extracted from the financial statements of the company by using McFas functions in the template spread sheet. The net operating profit after tax was calculated by taking the earnings before interest and tax (EBIT) and applying the corporate

tax rate for the year in question to this figure. For the capital expenditure component required two financial statement entries had to be used namely, Land & Buildings and Plant & Equipment. The following equation was then used to determine the annual free cash-flow (FCF) of each company:

FCF = EBIT x (1 – Tax Rate) + DEP – CAPEX – NWC

An example of this part of the template spread sheet with these free cash-flow calculations is given below:

Table 5: Example of calculation of free cash-flow

EBIT	NOPAT	DEPRECIATION	CAPEX	LAND & BUILDINGS	PLANT & EQUIPMENT	CHANGE IN WORKING CAPITAL
C701		C702		AS01	AS02	C706
Operating Profit/loss		Depreciation & Non Cash-items		Land & Buildings : gross	Plant & Equipment : gross	Decrease/increase Working Capital
R 492 319 000	R 354 469 680	R 115 803 000	R 457 742 000	R 7 384 501 000	R 1 387 000	-R 8 724 000
R 525 883 000	R 378 635 760	R 47 661 000	R 1 083 529 000	R 6 926 761 000	R 1 385 000	-R 5 858 000
R 427 677 000	R 307 927 440	R 62 660 000	R 481 285 000	R 5 841 064 000	R 3 553 000	-R 64 240 000
R 422 554 000	R 304 238 880	R 56 604 000	-R 170 957 000	R 5 360 301 000	R 3 031 000	-R 51 183 000
R 345 004 000	R 248 402 880	R 466 000	R 2 649 971 000	R 5 532 368 000	R 1 921 000	-R 2 998 000
R 137 329 000	R 97 503 590	R 70 753 000	R 580 371 000	R 2 883 409 000	R 909 000	R 2 050 000
R 171 840 000	R 122 006 400	R 125 000	R 637 914 000	R 2 303 302 000	R 645 000	R 1 870 000
R 116 205 000	R 82 505 550	R 15 278 000	#N/A	R 1 665 622 000	R 411 000	R 17 614 000
R 121 417 000	R 84 991 900	R 400 000	#N/A	R 1 067 900 000	#N/A	R 31 778 000
R 110 738 000	R 77 516 600	#N/A	#N/A	R 912 650 000	#N/A	R 24 265 000

The result of the aforementioned free cash-flow calculation was then appropriately adjusted and the forecasted growth rate was applied to it for a period of five years. As mentioned previously a combination of observed and forecasted or expected earnings were used for the free cash-flow calculations. This approach was followed by a number of previous empirical studies including Berger (2011), Levy (2011) and Borgman and Strong (2006). In the mentioned studies analysts' forecasts of earnings were used to determine the free cash-flows. In this research report actual earnings were used and then a forecasted annual growth in earnings of 10% was applied to calculate the future feee cash-flows. Refer to the example below:

Table 6: Example of free cash flow forecast for 5 years

FREE CASH FLOW INCLUDING DEPRECIATION AND CAPEX BUT EXCLUDING ABNORMAL ITEMS	FREE CASH FLOW EXCLUDING DEPRECIATION AND CAPEX	FORECASTED FCF BASED ON 5 YEAR GROWTH RATE - YR + 1	FORECASTED FCF BASED ON 5 YEAR GROWTH RATE - YR + 2	FORECASTED FCF BASED ON 5 YEAR GROWTH RATE - YR + 3	FORECASTED FCF BASED ON 5 YEAR GROWTH RATE - YR + 4
R 21 254 680	R 363 193 680	R 23 380 148	R 25 718 163	R 28 289 979	R 31 118 977
-R 651 374 240	R 384 493 760	-R 716 511 664	-R 788 162 830	-R 866 979 113	-R 953 677 025
-R 46 457 560	R 372 167 440	-R 51 103 316	-R 56 213 648	-R 61 835 012	-R 68 018 514
R 582 982 880	R 355 421 880	R 641 281 168	R 705 409 285	R 775 950 213	R 853 545 235
-R 2 398 104 120	R 251 400 880	-R 2 637 914 532	-R 2 901 705 985	-R 3 191 876 584	-R 3 511 064 242
-R 414 164 410	R 95 453 590	-R 455 580 851	-R 501 138 936	-R 551 252 830	-R 606 378 113
-R 517 652 600	R 120 136 400	-R 569 417 860	-R 626 359 646	-R 688 995 611	-R 757 895 172

It was necessary at this time of the data collection process to judge the free cash-flow of each company for each year and make a decision on whether, if any, abnormal items from the financial statements of the company had to be excluded from the calculations. In some cases it was necessary to exclude depreciation and capital expenditure from the calculation as well.

The free cash-flow valuation was completed by calculating the Net Present Value (NPV) of the five year free cash-flows and adding the NPV of the terminal value (TV) calculated using the long-term growth rate (GR). The long-term growth rate used in our study was

four percent. In their work on implied growth rates Ward and Muller (2010) found a long-term growth rate of 12% but this rate would have made the determination of cost of equity in this study nearly impossible. Therefore a percentage slightly higher than the expected long-term growth rate of South Africa was chosen as the long-term growth rate for the equation. The equation used for the calculation of the terminal value was:

TV = (FCF in year 5 x (1 + GR)) / (WACC – GR) x (1 / (1 + WACC))

An example of this part of the template spread sheet is shown below:

Table 7: NPV of cash-flows and terminal values

NPV OF TERMINAL VALUE	NPV OF CASH FLOWS	FREE CASH FLOW VALUATION BASED ON CAPM WACC
R 819 949 402	R 425 602 901	R 1 245 552 304
-R 19 162 421 171	-R 2 202 989 595	-R 21 365 410 766
-R 1 248 072 373	R 164 093 313	-R 1 083 979 060
R 11 091 189 351	R 2 503 041 773	R 13 594 231 124
-R 28 897 242 079	-R 8 124 712 549	-R 37 021 954 629
-R 6 695 955 530	-R 1 424 950 472	-R 8 120 906 002
-R 10 484 185 192	-R 1 839 130 769	-R 12 323 315 961

At this point in the construction of the template spread sheet it was possible to determine a CAPM based WACC and cost of equity for each company and use these estimations to determine a DCF based valuation for the company. The next step was to determine the market capitalisation of the company on the same date that the free cash-flow valuation was done based on the share price and thereafter determine the difference between the two values. It was however important to first adjust the market value of the company based on the share price by the debt and cash or near-cash in the company. There was substantial support to be found in the literature for the use of current stock prices in the determination of an implied cost of equity (Borgman & Strong, 2006). An example of this part of the template spread sheet is provided below:

Table 8: Adjusted market capitalization and difference from DCF valuation

MARKET CAP	MARKET CAP + DEBT LESS CASH ON BALANCE SHEET	DIFFERENCE BETWEEN FCF VALUATION AND MARKET CAP
R 7 223 151 100	R 12 774 878 100	R 11 529 325 796
R 5 904 674 963	R 11 268 372 963	R 32 633 783 729
R 5 211 824 997	R 10 062 516 997	R 11 146 496 056
R 4 048 094 732	R 8 640 305 732	-R 4 953 925 392
R 3 869 783 287	R 8 400 095 287	R 45 422 049 916
R 3 218 741 280	R 5 416 604 280	R 13 537 510 282
R 1 865 620 800	R 3 571 158 800	R 15 894 474 761

Working from the CAPM based WACC the goal-seek function of Microsoft excel was applied to obtain a WACC at which the difference between the market capitalisation of the company and the DCF valuation was zero. Following from the newly formulated implied WACC, it was possible to determine an implied cost of equity (ICOE) rom this new implied WACC by applying the following rearranged CAPM equation:

ICOE = (New WACC – (Kd x Debt/Total Capital)) / (1 – Debt/Total Capital)

The final part of the template spread sheet is presented below. The WACC is presented in yellow as it is the key component in the final step of the second stage in constructing the template spread sheet. The new implied WACC is presented in orange and the implied cost of equity, the ultimate aim for this stage of the research process, is presented in green:

Table 9: Calculation of implied cost of equity through goal-seek

CAPM BASED WACC	WACC IF DIFFERENCE BETWEEN FCF VALUATION AND MARKET CAP IS R0	NPV OF TERMINAL VALUE BASED ON NEW WACC	NPV OF CASH FLOWS BASED ON NEW WACC	FCF VALUATION BASED ON NEW WACC	DIFFERENCE BETWEEN FCF VALUATION AND MARKET CAP - GOAL SEEK TO R0	IMPLIED COST OF EQUITY
6.84%	7.50%	R 644 041 917	R 421 646 646	R 1 065 688 563	R 11 709 189 537	9.53%
7.59%	8.19%	-R 15 976 952 568	-R 2 155 429 005	-R 18 132 381 572	R 29 400 754 536	10.96%
7.88%	8.53%	-R 1 036 212 574	R 165 822 985	-R 870 389 589	R 10 932 906 586	11.86%
9.16%	9.03%	R 11 450 907 057	R 2 512 694 558	R 13 963 601 615	-R 5 323 295 883	9.93%
11.37%	7.68%	-R 68 503 173 461	-R 9 164 542 540	-R 77 667 716 001	R 86 067 811 288	0.97%
9.88%	6.18%	-R 21 406 541 947	-R 1 615 664 226	-R 23 022 206 173	R 28 438 810 453	0.42%
8.91%	8.13%	-R 12 909 801 590	-R 1 888 037 843	-R 14 797 839 433	R 18 368 998 233	8.05%
7.87%	7.17%	#N/A	#N/A	#N/A	#N/A	5.78%
8.00%	7.88%	#N/A	#N/A	#N/A	#N/A	10.36%
9.43%	9.38%	#N/A	#N/A	#N/A	#N/A	9.46%

Stage 3

Stage 3 of the research process entailed repeating the entire stage 2 of the process for each of the 100 companies in the study through the application of the template spread sheet and thereafter transferring the estimated cost of equity and the implied cost of equity to a final results spread sheet that would contain all the data points for final analysis (appendix 2). The actual spread sheet for each of the 100 companies in the study presenting the results of this repeated process is not included in the physical submission of this research report but it is included in the electronic copy of the submission.

4.5 Process used for the data analysis

The data analysis was performed on all the cost of equity data points in the final results spread sheet (appendix 2). The data points were always kept in two columns – estimated cost of equity and implied cost of equity – and then sorted as follows. The relevant spread sheets are also included in the electronic submission accompanying this report.

- Sheet 1 – All data points
- Sheet 2 – Data points per year
- Sheet 3 – Data points per company

The statistical analysis of the data was performed by applying descriptive statistics and a distribution fitting to the data with a focus on determining the mean for each set of data points. Next, a simple linear regression was conducted on all the data points to determine whether there was any correlation between the estimated cost of equity data points and the implied cost of equity data points. This statistical analysis was performed on the total sample but also applied on each company for each year of the study.

From the mean of the implied cost of equity data it was possible to determine an implied market risk premium for the South African equity market by rearranging the CAPM equation for a second time. This process was followed for the equity market as a whole as well as for every individual year of the study.

4.6 Limitations applicable to this study

Each part of the research process was considered with the greatest precision to ensure that each variable used was the most appropriate an accurate one possible. Care was taken to obtain data that would withstand scrutiny and where possible steps were taken to mitigate data integrity problems. It is however submitted that the data that this study is based on and the processes applied had several significant limitations. The most important limitations identified were:

- Financial statement information from the McFas database was not reviewed. Only a few random checks were done but the majority of the information was trusted.
- At certain times adjustments were needed to be made to the data. Abnormal items were excluded as far as possible but this was done based on the judgment of the researcher and it was prone to judgment error.
- Where a company made an EBIT loss in any given year it was not possible to determine an implied cost of equity for that specific year.
- It was difficult to determine an appropriate beta for each company for each year of the study and therefore the beta used was based on the 2012 beta for each company.

- Two important variables in the free cash-flow valuation had to be based on assumptions that could not be supported by empirical evidence, the forecasted annual growth rate of free cash-flow or earnings and the forecasted long-term growth rate used in the calculation of the terminal value. These two variables had a significant effect on the ultimate result of this study.
- The market capitalization used in the determination of the implied cost of equity was taken at a single, specific date. Short-term fluctuations in the share price and therefore the company market capitalisation, due to factors other than earnings expectations or the actual performance of the company, could have had a significant effect on the results of this study.
- Some of the results obtained in the analysis were so unlikely that they had to be excluded from the study. An extremely high or even negative cost of equity obtained from the analysis did cast doubt on the validity of the study. Due to this this some companies had to be excluded from the results entirely.

Some of these limitations and the steps taken to lessen the impact of these limitations are discussed in more detail in chapter 6 and 7 of the research report.

5. Results

5.1 Introduction to the results

This chapter of the research report presents the results of this research project. These results were used to answer the research questions posed in chapter 3 and to determine if there was evidence to either reject or not reject the hypotheses also presented in chapter 3. A detailed discussion of these results will follow in chapter 6.

The respective stages of the data collection and research design process will be discussed as was done in chapter 4 but focus will be on the results obtained from each stage and the specific adjustments to the data and assumptions that was needed to move through the data collection process and obtain the final data points. Thereafter results of the statistical analysis employed will be presented with references to the research questions and hypotheses posed earlier.

5.2 Sample generation

The first stage of the research process was focussed on identifying the JSE listed companies that would be used in this study. It was necessary to choose one specific date that would determine which companies would be included in the sample. It was noted that this would result in incomplete data for a number of companies that had not published data in its current form or did not exist in their current form for the entire time period of the study. It furthermore meant that some companies would have been included and others excluded if the 100 most valuable companies of each year as measured by market capitalisation was rather chosen. It is submitted that the method chosen provided more consistency in the data and results that would have been easier to compare and therefore the single date was kept for the sample generation.

The final list of 100 companies that would make up the sample used in this study is presented in Appendix 1 to this research project. The market capitalisation of each company as at 1 January 2013 is included and the relevance of the sample is confirmed by the fact that 95.23% of the total market capitalisation of the JSE is represented by these 100 companies.

5.3 Weighted average cost of capital

The determination of the first component of the WACC, cost of debt, was started by attempting to calculate the interest rate being paid on long-term debt by each company in the study. This proved to be very challenging and the results were confusing and unreliable. It was decided that a proxy for the interest rate applicable to each company was necessary and the average annual prime interest rate in South Africa for each year was chosen. This meant that the cost of debt for each company was identical. While this was not the ideal solution and a debt rating of each company that would determine the appropriate interest rate for that company would have been preferable, the focus of this study was the cost of equity and therefore it was decided to accept this limitation.

It is submitted that this limitation did not detract substantially from the validity of the study as a significant number of the companies where the specific interest rates they were paying were analysed, had a combination of debt at either slightly lower or slightly higher rates than the prime interest rate at the time. The after tax cost of debt used for the study of each company was as follows for each year:

Table 10: Annual after tax cost of debt used for all companies

YEAR	COST OF DEBT (Kd)
2012	6.12%
2011	6.48%
2010	6.84%
2009	8.64%
2008	10.80%
2007	9.59%
2006	8.17%
2005	7.46%
2004	7.70%
2003	9.38%

The second component of the WACC, estimated cost of equity, was estimated by using the CAPM equation. The risk-free rate that was used was the South African R157 bond rate (Sharenet, 2013), while a market risk premium of 7.2% and a 60-month beta specific to each company being analysed was also used. The only one of these three variables

where adjustments were made was beta. The 60-month beta for each company was determined from the database and then used as the beta for each of the eight years of the study. The third and final component of the WACC was the debt to total capital ratio of the specific companies where the actual data from the financial statements was used to calculate the ratios.

The results of this estimated cost of equity and WACC calculations for each of the 100 companies for each of the eight years were contained in the spread sheet done for each company and the results cannot be presented here. These results were included in the electronic submission accompanying this report.

5.4 Free cash-flow valuation

The basis for the DCF valuations done was as far as possible the actual financial statement data for each company in the study. The only assumptions and adjustments that had to be made were:

- Assumed forecasted growth rate for earnings and/or free cash-flow
- Assumed forecasted long-term growth rate
- Adjustments to the free cash-flow calculation for depreciation, capital expenditure and net working capital as well as abnormal items

Where companies made an EBIT loss in a specific year and the DCF valuation could not be completed for that specific year it was excluded from the final results.

5.5 Implied cost of equity

In the last stage of the data collection process all the steps described in this report were repeated 100 times to obtain an implied cost of equity for each company for each of the eight years of the study. Where the DCF valuation resulted in an unusually large or negative implied cost of equity it was excluded from the final results. Where the implied cost of equity data point had to be excluded for a specific company for a specific year the estimated cost of equity for that company for that year was also excluded from the final results to provide consistency in the final data points.

It is interesting to note that there were a number of companies where the result of an implied cost of equity calculation was completely unrealistic. This was the case for most banks and financial service companies. It is clear that an alternative valuation method is needed to determine a cost of equity for these types of companies, similar to what was seen for insurance companies in the literature review.

5.6 Data points

The research process yielded 602 estimated cost of equity data points and 602 implied cost of equity data points. These data points are contained in the excel spread sheet on the electronic submission accompanying this report. The data points were first presented as two lists of cost of equity rates, one estimated and one implied, containing all the data points. This is presented in table form in Appendix 2 to this research project. The data points were then sorted by year and then by company.

The first statistical analysis done on all the data points was descriptive statistics:

Table 11: Descriptive statistics for cost of equity - all data points

STATISTIC	CAPM BASED Ke	IMPLIED Ke
No. of observations	602	602
Minimum	0.031	0.003
Maximum	0.239	0.749
1st Quartile	0.108	0.094
Median	0.128	0.147
3rd Quartile	0.157	0.224
Mean	0.135	0.170
Variance (n-1)	0.001	0.012
Standard deviation (n-1)	0.036	0.110

The data points were also plotted in box plots – see below:

Figure 1: Box plot of estimated Ke – all data points

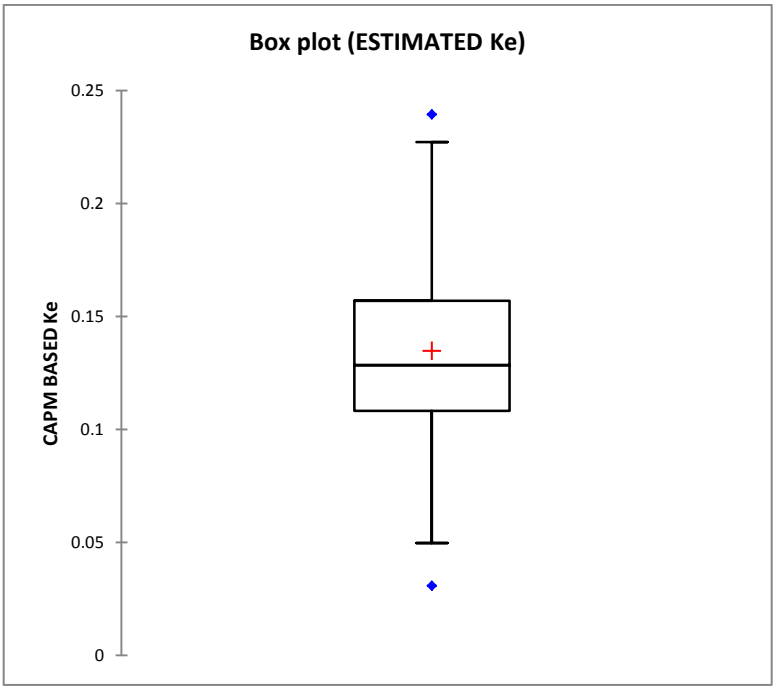
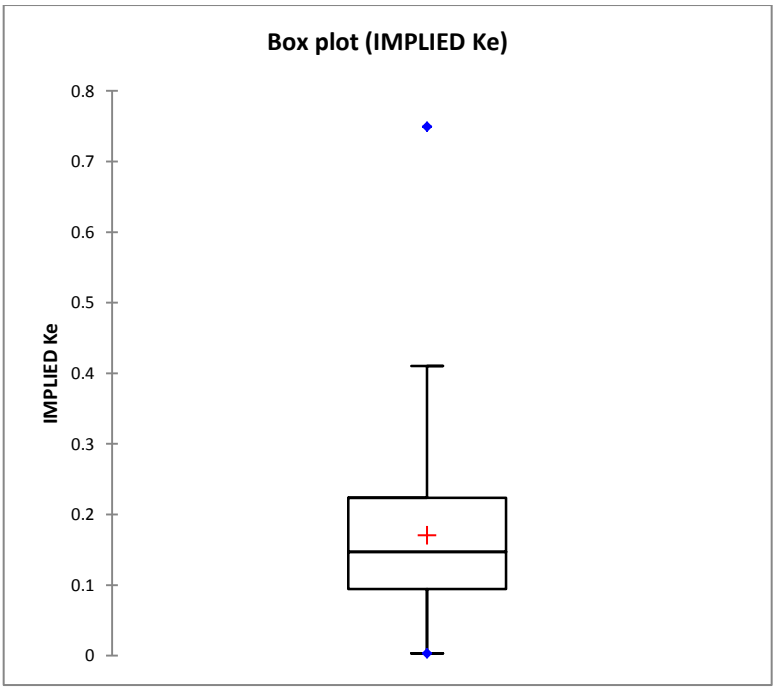


Figure 2: Box plot of implied Ke – all data points



This statistical analysis was completed to get an indication of the range of the data points and to obtain answers to the four research questions posed in chapter 3 of this research project.

The mean for all the estimated cost of equity data points was 13.5%. The mean for the implied cost of equity data points was substantially higher at 17.0%. If this implied cost of equity is entered back into the CAPM equation an implied market risk premium can be calculated for the South African equity market. At the risk-free rate of 6% for 2012, used in this study, the implied market risk premium can then be calculated as 11% for 2012, considerably higher than the estimated 7.2% market risk premium used in the CAPM equation in this research report.

A statistical distribution of the two sets of data points was also done:

Table 12: Statistical distribution estimated Ke – all data points

Statistic	Data	Parameters
Mean	0.135	0.135
Variance	0.001	0.001
Skewness (Pearson)	0.572	0.000
Kurtosis (Pearson)	-0.151	0.000
Kolmogorov-Smirnov test (ESTIMATED Ke):		
D	0.082	
p-value	0.001	
Alpha	0.05	

Figure 3: Histogram – distribution of estimated Ke – all data points

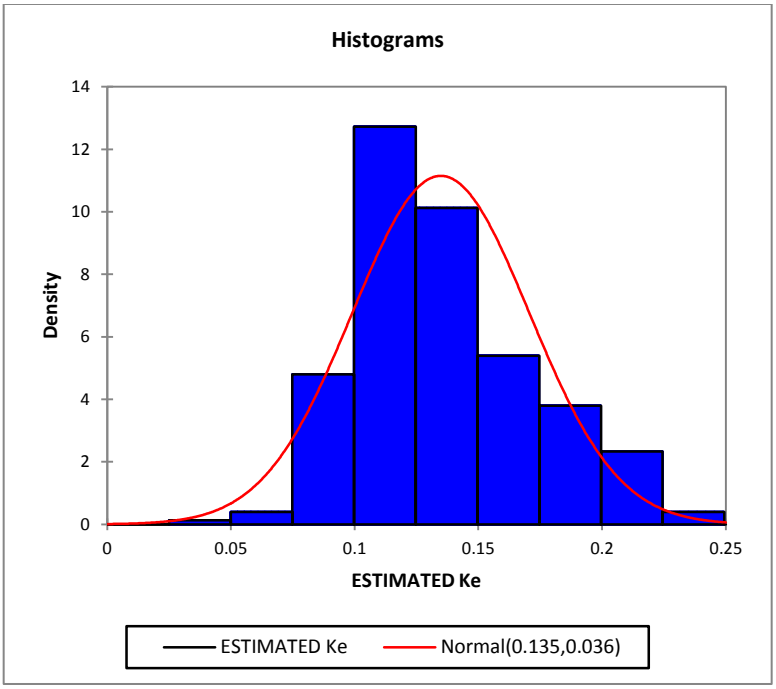
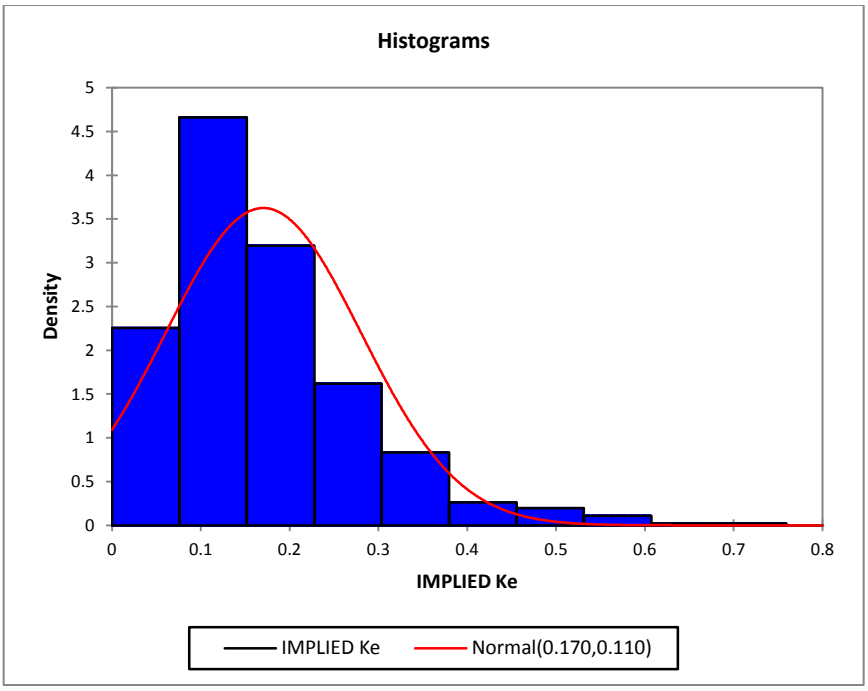


Table 13: Statistical distribution implied Ke – all data points

Statistic	Data	Parameters
Mean	0.170	0.170
Variance	0.012	0.012
Skewness (Pearson)	1.350	0.000
Kurtosis (Pearson)	2.852	0.000
Kolmogorov-Smirnov test (IMPLIED Ke):		
D	0.094	
p-value	< 0.0001	
alpha	0.05	

Figure 4: Histogram – distribution of implied Ke – all data points



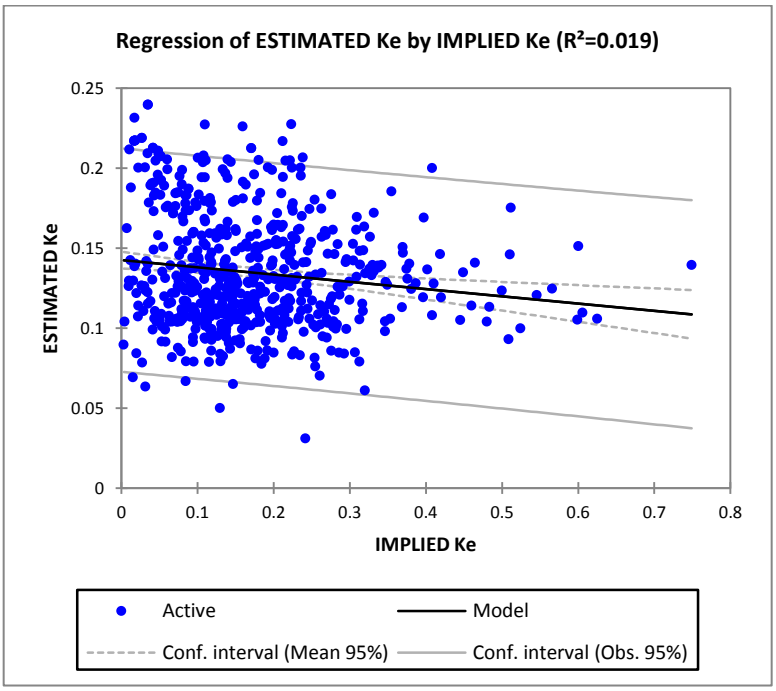
It was interesting that both sets of data did not show a normal distribution and was slightly skewed to the left or lower end of the cost of equity rates.

The final stage in the statistical analysis of the data was to search for a correlation between the estimated cost of equity and the implied cost of equity. If some kind of correlation could be found between the two that would have substantiated the calculation of the estimated cost of equity from assumed variables and also given some validity to the CAPM theory. The test for correlation was done using a simple linear regression test. This test was repeated a number of times, first on the total data set, then per year and finally per company in the study:

Table 14: Regression statistics – all data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	602.000
Sum of weights	602.000
DF	600.000
R^2	0.019
Adjusted R^2	0.018
MSE	0.001
RMSE	0.035
MAPE	23.115
DW	0.432
Cp	2.000
AIC	-4018.440
SBC	-4009.640
PC	0.987

Figure 5: Scatterplot for regression test – all data points



The regression tests done per year are all given below:

Table 15: Regression statistics – 2012 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	86.000
Sum of weights	86.000
DF	84.000
R^2	0.010
Adjusted R^2	-0.002
MSE	0.001
RMSE	0.035
MAPE	29.033
DW	1.881
Cp	2.000
AIC	-577.018
SBC	-572.109
PC	1.037

Figure 6: Scatterplot for regression test – 2012 data points

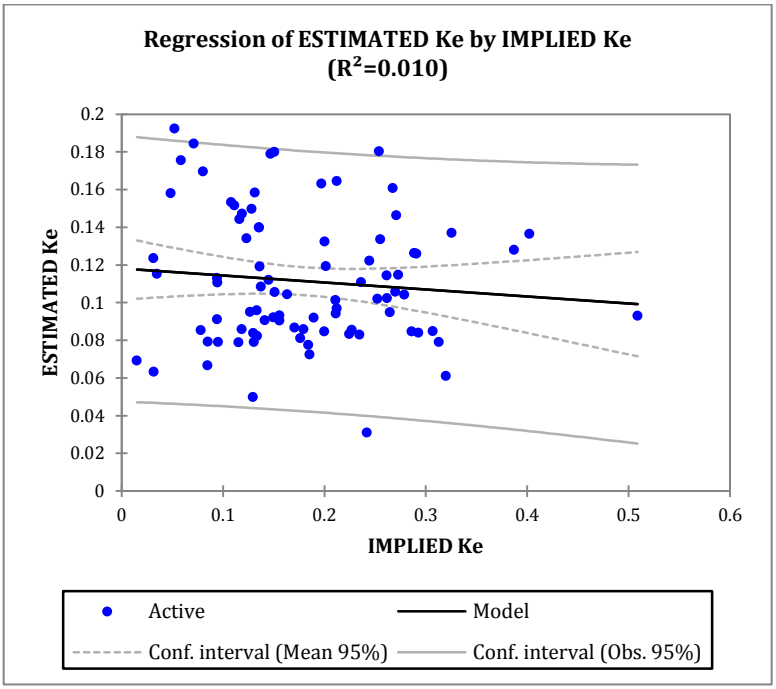


Table 16: Regression statistics – 2011 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	89.000
Sum of weights	89.000
DF	87.000
R^2	0.016
Adjusted R^2	0.005
MSE	0.001
RMSE	0.033
MAPE	22.291
DW	1.858
Cp	2.000
AIC	-605.888
SBC	-600.910
PC	1.029

Figure 7: Scatterplot for regression test – 2011 data points

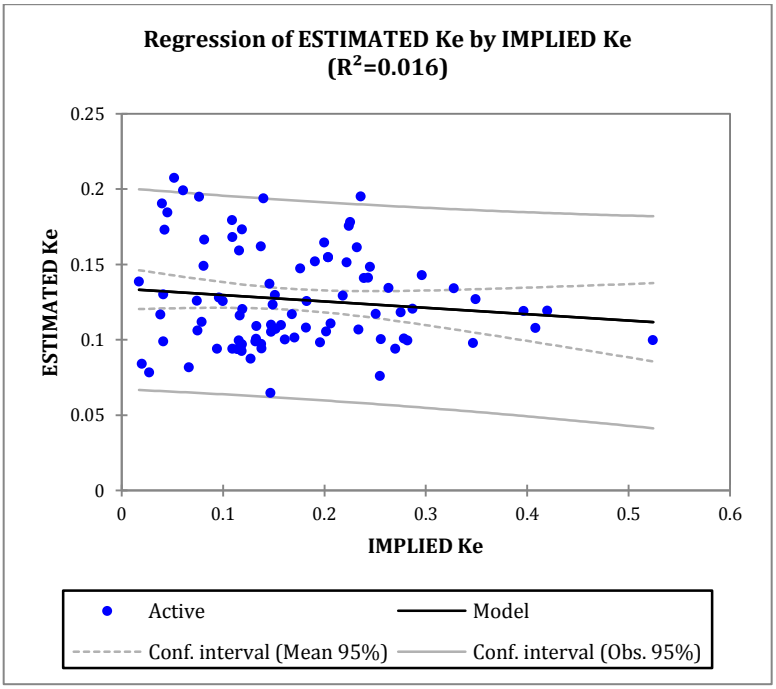


Table 17: Regression statistics – 2010 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	84.000
Sum of weights	84.000
DF	82.000
R^2	0.055
Adjusted R^2	0.043
MSE	0.001
RMSE	0.032
MAPE	21.013
DW	1.965
Cp	2.000
AIC	-574.772
SBC	-569.910
PC	0.991

Figure 8: Scatterplot for regression test – 2010 data points

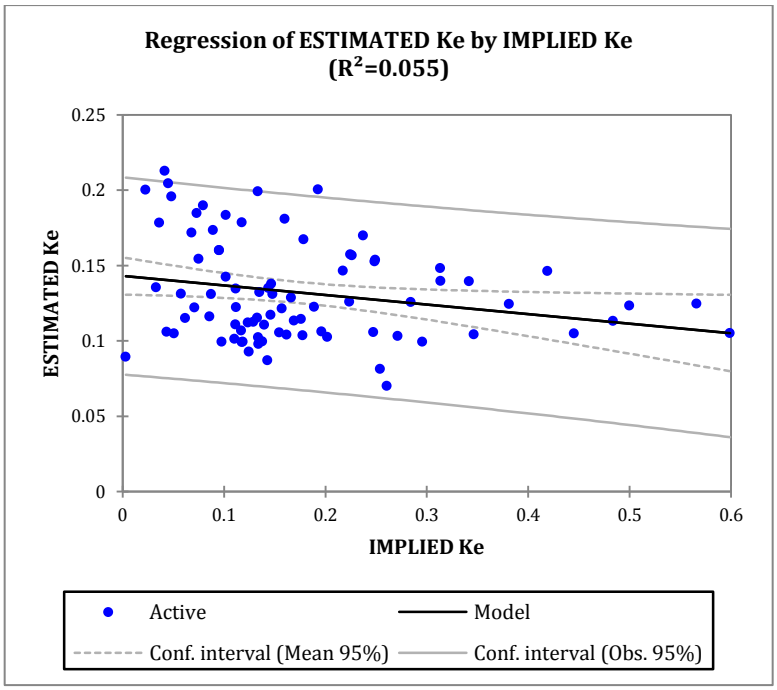


Table 18: Regression statistics – 2009 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	79.000
Sum of weights	79.000
DF	77.000
R^2	0.011
Adjusted R^2	-0.001
MSE	0.001
RMSE	0.033
MAPE	20.061
DW	2.014
Cp	2.000
AIC	-538.301
SBC	-533.562
PC	1.040

Figure 9: Scatterplot for regression test – 2009 data points

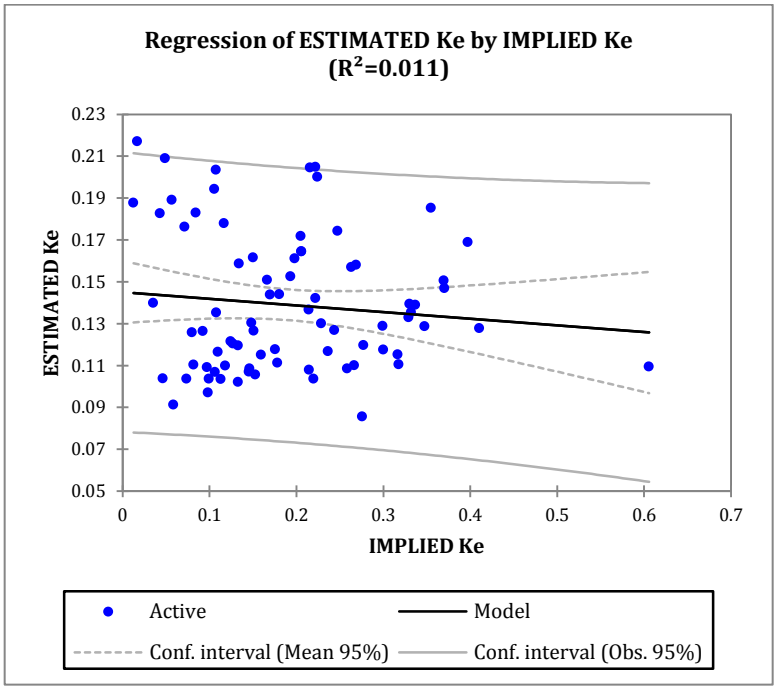


Table 19: Regression statistics – 2008 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	72.000
Sum of weights	72.000
DF	70.000
R^2	0.007
Adjusted R^2	-0.008
MSE	0.001
RMSE	0.032
MAPE	16.682
DW	1.765
Cp	2.000
AIC	-491.871
SBC	-487.318
PC	1.050

Figure 10: Scatterplot for regression test – 2008 data points

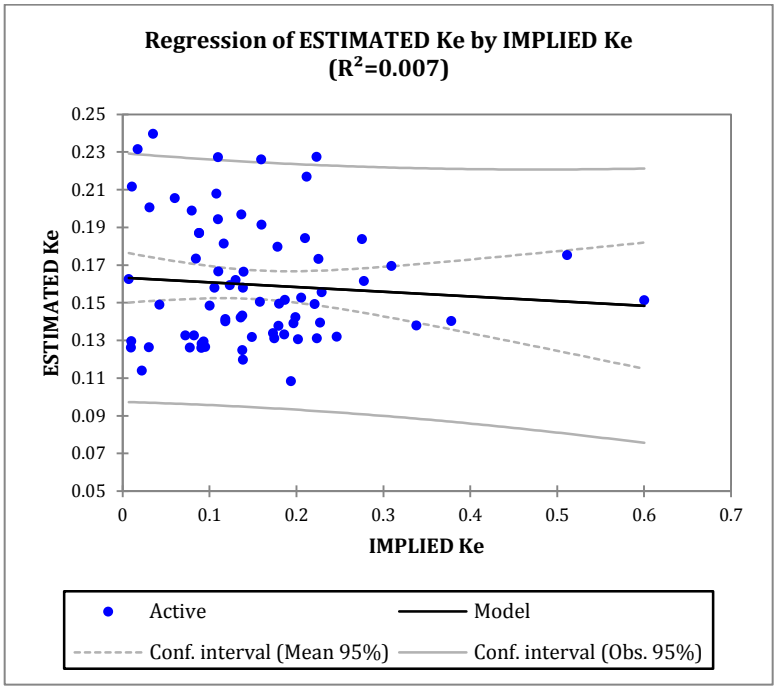


Table 20: Regression statistics – 2007 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	67.000
Sum of weights	67.000
DF	65.000
R^2	0.012
Adjusted R^2	-0.003
MSE	0.001
RMSE	0.032
MAPE	18.213
DW	1.612
Cp	2.000
AIC	-460.623
SBC	-456.214
PC	1.049

Figure 11: Scatterplot for regression test – 2007 data points

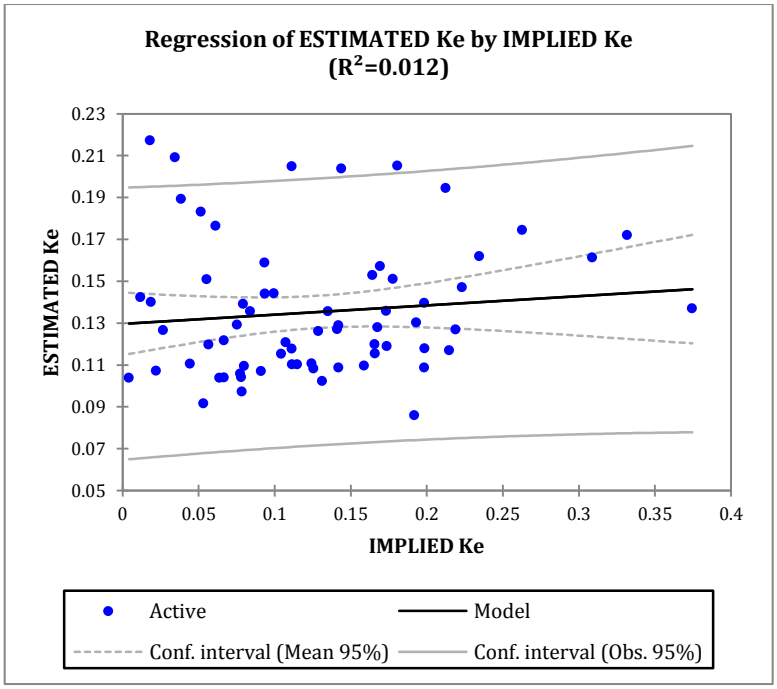


Table 21: Regression statistics – 2006 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	66.000
Sum of weights	66.000
DF	64.000
R^2	0.003
Adjusted R^2	-0.013
MSE	0.001
RMSE	0.032
MAPE	18.155
DW	1.629
Cp	2.000
AIC	-453.318
SBC	-448.939
PC	1.060

Figure 12: Scatterplot for regression test – 2006 data points

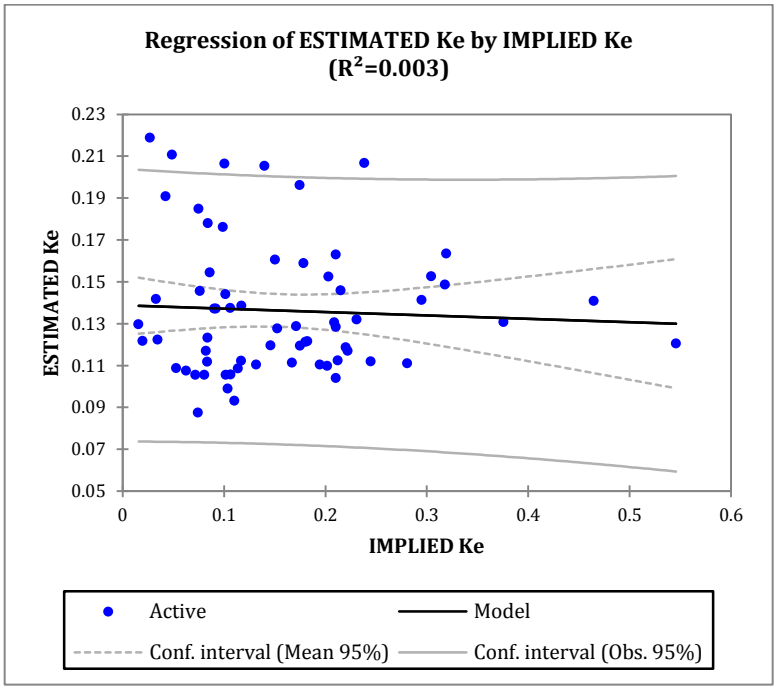
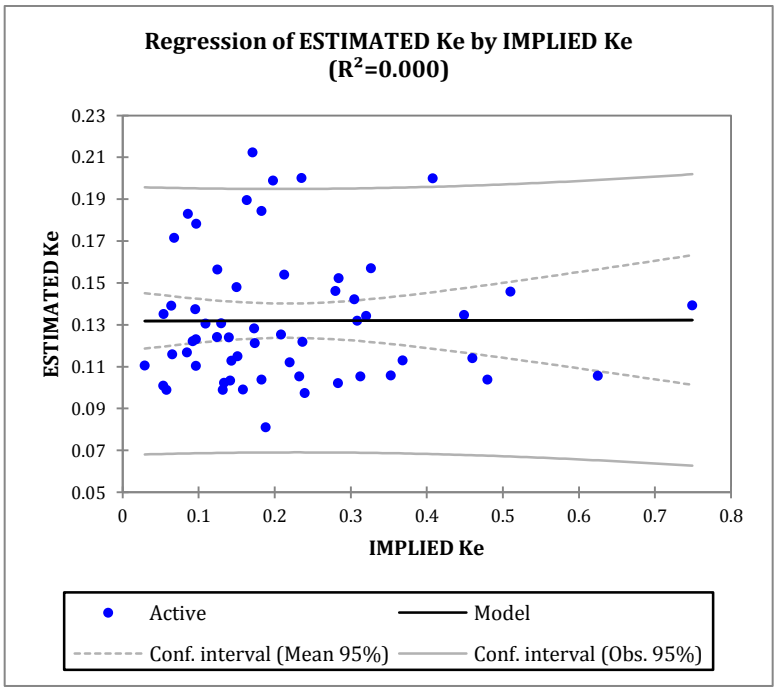


Table 22: Regression statistics – 2005 data points

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	58.000
Sum of weights	58.000
DF	56.000
R^2	0.000
Adjusted R^2	-0.018
MSE	0.001
RMSE	0.031
MAPE	18.368
DW	1.842
Cp	2.000
AIC	-400.469
SBC	-396.348
PC	1.071

Figure 13: Scatterplot for regression test – 2005 data points

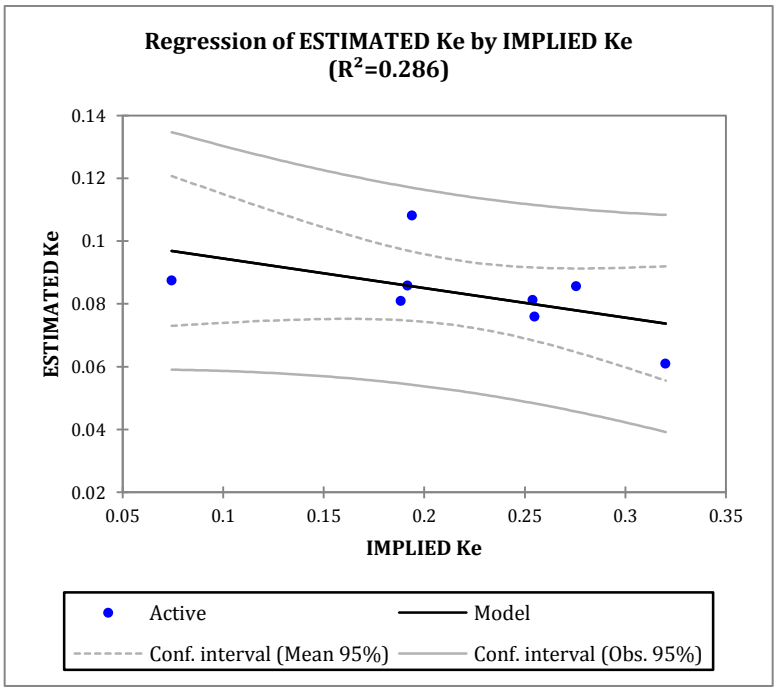


An example of a regression test for a single company is given below. The other regression tests for each company in the study are included in the electronic submission.

Table 23: Regression statistics – Company OCE

Regression of variable ESTIMATED Ke:	
Goodness of fit statistics:	
Observations	8.000
Sum of weights	8.000
DF	6.000
R^2	0.286
Adjusted R^2	0.167
MSE	0.000
RMSE	0.012
MAPE	9.357
DW	1.135
Cp	2.000
AIC	-69.069
SBC	-68.910
PC	1.190

Figure 14: Scatterplot for regression test – Company OCE



The aim of conducting the regression tests was to achieve results that would exhibit a correlation between the estimated cost of equity and implied cost of equity that was calculated in this study. It was furthermore hoped that this could supporting evidence of the validity of the CAPM in the South African equity market. The results of the statistical analysis for each of the hypotheses stated in chapter 3 of this study are shown in the table below:

Table 24: Results of the Hypotheses tests

Sample	Observations	R^2	Decision
Entire data set	602	0.019	Reject H_0
2012 data points	86	0.010	Reject H_0
2011 data points	89	0.016	Reject H_0
2010 data points	84	0.055	Reject H_0
2009 data points	79	0.011	Reject H_0
2008 data points	72	0.007	Reject H_0
2007 data points	67	0.012	Reject H_0
2006 data points	66	0.003	Reject H_0
2005 data points	58	0.000	Reject H_0
Company OCE data points	8	0.286	Reject H_0

6. Discussion of the results

6.1 Introduction to discussion of the results

The results of this research presented in chapter 5 are discussed in more detail in this chapter. This discussion is done in the context of the research questions and hypotheses posed in chapter 3 of this report. The implications of the results and some of the inferences that could be made from these results with reference to the theory and literature reviewed in chapter 2 are also discussed.

6.2 Determining an implied cost of equity

Empirical testing of the CAPM and cost of equity had been attempted by researchers ever since the model was first developed. Some researchers were content to offer evidence that the model was flawed while others added assumptions and factors that proposed modifications to the model. Sharpe and Lintner expanded on the model of Markowitz by adding two key assumptions (Fama & French, 2004b): the first was the assumption of complete agreement and the second, the assumption that there was unlimited borrowing and lending at the risk-free rate. Black introduced the idea of a zero-beta model (Black, 1972). Three-factor CAPM and four-factor CAPM theories were developed later with conditional CAPM versions emerging and a simple market adjusted returns model eventually being tested (Gregory & Michou, 2009).

It is evident that there are many models and approaches that can be used to estimate the cost of equity. There are various ways to do empirical tests of any aspect of the CAPM and simply changing a few assumptions fundamental to the different models give birth to a new model (Ashton & Wang, 2013). Given this environment it is hardly surprising that estimates of the equity risk premium as a component of cost of equity estimates has varied between studies from a negative number to more than 12% (Ashton & Wang, 2013). Botosan and Plumlee (2005) found that the market risk premium varied from 1% to 6.6% while the actual realized premium over the same period of the study was an average of 12.5%. Easton *et.al.* (2002) and Gode and Mohanram (2003) found the equity risk premium to be between 5% and 6% while Bogle (1999), Claus and Thomas (2001), Gebhardt *et.al*. (2001) and Pastor, Sinha and Swaminathan (2008) believed it to be between 2% and 4%. Some researchers even suggest that the market risk premium could

be close to zero for example Mehra and Prescott (1985) and Easton and Sommers (2007). The recent study of Ashton and Wang (2013) estimated cost of equity to be between 10.8% and 11.3% with the market risk premium estimated to be between 3.1% and 3.9%.

The cost of equity and market risk premium rates quoted in these studies are all based on data from US companies. This study was focussed on the South African equity market and it has already been shown earlier that there is an expectation that these rates would be higher in a country like South Africa than in the USA. It is therefore necessary to look more closely at studies done on JSE listed companies to find comparative rates.

6.3 Answering the research questions

Research question 1

> "Can an implied cost of equity be determined for the South African equity market using market capitalisation values, discounted free cash-flow valuations and a rearranged CAPM equation?"

It is submitted that the way the methodology was developed to determine an implied cost of equity in this research report was yet another different approach to the empirical testing of the CAPM and more importantly, the use of the CAPM to determine a more accurate cost of equity for the South African market. The first research question posed could be confirmed by developing a model that could determine the implied cost of equity of a company from the market value of the company, a DCF valuation and a rearranged CAPM equation. While it was necessary to make a number of assumptions and adjustments in the process, as discussed in chapter 5, the results proved thought provoking.

The process followed in this study shared similarities with the study by Claus and Thomas (2001) in which they equated US stock market valuations to a present value of forecasted earnings by estimating an appropriate discount rate. The methodology of rearranging the CAPM equation was used by Roll (1977) where he worked from a given market portfolio and made small adjustments to the variables so that the market portfolio could be positioned on the M-V efficient frontier. The differences in the results of this study and the two mentioned studies are striking. Claus and Thomas (2001) used their research to

provide evidence that the estimated cost of equity was higher than the implied cost of equity. Roll (1977) used his research results to conclude that the CAPM was indeed valid.

Research question 2

> "Using the method described in research question 1, what was the average implied cost of equity for the South African equity market that was obtained from these results and did this figure make intuitive sense?"

The first part of the second question posed in chapter 3 could now be answered. A mean of 17.05% for all the implied cost of equity data points was found. This is significantly higher than the estimated cost of equity of 13.48% as determined in this study using the CAPM equation. The second part of the question around the intuitive judgement of the implied cost of equity was a little more difficult to answer given the substantial difference between the implied cost of equity and the estimated cost of equity.

Evidence from other sources helped to determine how accurate the estimated cost of equity used in this research was and to determine which of the estimated or implied rates made more sense intuitively. Samouilhan (2007) found in his study a daily return to domestic equity risk of 0.0279% which represents an equivalent annual rate of 7.28%. This rate is very close to the market risk premium used in this study and supports the estimated cost of equity rate. A sample survey done around the same time as the Samouilan study by Correia and Cramer showed an even lower market risk premium of 5.35% (Correia & Cramer, 2008).

Looking at more recent evidence the well-respected study by Aswath Damodaran on worldwide equity risk premiums provides possibly the best indication of a CAPM estimated market risk premium for South Africa at 7.2% (Damodaran, 2012). This is the historical equity risk premium as determined in the period 1900 to 2011. This is also the equity market risk premium used in this research report for the determination of the estimated cost of equity.

Other sources for a market risk rate in South Africa are:

- The South African Financial Markets Journal – 6.3% (Luus, 2013)

- Publication by the IESE Business School in 2013 – 6.8% (Fernandez, Aguirreamalloa, & Corres, 2011)
- PWC Valuation methodology survey 2012 – between 3% and 12% with the low range average at 4.7% and the high range average at 6.6% (PWC Corporate Finance, 2012).

Based on this evidence the estimated cost of equity seems intuitively to be more correct than the higher implied cost of equity that was found in this study. The only problem with this assumption is that it seems to be in contradiction with the average annual returns that has been witnessed for JSE listed companies over the last eight years. It is important to refer back to the literature of Borgman and Strong who believed that over the long-term the cost of equity of a company would be equal to their ROE. Claus and Thomas (2001) also equated cost of equity to equity returns on shares. These theories seem to support the idea that the higher implied cost of equity might be a more accurate rate for the South African equity market.

Research question 3

> "Did the implied cost of equity for the South African equity market change significantly annually and if it did, what can be cited as the underlying reasons for this change?"

The mean of the implied cost of equity as compared to the mean of the estimated cost of equity for each year of the study is given in the table below:

Table 25: Means of the estimated and implied cost of equity for each year

YEAR	ESTIMATED Ke	IMPLIED Ke
2012	11.13%	18.12%
2011	12.67%	17.03%
2010	13.19%	17.57%
2009	13.90%	19.08%
2008	15.96%	15.33%
2007	13.53%	12.77%
2006	13.63%	15.72%
2005	13.20%	21.60%

There is again, as expected (correlation test results given in chapter 5) no correlation between the means of the estimated and implied cost of equity for each year of the study. There is a substantial decrease in the implied cost of equity rate in 2007 and the question has to be if this is related to the global financial crises in 2008. This might support the idea of Borgman and Strong that the cost of equity of companies will be equal to their ROE over the long-term. The only other interesting observation from the data is that while the estimated cost of equity has been decreasing in South Africa primarily due to the decrease in risk-free rates in South Africa over the last few years, the implied cost of equity rate has remained at approximately the same high rate over the same period. This again lends support to the higher implied cost of equity possibly being a more accurate rate at the moment.

Research question 4

> "What was the average implied market risk premium for the South African equity market that could be determined from the aforementioned implied cost of equity found in this research report and did this figure make intuitive sense?"

If the mean of the implied cost of equity rates for each year of the study is taken and the risk-free rate for each of those years is deducted the result is the implied market risk premium for each year. This approach ignores the effect of beta in the cost of equity equation but we are assuming a beta of one for the market as a whole so in determining a market risk premium for the market leaving beta out of the equation would not make a difference. The results are shown in the table below:

Table 26: Determination of the implied market risk premium

YEAR	IMPLIED Ke	RISK-FREE RATE	IMPLIED MARKET RISK PREMIUM
2012	18.12%	6.00%	12.12%
2011	17.03%	7.50%	9.53%
2010	17.57%	8.03%	9.54%
2009	19.08%	8.47%	10.61%
2008	15.33%	10.72%	4.61%
2007	12.77%	8.49%	4.28%
2006	15.72%	8.65%	7.07%
2005	21.60%	8.00%	13.60%
AVERAGES	**17.15%**	**8.23%**	**8.92%**

These market risk premiums are significantly higher than the estimated market risk premium as well as most estimates that could be found in the literature. It does again raise the question of the ultimate validity of the CAPM but it is submitted that these empirical rates offer a better indication of the actual market risk premium in the South African equity market.

Despite the lack of evidence for the validity of the higher implied cost of equity rates these rates do offer an important benchmark against which the return of different assets or investments and the performance of portfolio managers can be evaluated. Investment returns on South African equities have been significantly higher for a number of years now and using the estimated cost of equity of 13.48% as a benchmark may be misleading. In this sense the implied cost of equity does offer a better benchmark for measuring performance.

6.4 Hypotheses

It is clear from the statistical analysis that was done that all of the hypotheses can be rejected. The r^2 statistic for each of the simple regression tests done was extremely low. This showed that there was no correlation between the estimated cost of equity and the implied cost of equity irrespective of how the data was sorted and analysed. While in terms of the hypotheses formulated in chapter 3 this seems to imply that the validity of the CAPM is again questioned, it must be stated that the lack of correlation in the data could be attributed to other factors and that this does not necessarily equate to a further shortcoming in the CAPM theory. Unfortunately there are just to many variables in the research process used that could have an effect on the final results and there are too many assumptions that has to be made to get to the final results to be able to state definitively that it invalidates the CAPM theory.

6.5 Other observations

One of the key aspects that differentiated methodologies on a number of studies done on empirical testing of cost of equity was the use of observed returns as opposed to the use of forecasted or expected returns. In this study a combination of observed and forecasted returns or earnings was used to obtain the results. The actual returns for each year was used as the basis for the free cash-flow calculation but this amount was then increased by

a fixed percentage. Using forecasted returns rather than observed returns was supported by a number of recent studies (Berger, 2011) (Borgman & Strong, 2006) (Levy, 2011).

One of the problems of using the actual earnings as a basis for forecasts is the severe fluctuations regularly seen due to unforeseen circumstances. While it is attempted to address this problem by excluding abnormal returns in the free cash-flow calculations fluctuations still remain. Smoothing earnings has been suggested as a solution to this problem (McInnes, 2010) but no correlation was found in that study between smoothing earnings and a lower cost of equity.

In this study the current stock price and consequent market capitalisation of the companies analysed were used as a value to determine the implied cost of equity. While Borgman and Strong (2006) believe it is correct to use the current stock price in this determination of cost of equity, Easton (2007) warns against the noise of the stock price and suggests using different proxies to determine the value of the company. It is believed that this study would have benefited from a longer term view of the stock price of the companies being analysed and possibly using an average stock price to determine the value used in the estimation of an implied cost of equity.

The discount rate used in the DCF valuations of the companies in the study was based on the current debt to equity or debt to total capital ratio of the companies. In one study done on valuation methodologies used in South Africa it was found that 79% of valuation professionals used a target debt to equity ratio and not the actual debt to equity ratio (Correia & Cramer, 2008). Another South African based study found that valuation professionals used one of four different debt to equity ratios (PWC Corporate Finance, 2012). These are the average gearing level of the industry that the company operates in, the theoretical gearing level of the company, the actual gearing level of the company and the intended gearing level of the company. It does seem to be acceptable to base the discount rate on the actual gearing level as was done in this study.

It was interesting to note that for some of the 100 companies analysed it was impossible to determine a cost of equity. The percentage calculated was either too high or too low to make any practical sense and it was therefore necessary to exclude these data points from the study. Any implied cost of equity data point that was negative or more than 75% was excluded from the final results. Most of the banks and financial services companies in

the list of companies analysed fell into this category and they were excluded from the final results. This phenomenon has been seen in other studies, specifically in the case of insurance companies (Wen et al., 2008). It may be necessary to find alternative ways of determining the cost of equity of these types of companies that would address their unique valuations. One of the variables that was observed with a few of these companies that made the calculation of the cost of equity difficult was their very high levels of debt. These findings confirm the findings of previous studies showing a difference in the estimation of cost of equity based on the specific industry that the company operates in.

7. Conclusion and recommendations

7.1 Summary

This research report investigated the CAPM and endeavoured through empirical testing to find an implied cost of equity for the South African equity market. This type of methodology had been followed before using different assumptions and proxies but the application in the South African equity market and emerging markets as a whole had been limited. The primary aim of the study was to discover a new method or a variation on an existing method whereby to obtain a more accurate cost of equity for use in company valuations and the evaluation of portfolio managers in the South African equity market. The secondary aim of this research report was to test the validity of the CAPM from data of JSE listed companies by comparing estimated cost of equity rates with implied cost of equity rates.

An extensive review of literature on the topic of the CAPM and specifically empirical testing of cost of equity was done. The focus of this literature review was to find all previous studies and work on this subject that was focussed on the South African equity market. A detailed analysis of the methodologies employed and the results found by these studies were done. The approach used to determine the implied cost of equity in this study was different to the methods used in previous studies and built on the work done by Ward and Muller (Ward & Muller, 2012) on the empirical testing of the CAPM on the JSE.

From the review of the literature it was evident that opinion is still divided in both the academic world and the business world, on the validity of the CAPM. Where valuation theories are taught in corporate finance classes of MBA's and when company valuations are done in business, the free cash-flow valuation method with the application of the CAPM is still the primary valuation method applied. In the recent PWC Valuation Methodology Survey (2012) all respondents stated that they always or frequently used the CAPM as the primary methodology to estimate the cost of equity. Despite this practical endorsement there is only limited support in the literature for the CAPM and a number of studies go as far as suggesting the theory is not valid. The South African studies on the subject that we have found, are even more condemning in terms of the applicability of the CAPM to the South African equity market.

This research report support the findings of those previous studies as no evidence could be found that the CAPM is successful in predicting the relationship between risk and returns of an asset with even reasonable accuracy in the South African equity market. No correlation could be found between the estimated cost of equity of the CAPM and the implied cost of equity determined from market values in this study. The finding that the implied cost of equity for the South African equity market is potentially significantly higher than the estimated cost of equity benchmark could be of value to business and academics alike. The higher returns on equity that has been seen consistently from JSE listed companies over the last five years support this finding. This higher implied cost of equity that feels intuitively closer to an accurate rate given these high equity returns, however still has to be subjected to more empirical testing.

A higher cost of equity for the South African market would mean a higher discount rate for business valuations. If a higher discount rate is used in valuations this would mean lower equity valuations for future transactions such as acquisitions, mergers and share incentive schemes. It also means a higher hurdle rate must be used in decisions around the viability of capital projects in companies. A higher cost of equity also implies a higher market risk premium or equity risk premium which would mean that the returns companies declare would potentially be measured against a higher benchmark than before.

Ibbotson and Sinquefield made the following comment about the difficult task of determining a cost of equity (they used the term cost of capital) in the regularly cited publication Stocks, Bonds, Bills and Inflation (Borgman & Strong, 2006):

> "Estimating the cost of capital is one of the most important and difficult tasks performed by financial analysts. There is no clear consensus on the best way to approach this problem. Because of the impact that the cost of capital can have on valuation and financial decision making, the analyst should typically use at least two methods to derive the cost of equity." (Ibbotson and Associates, 1997)

Despite the many criticisms levelled against the cost of equity concept and the apparent failure of empirical tests to provide an accurate estimation of cost of equity, it is submitted that the literature reviewed in this study and the work done on this research report have shown the importance of being able to determine an implied cost of equity for the South

African equity market. It is hoped that this work will contribute to the extant body of knowledge on this subject and provide a valuable addition to the limited work on the CAPM and cost of equity concept in the South African equity market.

7.2 Recommendations for future research

There are a number of limitations to this research that have been highlighted in chapter 4 of this research project. Simply addressing some of these limitations in the research methodology of future studies have the potential of creating new research opportunities where the results could be of even more value. The recommendations for future research on the CAPM and empirical testing of the cost of equity with a focus on the South African equity are limited to four basic ideas.

First, using the same methodology as applied in this study, address some of the limitations around the data used. The number of companies analysed could be expanded to include all listed companies on the JSE. If the methodology is enhanced and the process of valuations is made quicker through the help of template spread sheets that could control for different variables the process of data collection can be much quicker. It would be interesting to see the effect of using smaller companies in the study on the implied cost of equity. The companies can be grouped in larger market capitalisation and small market capitalisation portfolios to test for a size effect. The analysis can be done with data over a longer period of time than the eight years used in this study.

There were a number of years and a number of companies where the cost of equity could not be determined, primarily because of abnormal items and/or losses that the specific company made in a year. In the research process it was attempted to compensate for these abnormal items or to exclude them entirely but this process could be managed better leaving less opportunity for judgement in future research. Future studies might benefit from rather smoothing earnings or using average returns over a period of 5 years similar to what other studies on US companies had done before (McInnes, 2010) to solve the problem of abnormal items or years. At the same time it would make sense to use an average share price to determine the value of the company for use in the determination of an implied cost of equity rather than the share price on a specific date. This should give a more representative result as it would exclude short-term, abnormal share price movements based on factors such as emotion.

The second recommendation is around the assumptions used in this study, primarily on earnings. Instead of using a fixed percentage with which to increase the earnings every year to determine the free cash-flow, it may be possible to rather use the forecasts done by analysts on earnings of the different companies. Instead of using the debt to total capital ratio of the company as at the last year end it may be possible to look at a target debt to capital ratio for the company or even an average leverage ratio for the industry that the company operates in. More time can be spent in future research on ensuring that the adjustments made to the market capitalization of the company in terms of cash and debt is correct. Finally, more time can be spent on developing a methodology that would ensure an accurate cost of debt is calculated for each company for use in the WACC as a discount rate instead of using a cost of debt that is the same for all companies. More in depth study of the financial statements of the companies would be needed to achieve this in future studies.

The third recommendation for future studies is to try and do a simultaneous analysis of the three key variables used to determine an implied cost of equity: beta, the risk-free rate and the market risk premium. This approach has been tried by previous researchers (Easton, Taylor, Shroff, & Sougiannis, 2002) but no such study for the South African equity market could be found. In such an analysis it might be valuable to see the results from changing each of the variables one at a time while keeping the other two variables constant. This type of methodology would again be much easier to accomplish if the correct framework for valuations is developed as we have endeavoured to do in this study. This kind of empirical testing has been tried in the USA but never in South Africa. Some work has been done independently on each of the components of cost of equity in the South African equity market but there has been no simultaneous studies done before.

A fourth recommendation for future research that could prove interesting comes from the work of Borgman and Strong (2006). They stated in their research that the ROE of a company and the cost of equity of that company should be equal over the long term. Future research can be done on determining if there is such a correlation between ROE and cost of equity and if it might be possible to determine an implied cost of equity from the observed ROE or the forecasted ROE of a company.

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Appendices

Appendix 1: List of JSE listed companies with their market capitalizations used in this study.

Com-pany Code	Company Name	% of Total JSE Market Capitalization - 2013	Cumulative % of Total JSE Market Capitailization - 2013	Market Cap
BTI	British American Tob plc	11.67%	11.67%	R 940 512 379 891.68
SAB	SABMiller plc	9.13%	20.81%	R 735 963 642 323.80
BIL	BHP Billiton plc	8.15%	28.96%	R 657 026 560 086.78
CFR	Compagnie Fin Richemont	4.80%	33.76%	R 386 802 000 000.00
AGL	Anglo American plc	4.69%	38.45%	R 378 069 397 974.00
MTN	MTN Group Ltd	4.09%	42.54%	R 329 798 105 132.40
SOL	Sasol Limited	3.11%	45.65%	R 250 259 418 157.32
NPN	Naspers Ltd -N-	2.98%	48.63%	R 239 873 090 216.97
KIO	Kumba Iron Ore Ltd	2.41%	51.03%	R 193 937 262 200.32
SBK	Standard Bank Group Ltd	2.33%	53.36%	R 187 400 162 087.37
VOD	Vodacom Group Ltd	2.30%	55.66%	R 185 652 020 580.00
FSR	Firstrand Ltd	2.26%	57.92%	R 181 823 619 470.25
OML	Old Mutual plc	1.61%	59.53%	R 129 913 402 985.73
ASA	ABSA Group Ltd	1.53%	61.06%	R 123 173 022 374.50
AMS	Anglo American Plat Ltd	1.47%	62.53%	R 118 120 666 068.00
IMP	Impala Platinum Hlgs Ltd	1.27%	63.80%	R 102 584 039 707.80
NED	Nedbank Group Ltd	1.23%	65.03%	R 98 842 548 467.16
SHP	Shoprite Holdings Ltd	1.19%	66.22%	R 96 142 639 010.00
SLM	Sanlam Limited	1.19%	67.41%	R 95 634 000 000.00
ANG	Anglogold Ashanti Ltd	1.18%	68.59%	R 95 448 685 446.00
REM	Remgro Ltd	0.98%	69.56%	R 78 569 481 284.70
GFI	Gold Fields Ltd	0.94%	70.51%	R 75 915 860 188.64
APN	Aspen Pharmacare Hldgs Ltd	0.93%	71.44%	R 75 089 331 577.77
BVT	Bidvest Ltd	0.87%	72.31%	R 70 086 114 566.65
EXX	Exxaro Resources Ltd	0.78%	73.09%	R 62 977 805 915.70
ASR	Assore Ltd	0.77%	73.86%	R 62 125 115 000.00
RMH	RMB Holdings Ltd	0.75%	74.61%	R 60 590 302 116.56
TBS	Tiger Brands Ltd	0.70%	75.31%	R 56 307 233 191.00
WHL	Woolworths Holdings Ltd	0.66%	75.98%	R 53 467 004 793.60
SHF	Steinhoff Int Hldgs Ltd	0.62%	76.59%	R 49 851 586 421.40
TRU	Truworths Int Ltd	0.58%	77.18%	R 46 992 518 182.80

MDC	Mediclinic Internat Ltd	0.58%	77.76%	R 46 838 862 888.00
GRT	Growthpoint Prop Ltd	0.55%	78.31%	R 44 525 933 651.21
CSO	Capital Shop Cent Grp plc	0.54%	78.86%	R 43 909 994 930.56
ARI	African Rainbow Min Ltd	0.54%	79.39%	R 43 429 702 030.00
IPL	Imperial Holdings Ltd	0.51%	79.90%	R 40 922 035 053.60
MSM	Massmart Holdings Ltd	0.49%	80.40%	R 39 692 256 229.72
INP	Investec plc	0.49%	80.89%	R 39 528 611 559.50
DSY	Discovery Holdings Ltd	0.49%	81.37%	R 39 205 627 113.60
MNP	Mondi plc	0.48%	81.86%	R 38 927 525 330.00
MMI	MMI Holdings Limited	0.45%	82.31%	R 36 497 936 025.00
RMI	Rand Merchant Ins Hldgs Ltd	0.42%	82.73%	R 34 022 263 123.40
REI	Reinet Inv Soc Anon	0.41%	83.14%	R 33 310 018 620.00
LBH	Liberty Holdings Ltd	0.41%	83.55%	R 33 056 374 081.50
LHC	Life Healthc Grp Hldgs Ltd	0.41%	83.96%	R 32 787 918 735.00
MPC	Mr Price Group Ltd	0.38%	84.35%	R 30 931 964 969.40
TSH	Tsogo Sun Holdings Ltd	0.36%	84.71%	R 29 036 905 005.40
NTC	Netcare Limited	0.36%	85.06%	R 28 757 578 640.00
LON	Lonmin plc	0.36%	85.42%	R 28 740 739 998.15
TFG	The Foschini Group Limited	0.35%	85.77%	R 28 164 749 003.51
RDF	Redefine Properties Ltd	0.33%	86.10%	R 26 529 524 204.96
CCO	Capital&Counties Prop plc	0.32%	86.42%	R 25 960 315 369.41
HAR	Harmony GM Co Ltd	0.32%	86.74%	R 25 606 209 961.53
ABL	African Bank Inv Ltd	0.31%	87.05%	R 24 995 660 840.30
SNT	Santam Limited	0.29%	87.34%	R 23 260 616 673.30
UUU	Uranium One Inc	0.28%	87.62%	R 22 884 189 196.25
DST	Distell Group Ltd	0.28%	87.90%	R 22 362 813 110.00
CPI	Capitec Bank Hldgs Ltd	0.27%	88.17%	R 21 972 810 048.00
NPK	Nampak Ltd	0.27%	88.44%	R 21 884 828 503.44
PIK	Pik n Pay Stores Ltd	0.27%	88.71%	R 21 862 882 078.71
SPP	The Spar Group Ltd	0.25%	88.97%	R 20 288 228 280.32
PPC	PPC Limited	0.25%	89.21%	R 19 826 183 472.00
BAW	Barloworld Ltd	0.24%	89.45%	R 19 405 006 404.00
AVI	AVI Ltd	0.23%	89.69%	R 18 814 236 812.70
INL	Investec Ltd	0.22%	89.91%	R 18 061 893 602.76
HYP	Hyprop Inv Ltd	0.22%	90.13%	R 17 394 747 241.95
SAP	Sappi Ltd	0.21%	90.34%	R 16 931 023 393.21
CPL	Capital Property Fund	0.21%	90.55%	R 16 905 495 655.08
BAT	Brait SE	0.20%	90.75%	R 16 323 915 104.00
CLS	Clicks Group Ltd	0.20%	90.95%	R 16 099 409 880.00
ACL	ArcelorMittal SA Limited	0.19%	91.14%	R 15 623 612 226.60
TON	Tongaat Hulett Ltd	0.19%	91.33%	R 15 081 612 034.00

PFG	Pioneer Foods Group Ltd	0.19%	91.52%	R 15 055 063 114.77
RLO	Reunert Ltd	0.19%	91.70%	R 14 959 126 581.00
HCI	Hosken Cons Inv Ltd	0.18%	91.89%	R 14 903 959 983.36
RES	Resilient Prop Inc Fund	0.18%	92.07%	R 14 430 075 535.00
NHM	Northam Platinum Ltd	0.18%	92.24%	R 14 102 123 277.40
ILV	Illovo Sugar Ltd	0.17%	92.41%	R 13 989 282 212.80
CML	Coronation Fund Mngrs Ld	0.17%	92.59%	R 13 845 748 064.16
PSG	PSG Group Ltd	0.16%	92.74%	R 12 672 187 466.40
MND	Mondi Ltd	0.16%	92.90%	R 12 602 698 097.00
TRE	Trencor Ltd	0.15%	93.05%	R 12 350 493 767.25
AEG	Aveng Group Limited	0.15%	93.20%	R 12 182 440 531.25
SUI	Sun International Ltd	0.14%	93.35%	R 11 632 434 412.50
MUR	Murray & Roberts Hldgs	0.14%	93.49%	R 11 318 534 203.10
AFE	AECI Limited	0.14%	93.62%	R 10 931 274 773.60
PWK	Pik n Pay Holdings Ltd	0.13%	93.75%	R 10 323 537 025.56
WBO	Wilson Bayly Hlm-Ovc Ltd	0.13%	93.88%	R 10 230 000 000.00
AIP	Adcock Ingram Hldgs Ltd	0.12%	94.00%	R 10 048 452 495.20
GND	Grindrod Ltd	0.12%	94.13%	R 9 948 447 559.26
FPT	Fountainhead Prop Trust	0.12%	94.25%	R 9 883 032 858.00
OMN	Omnia Holdings Ltd	0.12%	94.37%	R 9 687 337 291.25
RBP	Royal Bafokeng Platinum Ltd	0.12%	94.49%	R 9 610 065 289.35
JDG	JD Group Ltd	0.11%	94.60%	R 9 026 219 800.00
DTC	Datatec Ltd	0.11%	94.71%	R 8 988 726 896.40
TKG	Telkom SA SOC Ltd	0.11%	94.82%	R 8 665 844 062.72
AFX	African Oxygen Limited	0.10%	94.93%	R 8 451 324 231.50
ACP	Acucap Properties Ltd	0.10%	95.03%	R 8 413 983 155.55
OCE	Oceana Group Ltd	0.10%	95.13%	R 8 180 897 254.50
CAT	Caxton CTP Publish Print	0.10%	95.23%	R 8 174 739 107.50

Appendix 2: Estimated cost of equity and implied cost of equity – all data points

ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke
6.09%	32.00%	16.43%	21.24%	10.15%	17.06%
7.59%	25.49%	17.93%	10.93%	10.68%	11.71%
8.12%	25.39%	18.46%	7.30%	11.12%	17.82%
8.56%	27.57%	18.90%	5.66%	13.37%	17.35%
10.81%	19.39%	21.15%	1.08%	10.42%	16.33%
8.58%	19.17%	18.92%	3.85%	11.92%	42.01%
8.74%	7.44%	19.08%	4.24%	12.45%	56.60%
8.09%	18.84%	18.43%	18.28%	12.89%	29.93%
9.58%	13.33%	12.61%	28.87%	15.14%	18.69%
11.08%	20.63%	14.11%	24.33%	12.91%	7.53%
11.61%	8.57%	14.64%	21.75%	13.07%	37.58%
12.05%	12.68%	15.08%	16.64%	12.42%	12.43%
14.30%	13.78%	17.33%	8.47%	8.47%	30.69%
12.07%	10.72%	15.10%	17.77%	9.97%	52.41%
12.23%	3.46%	15.26%	30.45%	10.50%	59.90%
11.58%	6.56%	14.61%	28.02%	10.94%	60.56%
7.89%	9.53%	9.10%	9.44%	13.19%	24.67%
9.39%	10.96%	10.60%	7.49%	10.96%	15.88%
9.92%	11.86%	12.59%	29.09%	11.12%	16.72%
10.36%	9.93%	14.09%	23.90%	11.47%	27.28%
12.61%	0.97%	14.62%	41.90%	12.97%	15.14%
10.38%	0.42%	15.06%	36.97%	13.50%	14.38%
10.54%	8.05%	17.31%	22.56%	13.94%	33.03%
9.89%	5.78%	15.08%	5.53%	16.19%	13.02%
8.45%	20.01%	15.24%	20.30%	13.96%	19.83%
9.95%	11.56%	14.59%	51.05%	14.12%	29.49%
10.48%	5.06%	7.87%	11.53%	13.47%	44.93%
10.92%	9.71%	9.37%	11.41%	13.77%	14.66%
13.17%	14.89%	9.90%	11.76%	14.21%	22.19%
10.94%	7.99%	10.34%	11.28%	14.23%	1.18%
11.10%	28.06%	12.59%	9.09%	14.39%	10.15%
10.54%	15.10%	14.95%	12.83%	13.74%	9.60%
12.04%	11.91%	16.45%	20.00%	10.40%	27.90%
12.57%	28.42%	16.98%	23.73%	11.90%	39.66%
13.01%	22.85%	17.42%	24.73%	12.43%	38.12%
15.26%	20.57%	19.67%	13.68%	12.87%	34.75%
13.03%	19.32%	17.44%	26.28%	15.12%	60.03%
13.19%	23.09%	17.60%	9.90%	12.89%	14.19%
12.54%	20.84%	8.65%	17.07%	13.05%	20.89%

ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke
12.40%	13.98%	12.11%	17.42%	14.12%	11.85%
11.90%	13.61%	16.95%	8.04%	11.89%	17.37%
13.40%	32.79%	18.45%	4.53%	12.05%	54.57%
13.93%	34.18%	18.98%	7.94%	11.40%	46.01%
14.37%	16.95%	19.42%	10.56%	14.41%	11.63%
16.62%	13.95%	21.67%	21.21%	15.91%	11.61%
14.39%	9.35%	19.44%	21.23%	16.88%	39.73%
14.55%	7.63%	19.60%	17.47%	19.13%	16.00%
13.90%	6.44%	18.95%	16.37%	10.56%	27.01%
9.47%	26.47%	6.66%	8.47%	12.06%	28.70%
10.97%	15.73%	8.16%	6.66%	12.59%	22.38%
11.50%	6.19%	8.69%	14.30%	13.03%	14.82%
11.94%	13.28%	9.13%	5.84%	11.66%	3.83%
14.19%	13.62%	11.38%	2.24%	12.19%	7.10%
11.96%	5.66%	9.15%	5.31%	12.63%	9.24%
12.12%	18.04%	9.31%	11.04%	14.88%	4.25%
13.97%	13.57%	9.05%	14.13%	12.65%	2.67%
15.47%	20.37%	10.55%	20.19%	12.16%	1.99%
16.00%	9.51%	11.08%	11.12%	9.70%	11.90%
16.44%	20.58%	11.52%	31.67%	10.23%	13.37%
18.69%	8.84%	13.77%	33.83%	10.67%	10.61%
12.59%	7.43%	11.54%	16.59%	12.92%	9.33%
13.12%	5.76%	11.70%	8.23%	10.69%	9.10%
13.58%	17.34%	11.05%	2.92%	10.85%	11.39%
13.74%	10.64%	10.19%	25.25%	10.20%	28.33%
11.19%	14.52%	11.69%	16.80%	16.30%	19.70%
12.69%	34.94%	12.22%	11.21%	17.80%	22.56%
13.22%	13.49%	12.66%	15.09%	18.33%	10.17%
13.66%	21.41%	14.91%	22.12%	18.77%	1.26%
15.91%	12.34%	12.68%	21.89%	18.30%	8.59%
13.68%	37.45%	12.84%	21.03%	7.90%	13.05%
13.84%	11.72%	12.19%	23.66%	9.40%	9.44%
13.19%	30.89%	9.17%	18.96%	9.93%	9.79%
10.11%	21.10%	10.67%	23.36%	10.37%	7.37%
11.61%	11.66%	11.20%	12.36%	12.62%	3.03%
12.14%	15.69%	11.64%	10.97%	10.39%	6.65%
12.58%	7.98%	13.89%	19.71%	10.55%	7.18%
14.83%	10.03%	9.40%	21.13%	13.34%	25.53%
12.60%	12.86%	10.90%	13.32%	14.84%	24.51%
12.76%	15.25%	11.43%	17.61%	15.37%	24.93%

ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke
15.81%	26.86%	10.58%	35.31%	16.14%	27.78%
9.29%	15.57%	8.53%	22.71%	13.91%	7.93%
10.79%	18.21%	10.03%	25.59%	14.07%	46.48%
11.32%	16.92%	10.56%	24.72%	13.42%	32.07%
11.76%	17.54%	11.00%	26.65%	8.09%	17.62%
14.01%	37.85%	13.25%	8.24%	9.59%	11.80%
11.78%	19.86%	11.02%	11.48%	10.12%	11.04%
11.94%	14.60%	11.18%	24.47%	10.56%	15.28%
11.29%	36.86%	10.53%	23.25%	12.81%	9.12%
13.64%	40.22%	10.22%	26.17%	10.58%	7.73%
15.14%	22.20%	11.72%	25.07%	10.74%	6.28%
15.67%	22.61%	12.25%	18.91%	10.09%	5.36%
16.11%	19.80%	12.69%	24.36%	6.32%	3.19%
18.36%	27.58%	14.94%	18.05%	7.82%	2.73%
16.13%	30.89%	12.71%	14.11%	7.91%	8.52%
16.29%	21.04%	12.87%	17.12%	9.41%	13.81%
15.64%	12.48%	12.22%	9.26%	9.94%	13.79%
9.28%	50.88%	7.74%	18.42%	10.38%	4.63%
10.78%	40.82%	9.24%	11.86%	12.63%	9.54%
11.31%	48.37%	9.77%	13.41%	10.40%	7.79%
11.75%	29.98%	10.21%	13.29%	10.56%	10.65%
14.00%	11.85%	12.46%	13.80%	9.91%	15.87%
11.77%	11.13%	10.23%	13.13%	14.62%	27.11%
11.93%	17.50%	10.39%	21.03%	16.12%	23.20%
11.28%	14.36%	9.74%	23.99%	19.22%	5.23%
8.22%	13.37%	17.54%	5.85%	20.72%	5.19%
9.72%	13.78%	19.04%	4.00%	21.25%	4.17%
10.25%	20.19%	19.57%	4.80%	21.69%	1.68%
10.69%	14.54%	20.01%	22.42%	23.94%	3.51%
12.94%	1.02%	8.56%	11.85%	21.71%	1.81%
10.71%	2.21%	10.06%	13.28%	21.87%	2.71%
10.87%	5.28%	10.59%	4.35%	21.22%	17.10%
10.22%	13.35%	11.03%	8.15%	19.22%	5.23%
8.58%	17.94%	11.05%	4.44%	20.72%	5.19%
10.08%	27.85%	11.21%	11.70%	21.25%	4.17%
10.61%	19.62%	10.56%	62.53%	21.69%	1.68%
11.05%	31.75%	11.42%	26.16%	23.94%	3.51%
13.30%	18.62%	12.92%	21.82%	21.71%	1.81%
11.07%	12.43%	13.45%	11.15%	21.87%	2.71%
11.23%	21.22%	13.89%	33.67%	21.22%	17.10%

ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke
11.81%	27.54%	11.06%	13.97%	10.87%	14.20%
12.34%	49.99%	11.50%	15.92%	11.03%	19.46%
12.78%	41.05%	13.75%	17.96%	10.38%	18.27%
15.03%	15.81%	11.52%	10.43%	13.23%	20.03%
12.80%	16.75%	11.68%	22.21%	14.73%	17.63%
12.96%	1.58%	11.03%	9.67%	15.26%	24.86%
12.31%	9.68%	12.79%	38.70%	15.70%	26.31%
3.08%	24.20%	14.29%	29.63%	17.95%	17.85%
8.32%	22.45%	14.82%	31.34%	15.72%	16.93%
9.82%	19.58%	15.26%	19.31%	15.88%	17.85%
10.35%	17.76%	17.51%	51.16%	15.23%	28.45%
10.79%	21.46%	15.28%	16.42%	10.83%	13.73%
13.04%	20.21%	15.44%	8.62%	12.33%	14.91%
10.81%	12.56%	14.79%	15.00%	12.86%	16.62%
10.97%	20.18%	18.01%	25.40%	13.30%	32.91%
10.32%	14.15%	19.51%	23.61%	15.55%	22.94%
4.98%	12.95%	20.04%	19.29%	12.83%	17.33%
6.48%	14.68%	20.48%	22.19%	9.21%	14.98%
7.01%	26.07%	22.73%	22.32%	10.71%	15.21%
11.29%	9.42%	20.50%	18.07%	11.24%	12.89%
12.79%	9.62%	20.66%	23.83%	11.68%	23.64%
13.97%	13.57%	20.01%	23.56%	13.93%	22.75%
15.47%	20.37%	12.35%	3.16%	11.70%	21.48%
16.00%	9.51%	13.85%	1.72%	11.86%	22.02%
16.44%	20.58%	8.29%	23.46%	11.21%	22.01%
18.69%	8.84%	9.79%	34.66%	11.06%	9.46%
15.31%	10.82%	10.32%	27.14%	12.56%	9.98%
16.81%	10.95%	7.89%	31.30%	13.09%	8.73%
17.34%	8.93%	9.39%	27.02%	13.53%	10.79%
17.78%	11.65%	9.92%	29.56%	15.78%	10.59%
20.03%	3.13%	10.36%	21.95%	13.55%	8.39%
9.67%	21.23%	12.61%	7.74%	13.71%	9.03%
11.17%	7.93%	10.38%	6.36%	13.06%	10.92%
11.70%	14.61%	10.54%	10.20%	12.21%	24.44%
12.14%	12.42%	9.89%	13.18%	13.71%	14.60%
12.16%	6.65%	8.38%	12.99%	14.24%	10.19%
12.32%	8.38%	9.88%	13.20%	14.68%	37.02%
11.67%	8.50%	10.41%	16.17%	16.93%	30.97%
9.03%	15.59%	10.85%	14.61%	14.70%	22.33%
10.53%	14.75%	13.10%	17.47%	14.86%	31.80%

ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke	ESTIMATED Ke	IMPLIED Ke
14.21%	30.49%	10.02%	16.11%	15.19%	19.07%
14.70%	11.89%	10.55%	15.44%	15.72%	22.46%
16.20%	13.75%	10.99%	11.80%	16.16%	15.01%
16.73%	17.84%	13.24%	7.23%	18.41%	21.03%
17.17%	20.49%	11.01%	11.14%	16.18%	23.44%
19.42%	10.98%	11.17%	8.36%	16.34%	31.94%
17.19%	33.18%	10.52%	31.29%	15.69%	32.67%
11.06%	23.63%	17.88%	14.69%	11.92%	20.17%
12.56%	18.26%	19.38%	13.99%	13.42%	26.33%
13.09%	14.80%	19.91%	13.34%	13.95%	31.37%
13.53%	33.20%	20.35%	10.73%	14.39%	18.04%
15.78%	13.87%	22.60%	15.97%	16.64%	11.04%
13.55%	13.50%	20.37%	14.38%	14.41%	9.94%
13.71%	9.19%	20.53%	13.99%	14.57%	21.52%
13.06%	12.98%	19.88%	19.81%	13.92%	74.92%
9.49%	12.68%	17.98%	15.06%	18.42%	7.12%
10.99%	14.76%	19.48%	7.66%	19.92%	6.07%
11.52%	13.27%	20.01%	2.25%	20.45%	4.51%
11.96%	27.70%	20.45%	21.58%	20.89%	4.90%
14.21%	19.91%	22.70%	10.98%	23.14%	1.74%
11.98%	16.57%	20.47%	11.11%	20.91%	3.44%
12.14%	18.24%	20.63%	10.07%	21.07%	4.87%
11.49%	15.15%	19.98%	40.81%	15.79%	4.85%
15.14%	11.13%	8.45%	28.60%	17.29%	4.24%
16.64%	8.17%	9.95%	28.19%	17.82%	3.63%
17.17%	6.82%	10.48%	44.51%	18.26%	4.30%
17.61%	7.11%	16.05%	26.76%	15.82%	13.16%
19.86%	7.99%	17.55%	22.43%	17.32%	11.90%
17.63%	6.11%	18.08%	15.98%	17.85%	11.78%
17.79%	8.42%	18.52%	35.48%	18.29%	8.41%
17.14%	6.81%	20.77%	10.83%	20.54%	6.02%
8.38%	29.28%	13.40%	12.33%	18.31%	5.15%
9.88%	4.14%	14.90%	8.10%	18.47%	7.50%
10.41%	34.65%	15.43%	7.49%	17.82%	9.71%
10.85%	25.85%	15.87%	13.38%	11.51%	3.49%
13.10%	22.38%	18.12%	11.65%	13.01%	4.11%
10.87%	19.84%	15.89%	9.34%	13.54%	3.31%
11.03%	13.18%	16.05%	15.05%	13.98%	3.51%
10.38%	48.01%	15.40%	21.28%	16.23%	0.72%
8.52%	7.82%	13.69%	32.57%	14.00%	1.86%
14.16%	3.30%	6.91%	1.52%	8.94%	0.32%
13.51%	5.41%	8.41%	2.01%		

Appendix 3 – Estimated cost of equity and implied cost of equity – data points per year

The data points per year have been included in the accompanying electronic submission to this research report.

Appendix 4 – Estimated cost of equity and implied cost of equity – data points per company

The data points per company have been included in the accompanying electronic submission to this research report.

Appendix 5 – Free cash-flow valuation template spread sheet

The free cash flow valuation template spread sheet is a Microsoft Excel spread sheet that is too large to include in this report. Extracts from this spread sheet have been included in the test of this document in chapter 4 describing the research methodology used. The spread sheet has been included in the accompanying electronic submission to this research report.

Appendix 6 – Free cash-flow valuation spread sheet for each company in the study

The template in Appendix 3 was used to do a free cash-flow valuation for each of the 100 companies included in this study. These 100 spread sheets could not be practically be included in this report and has been included in the accompanying electronic submission to this research report.

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Supervisor:	**Professor Mike Ward**		
Supervisor email:	**mchlwrd@gmail.com**		
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