



**The relationship between various risk factors and the cost of equity
premium implied by analysts' forecasts on the New York Stock Exchange**

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I, Heleen Goussard, do hereby declare that the work presented in this thesis, is my own, except where acknowledged and that this thesis or any part of it, has not been previously submitted for the award of a degree at any university.

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Abstract

The cost of equity is used extensively for capital allocation decisions, and the various methods used to estimate it often result in materially different outcomes. A model of the impact of known risk factors on the implied cost of equity used by equity analysts, who are seen as informed market participants, could be a guideline and sense check for other professionals estimating cost of equity for capital allocation decisions.

This study, an implementation of Arbitrage Pricing Theory, attempts to create a parsimonious model of factors that are associated with the implied cost of equity premium utilised by equity analysts on the New York Stock Exchange (“NYSE”). After limiting the sample to NYSE-listed companies that were primarily exposed to US macro-economic conditions and were likely to be valued overwhelmingly on a going-concern basis, the test sample consisted of 5,343 company quarters covering the period 2006 to 2015.

In the first part of the methodology, sixteen factors identified from previous literature as possibly influencing the cost of equity were tested for their association with the implied equity risk premium, as calculated from analysts’ two-year earnings forecasts and target share prices using the Easton-method. Only those factors that were statistically significantly associated with the implied cost of equity were retained for the second part of the methodology, in which mixed effects modelling and optimisation using the Akaike information criterion was used to find a parsimonious model linking the statistically most significant factors to the implied cost of equity. The final model could explain 40% of the variation in implied risk premium by the fixed effects (specified variables), and 62% when the random effects (observable effects of unspecified variables) were included.

The study found that the risk free rate was most strongly (and negatively) associated with the size of the implied equity risk premium. Other factors that are statistically significantly associated with the implied equity risk premium are the two-year beta (+), the profitability dummy variable (-), return on equity (-), two-year share price volatility (+), long-term growth (+), Market momentum (+), and the debt to equity ratio (+). It was further found that not all factors which have historically been shown to influence returns are significantly associated with implied cost of equity estimates, which is contrary to expectations in a fully efficient market, where the only difference in the two would result from the information that changes cash flow expectations or the risk profile of the cash flows.

This study contributes to the current body of literature on cost of equity in the following ways:

- To the author’s knowledge, this study combines a far wider array of factors of all types than any of the previous studies on the topic, and uses target prices rather than market prices to calculate the implied cost of equity premium.
- The study uses the adaptive and recursive option valuation model to eliminate companies for which the testing would not be relevant.
- The study used mixed effects modelling to measure the impact of the various factors on the cost of equity premium.

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Chapter 1: Introduction and background

The purpose of the current study was to try to create a parsimonious model of fundamental factors that are associated with the cost of equity premium (the difference between total cost of equity and the risk free rate) utilised by equity analysts, focussing on the US in particular. The concept of a cost of equity is used in various fields within finance, such as the allocation of capital to projects within a firm and the evaluation of investments. Thus, when evaluating an investment, an investor must decide whether the price at which the asset can be bought is a fair price. To establish the fair value of an asset, the likely risks and rewards need to be weighed, with the risks reflected in the cost of equity, or expected return, and the rewards in the estimated future cash flows.

The practical problem faced by investors is to identify which risks should influence the expected return, and how much excess return the market expects for the risks that have been identified. This is further complicated by the fact that the supply of capital is not constant between markets or over time, and may influence the returns required for the risk being taken. The return that the market requires for an equity investment is defined as the cost of equity. If an asset is correctly priced, the cost of equity is the internal rate of return that equates the market value to the present value of the expected future cash flows to equity. A consistent and universal methodology to accurately estimate the cost of equity *ex ante*, and implicitly also the fair value, has not yet been established.

Investment professionals, managers in charge of capital allocation and valuation experts all use cost of equity estimates. If this cost of equity estimates could be done more accurately, capital would be allocated to investments that provide the highest return for their risk profile, maximising investor return and the efficiency of the capital markets.

The accounting world has over the last couple of decades moved away from cost accounting to fair value accounting. The purpose of this was to increase the value of the information supplied by the financial statements and increase the comparability between entities. For fair value accounting to be truly comparable, the same asset should be valued materially the same by two different preparers of financial statements. If an accurate estimate of the cost of equity was available, this would increase the accuracy of valuation, and thus the value of the information supplied by the financial statements.

Methods which are currently being used to derive estimates of the cost of equity include the Capital Asset Pricing Model ("CAPM") of Sharpe (1964), Lintner (1965), and Black (1972), and the Arbitrage Pricing Theory ("APT") of Ross (1976, 1977). The APT is related to the Capital Asset Pricing Model, unlike the CAPM it does not assume that the variance of an asset to a market portfolio is sufficient to describe the risk of an asset. This assumption allows for the theory to be implemented on any portfolio, rather than just the market portfolio. In place of the market beta, other factors which are known to influence risk are assumed to have a linear relationship with the cost of equity of the asset. Fama and French (1993) further

developed a three-factor model (later extended to a five-factor model), which then allows for size and market to book value to be considered in the calculation of risk.

This study is an implementation of APT, the theory that links risk, as expressed in the cost of equity, to fundamental and economic risk factors other than the market beta. The study therefore tested whether a selected number of fundamental, macroeconomic and behavioural factors have a significant association with the risk profile (cost of equity) of a company, as perceived by analysts. Thus, the study made use of investment analysts' two-year earnings predictions and target share prices over the period of the study. Investment analysts are investment professionals employed by stockbrokers, investment banks and independent research companies to perform research on companies listed on various stock exchanges. From time to time these analysts release target prices for a specific share, which is the price they believe to be the fair value of the share, and therefore predict to be the share price in 12 months' time. It is these two-year earnings predictions and 12-month ahead target share prices that were used in this study to calculate the various costs of equity implied by these inputs.

Although the study did not directly survey analysts to establish what risk factors they consider, a strong association of a specific factor with the cost of equity as implied in their price and earnings targets would indicate that the factor is potentially relevant to their estimation of the required return (*i.e.* their cost of capital estimate). The study focused on the New York Stock Exchange ("NYSE"), and covered a period of ten years period 2006 and 2015. The NYSE was used as it has many companies which are extensively covered by investment analysts.

To more accurately determine which companies should be included in the test sample, the adaptive and recursive option valuation model was used as sample filter. The adaptive and recursive model is sometimes also referred to as management's real option to dispose of the assets of the entity, rather than to continue trading. Thus, the study attempted to exclude from testing any companies that were possibly in part valued using the fair value of their net assets¹, rather than being nearly exclusively valued based on their future predicted cash flows². The first group of companies needed to be eliminated from the sample, as any implied cost of equity derived for them would be incorrect due to the target price not only reflecting their discounted cash flows, but also possibly some element of analysts' estimate of the fair value of their net assets.

A large number of factors, which have either been theoretically derived or empirically shown to be determinants of, or correlated with, the cost of equity were then tested for the strength of their association with the implied cost of equity premiums calculated from the analyst forecasts.

¹ In the extreme case such companies would be in severe distress, where the best value that can be realised would be by means of asset sales, and the valuation would thus

² *I.e.*, fully valued as a going concern

1.1. Research objective

By testing a large number of factors concurrently, this study aims to derive a parsimonious model of fundamental, macro-economic and behavioural factors that are statistically significantly correlated with the implied cost of equity when considered in combination with other factors.

1.2. Relevance

There are a number of practical uses to understanding which factors are linked to analysts' cost of equity premium estimates. Cost of equity is currently estimated using many diverse methods and idiosyncratic considerations. An empirically derived model could provide a sense check for analysts, by allowing them to benchmark their cost of equity estimates to the estimate that would be obtained from the model.

Another use could be to identify shares for which analysts' current estimate of risk (cost of equity) is substantially different from the cost of equity that is implied by the values of the fundamental factors. This could then be used to identify shares which are potentially mispriced.

Another possible application is to compare the factors that prove to be significantly related to analysts' implied cost of equity estimates to the factors that have been shown to affect return. Both the factors included and the weighting of the factors may differ significantly. This may help to explain some of the differences between analysts' projected target prices and the actual prices achieved by assets.

This study cannot solve the fundamental problem of being able to accurately calculate the true justified cost of equity for an investment. Rather, it empirically investigated and modelled the link between the implied cost of equity premiums used by market participants, using US equity analysts as proxy, and the different risk indicators that can be used to estimate the cost of equity. This study did not rely on the efficient market theory, as the implied cost of equity was not calculated using the current market prices, but rather the analysts' target prices and earnings forecasts, nor did it use the actual returns earned on assets historically.

1.3. Contribution

This study contributed to the current body of literature in the following ways:

- This study combined fundamental (company) characteristics, as well as economic and behavioural indicators into a single model for cost of equity premium, to determine which factors are significantly linked to the cost of equity premium estimate. The nature of the modelling also allowed the identification of factors which may be significant on their own, but do not add sufficient explanatory power to the model to justify inclusion. To the author's knowledge, this study combines a far wider array of factors of all types compared to any of the previous studies on the topic.

- The study uses the adaptive and recursive option valuation model to allow for a more robust selection of companies to be included in the sampling. This is a novel addition to this area of research, and contributes to the accuracy of the final model.
- The study used mixed effects modelling to measure the impact of the various factors on the cost of equity premium. Studies of this nature were historically done by means of least squares regression. Mixed effects modelling allows the model to adjust for factors (random effects) which are not included in the model, but that influence each company in a unique way, thus increasing the accuracy with which the significance of factors can be established.

1.4. Thesis structure

The remainder of this thesis is structured as follows:

Chapter 2 is a review of the literature used in this study. The chapter has been divided into two sections. The first deals with the theories and derived methods for calculating cost of equity, and the second deals with the relevance of fundamental, economic and behavioural finance factors to cost of equity.

Chapter 3 is a summary of the data characteristics and sources. Firstly, the source and selection of the sample and data is discussed, including the use of the adaptive and recursive option valuation to exclude certain entities is addressed, followed by any other exclusions from the data set.

Chapter 4 summarises the methodology used in the model. This chapter describes how a methodology for the estimation of cost of capital was selected and what inputs into the methodology was used. As cost of equity is determined by risk factors, which are not directly measurable in most cases, the selection of proxies for these risk factors is described. Finally, this chapter describes the use of mixed effects modelling and how it impacts the model and its results. Finally, the chapter describes the method used to optimize the model's parsimony.

Chapter 5 describes the results. It first describes the cost of equity premium estimates that were made and how this compares to prior estimates. The next section of the results chapter describes the test results for individual factors and the final model produced after optimization. The section then also reports the model's ability to predict cost of equity premiums in the sample.

Chapter 6 is the conclusion and discusses the main findings and implication of these findings. The chapter also deals with the relevance of these findings in the field of finance and further research opportunities.

Chapter 2: Literature review

This literature review consists of two sections. The first part of the review considers the theoretical models underlying the cost of equity concept, as well as the practical models derived from these theories that are available to calculate implied cost of equity. The second part of the chapter reviews the studies that identify factors with a significant association with return, pricing or cost of equity.

2.1. Estimating the cost of equity

A key step in this study was to calculate the implied cost of equity, given analyst estimates of earnings and target share prices. There are a few theoretical models on which methods for calculating the cost of equity are based. In this section of the literature review, the theoretical models used in the different methods is first dealt with, followed by the various practical methods that have been derived by other researchers.

2.1.1. Theoretical models for cost of equity calculations

The following valuation models are derived from theoretical relationships between value and the cost of capital: the dividend discount model, Gordon's growth model, residual income valuation models, the capital asset pricing model (CAPM), and Arbitrage Pricing Theory models. Each of these, which can be used to determine implied cost of capital numbers from asset market prices, are discussed below.

The dividend discount model

The dividend discount model rests on the basic principle that an asset's value is equal to the future cash flows attributable to equity owners, discounted at an appropriate rate of return. This appropriate rate of return is the cost of equity, *i.e.* the required rate of return for a specific level of risk borne by the investor. The return on equity is both the dividends and the increase in the value of the share. The increase in value will of course be dependent on the value at the future date of realisation. The value of the asset at this time of realisation in the future can also be calculated using the projected dividends at that future date and an increase in value to a projected further realisation point. By substituting the future realisation value endlessly for projected dividends, the value can be calculated using an infinite stream of dividends.

The theory is thus stated as follows:

$$\text{Value per stock} = \sum_{t=1}^{t=\infty} \frac{E(DPS_1)}{(1+k_e)^t} \quad \text{Eq. 2.1}$$

Where:

$E(DPS_1)$ = Expected dividend per share at time 1

k_e = cost of equity

The dividend per share at time 1 can be estimated by making assumptions about expected future growth rates in earnings and pay-out ratios. The second input needed to value the share is then cost of equity.

Gordon's growth model

Gordon (1956) growth model is a specific case of the dividend discount model, where the growth in dividends per share is assumed to be constant over the period. The Gordon formula is deduced below from the dividend discount model.

$$P_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t} \quad \text{Eq. 2.2}$$

...Where:

P_0 = Price at time 0

D_t = Dividend expected at time = t

k = required rate of profit/return

The model then assumes that the dividend is paid and discounted continuously at annual rates D_t and k , which results in:

$$P_0 = \int_0^{\infty} D_t e^{-kt} dt \quad \text{Eq. 2.3}$$

Since P_0 is known, estimating the rate of return (cost of equity) requires the determination of $D_t, t = 1, 2, \dots, \infty$, which would be the expected future dividends at time t . A company is then expected to retain a fraction of its income after taxes (b); and a company is expected to earn a return of r on the book value of its common equity. Let Y_t equal a corporation's income per share after taxes at time t . Then the expected dividend at time t is:

$$D_t = (1 - b)Y_t \quad \text{Eq. 2.4}$$

The income per share at time t is the income at $(t - 1)$ plus r percent of the income at $(t - 1)$ retained, or

$$Y_t = Y_{t-1} + rY_{t-1} \quad \text{Eq. 2.5}$$

This can be seen as a compound interest expression so that, Y_t grows continuously at the rate $g = br$, or

$$Y_t = Y_0 e^{gt} \quad \text{Eq. 2.6}$$

Using Equation (2.3) above, Equation (2.5) can be rewritten as

$$D_t = D_0 e^{gt} \quad \text{Eq. 2.7}$$

Substituting this Equation (2.6) for D_t into Equation (2.2) and integrating yields:

$$\begin{aligned} P_0 &= \int_0^{\infty} D_0 e^{gt} e^{-kt} dt \\ &= D_0 \int_0^{\infty} e^{-t(k-g)} dt \\ &= \frac{D_0}{(k-g)} \quad \text{Eq. 2.8} \end{aligned}$$

The condition for a solution existing for P_0 is that $k > g$, which makes logical sense, as else P_0 is infinite or negative.

Residual Income Valuation model

The residual income valuation model, developed by Edwards & Bell (1961), Peasnell (1982), and (Ohlson, 1995), is based on the dividend discount model, but also uses the principle of clean surplus accounting; *i.e.* the change in book value is equal to earnings minus dividends (net of capital contributions).

Ohlson (1995) uses the principle set by Peasnell (1982) that ‘abnormal’ or ‘residual’ income can be defined as the earnings in excess of the ‘normal’ earnings. The ‘normal’ earnings are defined as the beginning book value of the company multiplied by the company’s cost of equity. The assumption then, using the clean surplus accounting model, is that the present value of the abnormal earnings is equal to the goodwill of the company.

A final assumption of the model is that the abnormal earnings at time $t + 1$ are linearly related to the abnormal earnings at time t , plus a numerical variable that represents information other than the accounting data and the dividends. The variable for “other information” satisfies a regular autoregressive process.

Ohlson also notes that two closely related Miller and Modigliani (1958, 1963) principles are also satisfied by the model - firstly, that a dollar dividend paid reduces the market value of the entity of the company by one dollar (by reducing the book value), and secondly that dividend payments have opportunity costs and reduces future earnings capacity, but not current earnings.

The model can be expressed as follows:

$$P_t = \sum_{\tau=1}^{\infty} R_f^{-\tau} E_t[d_{t+\tau}] \quad \text{Eq. 2.9}$$

Where:

P_t = the market value, or price, of the firm's equity at date t

d_t = the dividends paid at date t

R_f = the risk free rate plus 1

$E_t[.]$ = the expected value operator conditioned on the date t information

Also:

x_t = earnings for the period $(t - 1, t)$

y_t = (net) book value at date t

$$y_{t-1} = y_t + d_t - x_t \quad \text{Eq. 2.10}$$

And

$$\frac{\partial y_t}{\partial d_t} = -1$$

$$\frac{\partial x_t}{\partial d_t} = 0$$

The above equation states clean surplus accounting mathematically.

One can then use the Equation 2.9 and Equation 2.10 to express P_t in terms of future (expected) earnings and book values in lieu of the sequence of (expected) dividends in the dividend discount model in Equation 2.1.

$$x_t^a = x_t - (R_f - 1)y_{t-1} \quad \text{Eq. 2.11}$$

Combined with the clean surplus restriction in Equation 2, the definition implies:

$$d_t = x_t^a - y_t + R_f y_{t-1} \quad \text{Eq. 2.12}$$

Using Equation 2.12 to replace d_{t+1}, d_{t+2} in the dividend discount model yields the following:

$$P_t = y_t + \sum_{\tau=1}^{\infty} R_f^{-\tau} E_t[\tilde{x}_{t+\tau}^a] \quad \text{Eq. 2.13}$$

Provided that $\frac{E_t[\tilde{y}_{t+\tau}]}{R_f^{-\tau}} \rightarrow 0$ as $\tau \rightarrow \infty$. The last condition is assumed to be satisfied.

x_t^a is defined as abnormal earnings, with the normal earnings being the risk related “normal” return that would be earned on the capital invested. The model makes intuitive sense as the book value is the present value of the “normal” earnings discounted at the “normal” expected rate of return and any value above the book value, would be the result of earnings in excess of the “normal” earnings.

Capital asset pricing model (“CAPM”)

The traditional method used to estimate the *ex-ante* cost of equity is the CAPM model of Sharpe (1964), Lintner (1965), and Black (1972). Sharpe’s theory is an extension of the Markowitz’s (1952) theory of portfolio selection, which rests on the principle that investors do (or should) consider expected return as desirable and variance of return as undesirable. This is an implication of the finance principle of maximizing returns while minimizing risk. Building on this principle, Lintner (1965) then split the return of a single share into two components, being the risk free portion of the return, and the portion that has a certain variance and co-variance to a particular portfolio. If two shares are being considered, and neither lower the return of the portfolio, the share which does lower the co-variance will be preferred.

This principle translates mathematically as follows in the model that permits short sales:

Conditions:

m = the number of different stocks in a portfolio denoted by $i = 1, 2 \dots m$

$|h_i|$ = The ratio of the gross investment in the i^{th} stock to the gross investment in all stocks

\tilde{r}_i = The return per dollar invested in a purchase of the i^{th} stock

\tilde{r} = Return per dollar invested in a particular mix or portfolio of stock

r^* = riskless rate

The actual investment in the i^{th} share is equal to $|h_i|$. For the non-short sale option, the returns are then simply $h_i\tilde{r}_i$. The equation is then stated in terms of a risk free portion of the returns, which always has a covariance of one with the risk free portion of every other asset in the portfolio, resulting in a specific case of the familiar CAPM formula.

$$h_i\tilde{r}_i = h_i(\tilde{r}_i - r^*) + |h_i|r^* \quad \text{Eq. 2.14}$$

Black (1972) restated the model in terms of the relationship between the expected risk premiums on individual assets and their “systematic risk”. He defined “systematic risk” as the coefficient that the expected return of the market must be multiplied by to give the expected return of a specific asset. This is expressed as follows:

$$E(\tilde{R}_j) = E(\tilde{R}_m)\beta_j \quad \text{Eq. 2.15}$$

And:

$$E(\tilde{R}_j) = \frac{E(P_t) - P_{t-1} + E(D_t)}{P_{t-1}} - r_{Ft} \quad \text{Eq. 2.16}$$

\tilde{D}_t = Dividend paid on the j th security at time t

r_{Ft} = risk less rate of interest

$E(\tilde{R}_M)$ = excess returns on a market portfolio consisting of an investment

in every asset outstanding in proportion to its value

$$\beta_j = \frac{\text{cov}(\tilde{R}_j, \tilde{R}_M)}{\sigma^2(\tilde{R}_M)} = \text{the systematic risk of the } j\text{th asset}$$

The model is dependent on four assumptions: (1) all investors are single period risk-averse utility of terminal wealth maximisers, and can choose among portfolios solely on the basis of mean and variance, (2) there are no taxes or transactions costs, (3) all investors have homogeneous views regarding the parameters of the joint arbitrage probability distribution of all security returns, and (4) all investors can borrow and lend at a given riskless rate of interest.

This model has been widely applied in practice and uses an index or return as the market portfolio, but Ross (1980) in his empirical investigation of Arbitrage Pricing Theory (“APT”), noted that two of the assumptions used in the CAPM are difficult to justify. The first is the assumption of normality of returns, and the second is the assumption regarding utility functions for investors. Ross’ (1980) study tested additional factors apart from beta’s influence on returns, and found a number of other factors to be relevant to returns, as did a number of other studies at the time, including those by Langetieg (1978), Lee and Vinso (1980), and Meyers (1973). Although the aforementioned research was more focussed on supporting APT modelled by Ross (1976) and identifying possible factors to use in the model, these studies indirectly provided evidence against the CAPM and/or the efficient market theory. In fact, the very existence of these factors is incompatible with CAPM.

A direct critique of the CAPM was done by Roll (1977), who concluded the following: 1) that the only way to test CAPM was to prove the market portfolio is mean-variance efficient and 2) there will always be an infinite number of *ex post* efficient portfolios, which will perfectly reflect CAPM, without the market portfolio being mean-variance efficient. This results in Roll concluding that the theory is not testable unless all individual assets are included in the sample rather than a proxy such as the listed stock market.

Some of the first studies to identify additional factors outside of CAPM that influence return are Basu (1977), Ball (1978) and Reinganum (1980). Basu (1977) tested the value of the price-to-earnings ratio as an indicator of future returns and found that low price-to-earnings portfolios earn higher absolute and risk-adjusted (using beta) equity returns when compared to high price-to-earnings portfolios. This is not consistent with CAPM, and supports the use of APT.

Ball (1978) tested if excess return is earned after the announcement of earnings if the announcement materially differs from the expectation prior to the announcement. The finding that this is true is also inconsistent with CAPM and the efficient market theory. Reinganum (1980), in a similar study to Basu (1977) used price-to-earnings ratios and the size of companies to construct portfolio, which consistently had average returns which deviated from the expectation set by the CAPM.

Subsequently a very large number of studies have been performed showing the association of different factors with return. Some of these studies are also included in the justification for the inclusion of specific risk factors as discussed below.

Currently, utility theory (one of the assumptions on which CAPM rests) is being challenged by proponents of behavioural finance, who suggest that Prospect Theory (Kahneman, 1979), and its modified version, Cumulative Prospect Theory (Tversky, 1992), also known as loss aversion, explains investors’ behaviour better than utility theory. The theory disputes the assumption that a rational investor will maximize his utility over a given period, but theorizes that investors behave irrationally in a number of ways, *i.e.* they may limit their long term utility in order to avoid short term losses.

Arbitrage Pricing Theory

As alluded to above, another model to determine asset pricing, or cost of equity, is the arbitrage pricing theory model of Ross (1976). This theory states that the return on a share is explained by a number of factors, which may include macro-economic, market and company specific factors.

$$r_i = \alpha_i + \beta_{i_1}f_1 + \beta_{i_2}f_2 + \dots + \beta_{i_k}f_k + \epsilon_i \quad \text{Eq. 2.17}$$

Where:

r_i = Return on Company i 's share

α_i = A constant

f_k = factor k

β_{i_k} = the factor loading of the factor k

ϵ_i = idiosyncratic component of a stock's return

Similar to the Capital Asset Pricing Model,

$$\beta_{i_k} = \frac{COV(r_i, f_k)}{VAR(f_k)} \quad \text{Eq. 2.18}$$

Restating this in terms of expected return:

$$E(r_i) = \gamma_0 + \beta_{i_1}\gamma_1 + \beta_{i_2}\gamma_2 + \dots + \beta_{i_k}\gamma_k \quad \text{Eq.2.19}$$

Where:

γ_k = Risk premium associated with factor k

Some of the best know implementations of APT is the Fama and French three-factor model (1992), which, in addition to market returns, identified size and price-to-book value ratio as factors that could be used to estimate returns and thus, implicitly, cost of equity. Carhart (1997) then extended this to a four-factor model to include market momentum. Fama and French has since then extended their model to a five-factor model (see Fama and French 2014, 2016) to also include different market indicators.

The above theoretical frameworks form the basis for various methods for estimating the implied cost of equity from cash flow and price information. Botosan and Plumlee (2005) took five of the more popular methods, used (including their own) and evaluated which of these are associated with firm risk in a stable and meaningful manner. The same methods (excluding Botosan and Plumlee's own) was also used by Easton and Monaham (2005), in their evaluation of implied cost of equity proxies. These methods are the first to be discussed below, followed by other possible methods of estimating cost of equity.

The Botosan and Plumlee method

Botosan and Plumlee (2002) examined the link between softer metrics such as levels of disclosure in the annual report, timely disclosure of information, and investor relations activity to cost of equity. To test the levels of association with cost of equity, an implied cost of equity first needed to be calculated. Their method to estimate the equity risk premium is called the target price method. This method uses a specific forecast period and then has a forecasted terminal value. The method can be formulated as follows for a five-year specific forecast period:

$$P_0 = \sum_{t=1}^5 (1 + r_{DIV})^{-t} (dps_t) + (1 + r_{DIV})^{-5} (P_5) \quad \text{Eq. 2.20}$$

P_0 = Price at time 0

$Dpst$ = dividends per share (as predicted by analysts)

$Rdiv$ = estimated cost of equity

P_5 = Price at time 5 (as predicted by analysts)

Thus, if price (P_0), and the analyst predictions for dividends per share (dps_t) and the future share price (P_5) is available, the equation can be solved for the cost of equity (r_{div})

Gebhardt method

The second method is the industry method of Gebhardt *et al.* (2001). The purpose of the Gebhardt *et al.* (2001) study was to attribute fundamental factors to the cost of equity, much as this study is doing. To be able to perform the attribution, the researchers needed an accurate proxy for cost of equity, and similarly to this study estimated a forward looking implied cost of equity.

The calculation of implied cost of equity was based on the residual income valuation model. It was assumed that the rate of growth beyond the IBES³ forecast horizon is implied by fading the firm's return-on-book equity to its industry median over varying forecast horizons, with the justification for this assumption being that this fade captured the long-term erosion of excess return-on-equity over time. For the first three years the researchers used analysts' forecasts of earnings per share and book value per share. For the next nine years, the researchers assumed that firm ROE faded linearly to the industry median. Beyond the forecast horizon, it was assumed that the final term ROE (*i.e.* the industry median) remained constant over the future with a 100% dividend pay-out ratio beyond the final year. For this method, Compustat⁴ PST data was used and the industry classifications followed Fama and French (1997).

³ Institutional Brokers' Estimate System (IBES), is a system that gathers and compiles the different estimates made by stock analysts on the future earnings for the majority of U.S. publicly traded companies.

⁴ Compustat is a database of information on active and inactive global companies. The database includes financial, statistical and market information.

A similar study was performed by Claus and Thomas (2001), who followed an approach of not estimating the rate of growth beyond the forecast horizon, but rather using the residual income model after an initial five-year period. The researchers then estimated the growth in abnormal earnings, rather than the growth in earnings after the first five years of forecasts, based on an economic argument for assuming the rate of growth in residual income beyond the forecast horizon is the inflation rate. The implication of these model inputs is that in real terms the abnormal returns are “frozen” at year five, but that the company will continue to earn excess returns, as per Equation 2.21.

$$P_0 = b_0 + \sum_{t=1}^{11} \frac{(1 + RGLS)^{-t} ((ROE_t - RGLS)b_{t-1})}{((ROE_{12} - RGLS)b_{11})} + (RGLS(1 + RGLS)^{11})^{-1} \quad \text{Eq. 2.21}$$

Where:

$$ROE_t = \text{return on period } t = \frac{eps_t}{b_{t-1}}$$

eps_t = forecasted earnings per share, year t

b_t = book value per share, year t

$RGLS$ = estimated cost of equity

Neither Claus and Thomas (2001), nor Gebhardt, *et al.* (2001), examined the empirical validity of their growth assumption, but many studies have shown that long run earnings mean revert. Buus (2008) noted that abnormal earnings are in most cases transitory, and this has been supported by many (mainly U.S.) empirical studies, including those by Givoly (1985) and Fama and French (2000).

Gordon method

The third method for obtaining an implied cost of capital used the Gordon (1956) Growth Model for a finite horizon, as outlined in Gordon and Gordon (1997). The model states that all abnormal performance must have a finite horizon, thereafter the return on equity should be equal to the expected risk-relevant return on equity. Starting from the dividend discount model and with the use of the Gordon’s growth model, the following equation is derived:

$$PPS = \sum_{T=1}^N \frac{DIV(0)*(1+GRR)^T}{(1+EXR)^T} + \frac{NEPS(1)*(1+GRR)^N}{EXR*(1+EXR)^N} \quad \text{Eq. 2. 22}$$

Where:

$DIV(T)$ = dividend

PPS = current price per share

GRR = expected growth rate in the dividend

EXR = expected return (on equity)

NEPS = expected normalised earnings per share

If the current share price and dividend is known, and the short and long-term growth rate of the dividend can be estimated (for example by using analyst consensus forecasts), only the expected normalised earnings at the end of the specific forecast period remains as an unknown. Using an expected normalised earnings estimate for period 1 (perhaps also obtained from analyst's forecasts) and growing it by the short term growth rate an expected normalised earnings at the end of the medium term forecast period is obtained. The equation can now be solved for expected return on equity, if N is known. As analyst and valuation practitioners normally do medium term forecast of up to five years, Gordon (1997) assumed that N is between five and ten years.

Ohlson Juettner-Nauroth method

The fourth method for the determination of the implied cost of capital is the Ohlson Juettner-Nauroth (2005) ("OJN") method, using the same assumptions as Gode and Mohanram (2003). The assumptions are outlined in Equation 2.23 below, with an additional assumption that the terminal growth is equal to the economy-wide growth.

Ohlson and Juettner-Nauroth's (2005) study is one of the landmark studies which detail an approach for imputing the cost of equity through either current level of earnings, or forecasts. The purpose of the study was to suggest a possible quantitative model which could use the current price, the two-year EPS forecast, the one-year dividend forecast, and an assumed perpetual growth rate of earnings after two years, to calculate an implied cost of equity. The model was derived from the dividend discount model and the RIV model, but attempted to incorporate any changes in dividend policy over the period of time.

The reason for including the dividend pay-out ratios is that when income is exactly the required rate of return for equity, the future earnings of the entity at any point in time is equal to book value, and there is no need for an extended valuation, as the price will be equal to the book value. By implication, whether a dividend is paid out or not in a future period does not matter as the discounted cash flow value of the earnings forfeited by taking a dividend, would be exactly equal to the book value of the dividend, which is its cash value. Conversely, if excess returns are being earned, the value of future cash flow being forfeited exceeds the book value of the dividend (*i.e.* the cash value to the investor). The implication is that the more dividends that are paid out the more the growth of abnormal earnings are being reduced.

The model does not depend on whether excess earnings is the result of accounting conservatism or actual excess returns, nor does it depend on clean surplus accounting. Both these are significant advantages, as both are difficult to adjust for in testing. The model can be summarised as follows:

$$P_0 = \frac{eps_1}{r} + \sum_{t=1}^{\infty} (1+r)^{-t} z_t \quad \text{Eq. 2.23}$$

Where:

$$z_t = r^{-1}(eps_{t+1} - (1+r)eps_t + rdps_t)$$

$r, R - 1 = \text{Cost of Capital, or discount } r$

With the following limitations:

$$eps_1 > 0$$

$$z_1 > 0$$

$$\hat{g}_2 = g_2 - r$$

$$g_2 = \frac{eps_2 - eps_1}{eps_1} + \frac{rdps_1}{eps_1}$$

$$z_{t+1} = \gamma z_t \text{ for } t = 1, 2, \dots$$

$$1 \leq \gamma \leq (1+r)$$

Easton method

The Easton (2004) method was derived from the Ohlson Jeuttner-Nauroth (2005) method.). If a further assumption is made that excess return remains stable, the model can be further simplified as illustrated below. Practically, an excess return would only need to be the case until the discounted earnings for the next year becomes immaterial. In Easton's (2004) implementation of this method, the one-year (eps_1) and two-year (eps_2) forward earnings-per-share predictions were used.

Assuming efficient markets, Easton derives the model as follows:

$$P_0 = (1+r)^{-1}[P_1 + DPS_1] \quad \text{Eq. 2.24}$$

Where:

$P_0 = \text{current, date } t = 0, \text{ price of share}$

$P_1 = \text{expected, date } t = 1, \text{ price of share}$

$dps_1 = \text{expected dividend per share, at } t = 1, \text{ and}$

$r = \text{expected rate of return, and } r > 0 \text{ is a fixed constant}$

Capitalised earnings in then added to the formula to get

$$P_0 = \frac{eps_1}{r} - \left[\frac{eps_1}{r} - (1+r)^{-1}(P_1 + dps_1) \right] \quad \text{Eq. 2.25}$$

Where:

$eps_1 = \text{expected accounting earnings for period 1}$

Applying this formula to calculate the price at $t=1$ then results in:

$$P_1 = \frac{eps_2}{r} - \left[\frac{eps_2}{r} - (1+r)^{-1}(P_2 + dps_2) \right] \quad \text{Eq. 2.26}$$

Substituting Equation 2.26 into Equation 2.25, the below is obtained:

$$P_0 = \frac{eps_1}{r} + r^{-1}(1+r)^{-1}agr_1 + (1+r)^{-2}r^{-1} [rdps_2 - (r+1)eps_2 + (1+r)^{-2}P_0] \quad \text{Eq. 2.27}$$

And:

$$agr_1 = [eps_2 + rdps_1 - (1+r)eps_1] \quad \text{Eq. 2.28}$$

In the above equation agr_1 is the expected abnormal earnings in period 2. Using an example of a company which is not paying dividends, with all earnings getting re-invested to grow future earnings, the middle term would be nil, and as the expected growth in earnings will be the expected rate of return, the first and third term will be equal, resulting in excess returns being equal to 0.

The model can then be extended to periods beyond period two, by recursively substituting the price variable, resulting in:

$$P_t = \frac{eps_1}{r} + r^{-1} \sum_{t=1}^{\infty} (1+r)^{-1} agr_t \quad \text{Eq. 2.29}$$

The formula can be used for a finite forecast horizon by defining the Δagr to be the perpetual rate of change in agr . The following makes use of this definition for a two year period.

$$P_0 = \frac{eps_1}{r} + \frac{agr_1}{(r(r-\Delta agr))} \quad \text{Eq. 2.30}$$

And:

$$\Delta agr = \left(\frac{agr_{t+1}}{agr_t} \right) - 1 \quad \text{Eq. 2.31}$$

By assuming that $\Delta agr = 0$, Formula 2.30 can be simplified as follows:

$$P_0 = \frac{[eps_2 + rdps_1 - eps_1]}{r^2} \quad \text{Eq. 2.32}$$

Then by assuming that $dps_1 = 0$, Equation 2.32 can simplify as follows:

$$r = \sqrt{\frac{(eps_2 - eps_1)}{P_0}} \quad \text{Eq. 2.33}$$

Fitzgerald method

Although the Ohlson and Juettner-Nauroth (“OJN”) (2005) model, is a parsimonious model for estimating the cost of equity implied by the price and earnings forecasts of a share, one of the most judgemental areas is still estimating the terminal growth rate. In the OJN model it takes the form of λ , a constant factor, by which the excess returns above cost of equity deteriorates. To eliminate this problem a few researchers have applied methods by which the cost of equity and the terminal growth rate can be estimated simultaneously, reducing the amount of judgemental inputs.

Easton *et al* (2002) estimates the long-term change in abnormal growth and the implied cost of equity simultaneously in order to minimize error, while attempting to calculate the average US equity premium. As is found in all discounted cash flow valuations, the value estimate is extremely sensitive to the growth assumption in the terminal value. By estimating these factors simultaneously, Easton (2002) tries to eliminate one subjective input into the process of estimating the cost of equity.

The method by which this is done uses the residual income model, restated so that the intercept and the slope coefficient are functions of the expected rate of return and expected growth in residual income, permitting the estimation of these variables. The formula is as follows for each company j :

$$\frac{X_{jcT}}{B_{j0}} = \gamma_{j0} + \gamma_{j1} \left\{ \frac{P_{j0}}{B_{j0}} \right\} \quad \text{Eq. 2.34}$$

Where:

P_0 = market price per share at time 0,

B_0 = book value per share at time 0,

X_{cT} = aggregate four year cum-dividend earnings

$\gamma_0 = G-1$

$\gamma_1 = R - G$

$G = (1+g)^4$

g = the rate that allows the present value of the growing perpetuity of residual value explains the difference between price and current book value

$R = (1+r)^4$

R = the four-year expected return on equity

The least squares regression of the above equation gives the value of the intercept and the slope coefficient, and these can be arithmetically converted into the perpetual growth of residual value and the expected return on equity (as an index). Nekrasov and Ogneva (2011) uses a weighted least squares method to expand the methodology from an average estimate of cost of equity to an estimate for a specific entity in the US

market between 1980 and 2007. They make use of indicators of risk to weight the importance of observations for each entity, and then perform a weighted least squares regression.

Fitzgerald *et al.* (2013) use a similar method as Nekrasov and Ogneva (2011) above, except that the initial estimate of the cost of equity for a company is not done by means of the weighted squares regression method within an entire portfolio of companies, but rather the Easton method is applied to the earnings forecasts and target prices produced by various analysts for a single company. The method then iteratively estimates the two parameters of growth and cost of equity. This is possible as the number of observation that needed fitting was much less.

Fitzgerald *et al.* (2013) call these estimates unconstrained because they are not constrained by the growth rate assumption made by the analysts or the assumptions made to allow for the calculation of implied cost of equity by any other method. Examples of the assumptions that normally need to be made is that cost or equity and growth is the same for all companies in an industry, or will converge to the average return on equity of the industry.

Brav method

Brav, Lehavy and Michaely (2005) developed a method of calculating the implied cost of equity which uses the Value Line⁵ four year forward looking price estimate and an estimated dividend yield, which is calculated by using the prior year dividend and historical dividend growth rate. This model is derived from the dividend discount model. The model can be expressed as follows:

$$(1 + ER_t^{VL}) = \frac{TP_t}{P_{t-9}} + \left(\frac{D}{P}\right)_H * (1 + g_H) * \left[\frac{(1+ER^{VL})^4 - (1+g_H)^4}{ER^{VL} - g_H}\right] \quad \text{Eq. 2.35}$$

Where:

g_H = *historical growth rate of dividends*

$\frac{TP_t}{P_{t-9}}$ = *rate of return implied by the forward price estimate without any dividends*

$\left(\frac{D}{P}\right)_H$ = *historical dividend yield*

ER_t^{VL} = *implied rate of return*

⁵ Value line is a supplier of historical and forecast financial data for companies globally

2.1.2. Evaluation of methods to calculate implied cost of equity

There are various ways to evaluate the efficacy of the methods to calculate cost of equity, and testing depends on which proxies are used for the true risk profile of the entity. Some studies, such as those by Guay, Kothari, and Shu (2005) and Easton and Monahan (2005), tried to test the methods by comparing cost of equity estimated obtained by using each of them with actual subsequent returns. This approach was not very effective and only weak relationships were found. This is not surprising, considering the market noise and unexpected events that actual returns are subject to.

However, the purpose of this study is not to examine the impact of risk factors on returns or even market pricing, but rather the impact of risk factors on the implied estimate of cost of equity made by analysts, as observable from their target price and earnings estimates. Thus, evaluations of the efficacy of the methods in terms of actual realised returns are not applicable in this context.

An example of the second type of test of efficacy would be Li, Ng, and Swaminathan (2013). This study tested the efficacy of the estimate on market level rather than at individual company level after aggregating company results. These studies do not supply strong evidence for the efficacy of these methods at company level, making them less applicable to this study.

Fitzgerald et al. (2013) tested their implied cost of equity estimate with a combination of the previous two methods, using market level implied cost of equity estimates and testing that against realised market returns over different return periods. This means that it is difficult to compare the efficacy of the Fitzgerald et al. (2013) method with that of the other six methods and thus this method was not utilised.

The third method, which is the comparison of the implied cost of equity estimates with company level risk indicators, is directly related to the research objective of this study. Amongst these studies are those of Botosan and Plumlee (2005) and Brav, Lehavy and Michaely (2005). The former group of researchers tested the accuracy of the different methods by regressing the calculated risk premium from each model against measures of risk. The risk factors that were regressed against included market beta, leverage, information risk, and a measure of firm size based on the market value of equity, as follows:

$$r_{PREmit} = \gamma_0 + \gamma_1 UBETA_{it} + \gamma_2 DM_{it} + \gamma_3 INFO_{it} + \gamma_4 LMKVL_{it} + \varepsilon_{it} \quad \text{Eq. 2.36}$$

Where:

r_{PREM} = estimated risk premium produced by one of the five methods

$UBETA$ = unlevered CAPM beta

DM = Leverage

FO = information risk

$LMKVL$ = the market value of equity

Botosan and Plumlee (2005) also, in separate extended models, included price-to-book value and growth, both of which are known to influence returns and by implication risk. Both factors were found to improve the explanatory power of the models significantly. In the above study, using the risk proxies as stated above, the cost of equities calculated by the Botosan and Plumlee (2005) and Easton (2004) methods were found to be the most consistently and predictably related to market risk, leverage risk, information risk, size, and the price-to-book value ratio. The Brav method was similarly evaluated by Brav, Lehavy and Michaely (2005). The explanatory power of the model in the Brav testing is lower than that of the Botosan and Plumlee (2005) model.

2.2. Factors that are linked to cost of equity

The number of studies that focus specifically on the determinants of cost of equity is limited, but as the cost of equity is used to calculate price and represents the expected return of an asset, studies which identify factors that influence price and expected return are discussed in the sections that follow. Price is further linked to valuation multiples, and thus studies which test the significance of factors for determining multiples have also been included.

The principle that the findings of studies testing the determinants of price, return and price multiples can be used to establish the determinants of the cost of equity, was established by Christie (1987), who considered the methodology used to perform studies similar to this one (*i.e.* in which both time series and cross-sectional accounting and economic information is used). Christie classified these studies into “valuation” studies and “return” studies. The former regress the market value of equity, the ratio of market-to-book value, or the price-earnings ratio, on explanatory variables. The second category uses rate of return (or unexpected return) as the dependent variable. It was noted that both these dependent variables (returns and price) are variables in the discounted cash flow formula. Price is dependent on the rate of return, implying that all factors that influence the rate of return will also influence price, and all factors that influence price (apart from expected cash flows), do so by affecting the rate of return.

In the discussion that follows, factors that are linked to the cost of equity have been separated into fundamental or company specific factors, macro-economic factors, and behavioural factors. As this study looks at the cost of equity premium, which is the investors’ perception of risk, a factor was only considered for inclusion in the discussion if it has a logical link to any of the following: the inherent risk of a company, market participants’ perception of risk, or the level of return that may be acceptable for a given level of risk.

2.2.1. Fundamental factors

Beta

The Capital Asset Pricing Model of Sharpe (1964), Lintner (1965), and Black (1972) defines an asset's expected return as the risk-free rate, plus a risk adjusted market premium. The risk adjustment is calculated using the volatility of the asset against the market portfolio, which is called beta. Using this model, the first (and only) factor that would need to be considered as an indicator of risk would be beta. As there is no methodology to calculate forward looking beta, historical beta is usually used as a proxy.

The relationship between beta and risk and return has been disputed, most famously by Fama and French (1992). They argue that since factors such as size and valuation multiples can explain a large portion of the cross-section of expected returns, beta is clearly not the only indicator of return, or expected return, which would imply that it is not the only indicator of the cost of equity premium. Most of the studies below highlight factors, other than returns relative to the market, which researchers have shown to possibly be related to the cross-section of expected returns.

In a seminal study on all the common shares quoted on the NYSE for at least five years between 1926 and 1975, Banz (1981) used risk adjusted returns to examine the link between return and company size. He found a premium on smaller shares, implying that CAPM does not hold, or that the market was not efficient. A similar study was performed by Reinganum (1981) on NYSE, AMEX and NASDAQ shares listed for the period 1962 to 1975. Using size and the price-to-earnings ratio as criteria, the average rate of return was computed for each of ten portfolios ranked by company size to determine whether their ranking was linked to returns. Similar to the Banz (1981) study, it was found that small sized companies do earn a risk-adjusted premium. When using the price-to-earnings ratio as basis for portfolio construction, it was found that a low price-to-earnings ratio resulted in excess return if beta is used as a risk adjuster. Furthermore, the outcome was not improved by an extension of the research period, implying that the issue is probably not an inefficient market, as the inefficiency would be expected to decrease over a longer time horizon.

Subsequently Basu (1983) performed similar tests on NYSE-listed industrial companies listed between 1956 and 1971, using price-to-earnings ratios and size as explanatory factors, and found that price-to-earnings had more explanatory power than size. In addition, Bhandari (1988), also on a sample of NYSE-listed shares, found that debt-to-equity was significantly related to returns, even after controlling for beta and firm size.

Using the normal distribution of returns to test if the cross-sectional implications of the CAPM model hold in a single variable model, Gibbons (1982) could reject the hypothesis with a significance level of less than 0.001. This test, with NYSE-listed share over the period 1924 to 1975, showed that a multi-variable non-linear model results in a better fit when examining returns. However, although beta is not the only factor determining the cost of equity premium, it is significantly related to the cost of equity premium. Thus, even

in a multi-variable model, the volatility of the beta of the share is still a risk factor that contributes to the estimation of cost of equity premium.

Marston and Harris (1992) used US analysts' growth forecasts and market prices to calculate the implied equity risk premium on a forward-looking basis. They found that equity premiums vary over time, with equity premiums being larger in low interest rate environments. They also pointed out that this is in line with the observed spreads on corporate bonds in low interest rate environments. To test the hypothesis that these forward-looking equity premiums are a good measure of risk, these researchers further tested the equity premium's relation to the beta of the share, and found the two to be related. This finding is also supported by Brav, Lehavy and Michaely (2005). The researchers acknowledged, however, that although the results supported beta as an indicator of the risk premium, they did not support the CAPM model, as the beta failed to explain the differences in equity risk premiums in its entirety.

Beta can be de-leveraged by adjusting the beta for the level of financial and operating gearing. A de-leveraged beta then suggests two further implied factors that contribute to risk, namely the relationship between the gross profit margin and EBITDA margin (derived from the relationship between the fixed and variable costs in Equation 2.38), and the level of debt-to-equity. The formulas as derived by Damodaran (2012) are as follows:

For financial deleveraging:

$$\text{Financially unlevered beta} = \frac{\text{market beta}}{1+(1-\text{tax rate})\left(\frac{\text{debt}}{\text{equity}}\right)} \quad \text{Eq. 2.37}$$

For operationally deleveraging:

$$\text{Pure business beta} = \frac{\text{Financially unlevered beta}}{\left(1+\left(\frac{\text{Fixed costs}}{\text{Variable costs}}\right)\right)} \quad \text{Eq. 2.38}$$

A high level of leveraging does not only increase earnings volatility, but also increases the possibility of financial distress when low earnings levels make it difficult to meet debt obligations. Under the Miller and Modigliani (1958) principle of capital structure irrelevance, the increase in return on equity should be a direct consequence of an increase in the debt-to-equity ratio.

The association of leverage with the implied cost of equity was investigated by Brav, Lehavy and Michaely (2005) from Value Line predictions for NYSE, AMEX and NASDAQ companies between 1974 and 2001. The study found that the implied cost of equity estimate was statistically significantly related to the debt-to-equity ratio. Andrade and Kaplan (1998) similarly established a negative relationship between value and financial leverage for financially distressed companies in a study that considered 124 management buyout transactions in the 1980s, to test if this type of transaction on average added value and what the cost was to firms that ended up in financial distress. In order to establish if there was cost of distress, the movement in EBITDA margin over time was calculated and compared to the average movement in the industry margin. Evidence of significant cost of financial distress was found.

Dividend yield

Dividends can be seen as a form of downside risk protection. A high dividend yield can be interpreted as being the result of: 1) a cash generating entity; 2) possibly a management team which has good alignment with shareholders' interest; and 3) a business which is currently not in a high growth stage, which is a factor that lowers the risk profile of the entity, thus lowering the cost of equity.

Campbell and Schiller (1988a and b), predicted both dividend yield and pricing by performing vector-autoregressive ("VAR") analysis on historic dividend yield and returns for companies on the NYSE between 1901 and 1986. Total return is thus dependent on prior dividend and prior returns. This model has been widely used and duplicated. More recently, Jiang and Lee (2007) used the Campbell and Schiller model to build a co-integrated log-linear model to predict future returns, using historic dividend yield and accounting earnings. The model proved to be effective in predicting future returns, supporting the inclusion of dividend yield in a cost of equity model.

Many researchers have confirmed the impact of dividend yield on returns. For example, Shamsuddin and Hiller (2004) examined the determinants of the P/E ratio in the Australian stock market from 1984 to 2003. A price-to-earnings ratio was calculated for the ASX200 as a proxy for the Australian market, and regressed against the dividend yield of the index. The dividend yield was found to be significant. Interest rates and GDP growth rates were also found to explain a large portion of the variation in the price-to-earnings ratio. These macro-economic factors are discussed in more detail in Section 2.3.2.

Chan (1997), in a working paper for the US National Bureau of Economic Research, took companies listed on the NYSE and AMEX between 1968 and 1993 and regressed various factors against the co-movement of returns. The conclusion was that company size, book-to-market value and dividend yield were the main three fundamental factors that drove co-movement in share returns. The purpose of the study was to identify systematic risk factors that could influence risk management by means of diversification. In the context of the above study, this implied the need to diversify according to size, dividend yield and book-to-market value, as these risk factors drives differences in returns.

As a further example, by tracking the expected real share returns of companies listed on the NYSE and AMEX in a time series of data for the period 1980 to 1989, Kothari (1997) performed an event study wherein it was found that dividend initiations had a significant positive impact on excess returns, while dividend omissions had a significant negative impact on returns over a three year period. Lastly, Fama and French (1988) tested the predictability of share returns and how it changes over different time periods. It was found that using dividend yield as a predictive parameter resulted in a small portion of the return (less than 5%), being predictable in the short term. In the long term, the dividend yield explained more than 25% of the variance of returns.

Margins

Bhojraj and Lee (2002) conducted a study to establish which fundamental factors could be used to choose a set of comparable companies for valuation purposes. The sample consisted of companies listed on the NYSE, AMEX and NASDAQ as at 29 May 2000 and that were domiciled in the United States, had a market capitalisation in excess of \$100 million, and fundamental data for the trailing 12 months. The study calculated pricing multiples (enterprise value to sales and price-to-book value) for each company, using a combination of factors to select comparators, and then compared the calculated multiple with the actual trading multiples one and three years ahead.

Since the similarity of these factors (discussed below) result in similar price multiples, they can in turn be possible determinants of cost of equity. Using the Residual Income Valuation model, and re-writing it in terms of the price-to-book value ratio, the following equation is derived:

$$\frac{P_t}{B_t} = 1 + \sum_{i=1}^{\infty} \frac{E_t[(ROE_{t+i}-r_e)B_{t+i-1}]}{(1+r_e)^i B_t} \quad \text{Eq. 2.39}$$

Where:

P_t = Price at time t

B_t = book value at time t

$E_t[.]$ = The expected values at time t

r_e = Cost of equity

ROE_{t+i} = the net returns on book equity for period $t + i$

On this basis Bhoraj and Lee (2002) included ROE, cost of equity and the growth rate of the book value in their model. They then used a similar approach to back out factors from the price to sales formula, as derived by Damodaran (1994) (see Equation 2.40 below), from the Gordon's Growth model.

$$P_0 = \frac{DPS_1}{r-g_n} \quad \text{Eq. 2.40}$$

Where:

P_0 = price at time 0

DPS_1 = dividend per share at time 1

r = cost of equity

g_n = stable stage growth rate

The equation is then divided by sales on both sides which results in the following formula:

$$\frac{P_0}{S_0} = \frac{\text{net profit margin} * \text{payout ratio} * (1+g_n)}{r-g_n} \quad \text{Eq. 2.41}$$

Based on Equation 2.41 Bhoraj and Lee (2002) also included the net profit margin, pay-out ratio and growth in their models as possible determinants of valuation ratios. The formula could easily also be extended to a two stage Gordon's Growth Model consisting of initial and final growth stages, both of which could then become possible inputs. Net margins can also, in turn, be decomposed further into gross and EBITDA margins.

As the goal of the study was to compare a company to its peers to find the most comparable company, the researchers used what they referred to as industry adjusted margins, which were defined as the difference between the operating (EBITDA) margin of the company and the average margin of its industry.

The factors found to be significantly correlated with valuation ratios included:

- The industry-adjusted profit margin. ⁶
- Return on equity or return on net operating assets, depending on which multiple is used;
- Forecast growth ⁷;
- Research and development expenditure; and
- A dummy variable to indicate if the firm is loss making or profit making.

Penman (1996) and Beaver and Ryan (2000) also established a link between ROE and the price-to-book value multiple. Penman (1996) factorised both the price-to-earnings and price-to-book value multiple. The methodology allows for the determination of the price-to-earnings ratio and price-to-book value ratio, within certain restrictive conditions. The formula, which is similar to the residual income model, is derived by using the dividend discount model, Ohlson's (1995) clean surplus assumption, and Miller and Modigliani's (1961) dividend irrelevance theorem.

$$P_t = \sum_{\tau=1}^{\infty} \rho^{-\tau} E \left((d_{t+\tau}) \middle| Z_t \right) \quad \text{Eq. 2.42}$$

Where:

$d_{t+\tau}$ is the dividend at time $t + \tau$

ρ is one plus the discount rate

Z_t is the conditioning information at time t

P_t is the theoretical price at time t , which would be equal to the market price in an efficient market

⁶ This variable is the difference between the firm's operating (EBITDA) profit margin and the median profit margin of the industry.

⁷ It makes logical sense that growth is highly significantly related to valuation multiples, as all the future growth is capitalised into a single number, but it possibly makes less sense as a risk factor contributing to the cost of equity. High levels of growth would be reflected in the expected future cash flows, rather than the cost of equity, when the two elements are separated.

The methodology then uses the clean surplus accounting principle established by Ohlson (1995), which is expressed as follows:

$$E(\tilde{B}_{t+\tau}) = E(\tilde{B}_{t+\tau-1}) + E(\tilde{X}_{t+\tau}) - E(d_{t+\tau}) \quad \text{Eq. 2.43}$$

Where:

$\tilde{B}_{t+\tau}$ is book value at $t + \tau$

$\tilde{X}_{t+\tau}$ is accounting earnings from $t + \tau - 1$ to $t + \tau$

$d_{t+\tau}$ is dividends declared from $t + \tau - 1$ to $t + \tau$

As the number of periods increases, T approaches infinity, and P_t in equation (42) approaches the following:

$$V_t^T = (\rho^t - 1)^{-1} E\{[(\sum_{\tau=1}^T \tilde{X}_{t+\tau} + \sum_{\tau=1}^T (\rho^{T-\tau-1}) d_{t+\tau})] | Z_t\} \quad \text{Eq. 2.44}$$

Equation 2.44 was derived by substituting dividends in Equation 2.43 into Equation 2.42, and assuming a convergence condition similar to that assumed for Equation 2.42. In this expression, expected accounting earnings from $t+1$ to $t+T$ are adjusted for the reinvestment value of dividends expected to be paid from $t+1$ to $t+T-1$, to reflect that future dividends displace subsequent earnings, as established by Ohlson (1995). V_t^T then gets substituted with P_t assuming market efficiency, for $T = \infty$, followed by division by B_t to derive the following formula:

$$\frac{P_t}{B_t} = \frac{E(\sum_{\tau=1}^T \tilde{X}_{t+\tau}^c | Z_t)}{B_t(\rho^T - 1)} \quad \text{Eq. 2.45}$$

The denominator, $B_t(\rho^T - 1)$, is the rate of return multiplied by the book value.

On a logical level, return on operating assets or return on book equity are measures of how effectively assets can be deployed by the enterprise to earn returns. They are also measures of the amount of capital that must be risked by the enterprise in order to earn additional return. Thus, the higher the ROE, the lower the risk of capital investment. It is this characteristic which warrants its inclusion in a valuation factor model, rather than the high levels of earnings that gives rise to the high ROE.

Theoretically, ROE should be equal to the cost of equity. The higher ROE is then seen as a justified reward for risk taken in an efficient market.

Size and price-to-book value

As noted above, one of the alternative asset pricing models to the CAPM is models based on APT. An example of the latter is the Fama and French three-factor model (1992) which, in addition to market returns, identified size and price-to-book value ratio as factors describing share returns (and hence, by implication, the cost of equity). In a subsequent paper (Fama & French, 1998) the authors argued that the significant relationship between price-to-book value and returns is that the former is a proxy for the risk of financial distress. Fama and French (2014) extended their model to a five-factor model, which includes additional factors for exposure to market risk and growth.

The identification of the price-to-book value ratio and size as determinants of excess returns was supported by numerous studies, and resulted in a whole generation of trading strategies. Thus, Jensen, Johnson and Mercer (1997) tested the impact of price-to-book value and size, taking into account US monetary policy, on NYSE and AMEX data for the period from 1965 to 1994, and found that the price-to-book value ratio and size variables are significant in restrictive monetary periods, but not in expansionary periods.

A test of earnings yield, size, book-to-market ratio, and cash flow yield for significance against the return in the Japanese stock market (Chan, Hamao and Lakonishok, 1991), found the book-to-market value and the cash flow yield to be the most significant. Some authors (see, for example, Lakonishok *et al.*, 1994; and Haugen, 1995) have argued that the premium is the result of behavioural finance effects, with the market overreacting to high growth and distressed shares.

In terms of the size effect, a similar large body of evidence exists to support the original findings of Fama and French (1992). For example, Chan, Chen and Hsieh (1985) tested the impact of size individually on the returns of two constructed portfolios from the US market between 1968 and 1993, and found smaller companies to have about 1-2% higher returns after risk adjustment. Similarly, Fama and French (2012) examined the size effect and momentum for its impact on returns between 1991 and 2000 in four regions, namely North America (the United States and Canada); Japan; Asia Pacific, (Australia, New Zealand, Hong Kong, and Singapore); and Europe (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom), and found that the size effect holds true for all markets tested except Japan.

Long-term growth

Up to this point, pricing and multiples studies have been assumed to be relevant to the current study, as they directly or indirectly relate to the cost of equity. However, growth which is discussed in this section, may be the single exception to this assumption, as growth forecasts determine the earnings forecast, and as such could influence returns and pricing without influencing the cost of equity.

The use of a growth rate to establish the future cash flows does not exclude the possibility of it also being a factor in determining the cost of equity. High growth could be a contributor to both risk and return. On the return side, the increase in future cash flows increases the return that can be earned. On the risk side,

the high growth also brings with it a high level of execution risk. In essence, although the growth is possible, the higher the estimation of growth the higher the risk that it will not realise as expected, and the higher the impact of it not realising. High growth companies also require high levels of capital investment, and a risk exists that the entity is unable to fund the growth, resulting in financial distress.

The possibility of not achieving high growth is in line with research, which finds a persistent over-estimation of growth by investment analysts. For example, Abarbanell (1991), used IBES data on the NYSE and AMEX from 1981 to 1984, to examine what happened to earnings forecasts after a price change in a share, and concluded that the revisions in forecasts are downwardly biased. For the purposes of this study forecast error was calculated by deducting actual earnings from forecast earnings, and it was hypothesised that if earnings forecasts correctly incorporated all available information (including price) in an efficient manner, the errors in forecasting should not be predicted by the direction of the price changes. However, it was found that the overwhelming majority of all revisions in forecasts are downward, which also reflects previous findings that about 70% of all revisions in the IBES database is downward. Consistent with this finding the estimation error was also on average found to be positive (*i.e.* earnings are generally overestimated by analysts). These findings implied that analyst possibly do not fully incorporate the information supplied by price changes into their earnings forecasts.

Easton (2007) performed a study that attempted to establish if the higher estimated cost of equity (that is, compared to actual returns earned) was the result of overestimation of future earnings by analysts. In order to test this hypothesis, the implied cost of equity from current prices and forecasts made by analysts in the IBES database were compared to the cost of equity that would be implied by the current actual company earnings, as well as earnings in the following year. It was found that optimistic earnings forecasts indeed caused an overestimation of the implied cost of equity. On a value-weighted basis, this premium was 1.60%, and on an average basis 4.43%. This allowed for a reconciliation of the *ex-ante* implied cost of equity premium of up to 7%, with the actual *ex-post* returns of approximately 3%.

This overestimation of future income would not be relevant if the impact was equally distributed, as it would be equally prevalent in all analyst estimates and as such would be expressed in the intercept. However, an overestimation of income is compounding in nature. If the first year's growth was estimated at 10%, the next year's growth is applied to the assumed income after the 10% estimate was met. This continues indefinitely. Thus, if the first year's growth was in reality only 4%, the impact is compounded as this impacts every income estimate after the error. Therefore, an overestimation causes a compounded error, resulting in the risk from this overestimation not being equally distributed amongst all analyst forecasts, but has more impact when the entity has very high growth forecasts and a more uncertain forecast.

Ackert (1997) found that the risk of over-estimation is more when there is more uncertainty, which was measured as the standard deviation of the earnings forecasts. High growth estimates are also subject to a higher level of uncertainty. The research was performed using the median IBES forecast from 1980 to 1991, dividing the sample into quartiles using the standard deviation of the earnings forecasts. The median level

of over-optimism for each firm was calculated, and compared between the different quartiles. The higher growth quartiles showed higher levels of over-optimism. The researchers speculated that when uncertainty is high, the reputational risk to the analyst is lower, and as such they are more likely to issue an overly optimistic forecast.

Continuing with this line of study, Skinner and Sloan (2002) found that the impact of revisions of earnings were asymmetrical between what they classified as high-growth shares and low-growth shares, with negative announcements eliciting a larger response than a positive announcement, which is hard to explain in an efficient market. Their study was conducted on IBES data for the period between 1984 and 1996, and they postulated that to explain their results, investors had to have an overoptimistic expectation for shares which exhibited high past growth and/or high expected short-run future growth. This results in high prices in the short-run, but low returns in the longer-run as prices adjust to more realistic expectations. Therefore, the higher the growth forecast of the analyst, the more difficult it is to predict the exact growth, and the higher the impact of negative revisions, both mathematically and as a result of behavioural finance effects. This represents risk.

One of the methods available to calculate implied cost of equity involves its calculation on the basis of the residual income valuation model. Gebhardt *et al.* (2001) used this approach and three years of specific income forecasts and a terminal assumption of growth, reverting to the industry ROE by year 15, to determine implied cost of equity numbers. The sample consisted of US companies between 1979 and 1995, and Gebhardt came to the conclusion that the price-to-book ratio, the dispersion of analyst forecasts, the long-term consensus analyst growth forecast, and an industry specific premium deduced from the average premium for that industry in the prior year, can explain 60% of the cross-sectional variation in cost of equity estimates two years ahead. This further supports the inclusion of the long-term growth rate in an implied cost of equity model.

Loss-making companies

The risk profile of loss making companies is significantly higher than that of profit making ones. Firstly, while a firm is loss-making it uses the capital that has either been contributed by the investors, or built up in the firm to fund the losses. Secondly, the company cannot merely maintain the status quo in order to create the returns that equity holders require, but would need to significantly improve its performance before any value is added.

Collins (1999) studied the value relevance of book value for US companies over the period 1974 to 1993, and in the process recorded that when regressing price against earnings and book value, the relevance of book value increases as the losses increase, and that the coefficients of the earnings of profit *versus* loss making companies differed significantly. This implies that a change in a unit of earnings for a loss-making firm is not reflected in the same manner as a change in the earnings of a profit-making firm, regardless of other factors. Considering the three types of studies that may provide one with information about cost of

equity, this would be classified as a level study. Thus, because the factor in question determines the level of a price, it implies that the factor influences the cost of equity.

In similar vein, Darrrough and Ye (2007) argued that the information content of losses is not always the same. Some companies may be loss making because they are in an initial high growth stage involving high fixed investment costs. Other companies, however, could also be loss making due to accounting conservatism - for example, by expensing research and development costs, which is actually of a capital nature. The final option is that companies are loss-making due to operational distress. It is this final option that has attracted the most research attention, with studies focussing on the value relevance of book value, on the assumption that loss making companies could sell their assets at book value, and thus that book value is more value relevant than earnings when companies are loss making⁸.

Darrrough and Ye (2007) further argued that it is not distressed companies that make up the majority of loss-making companies, but rather the other three categories mentioned above. These researchers focused on four potential value drivers in loss-making companies, and tested these drivers for relevance to the valuation of the company. The drivers were (1) nonrecurring charges; (2) research and development; (3) growth strategy; and (4) sustainability. The purpose of the study was to ascertain whether the information value of losses is reduced when all the factors above were considered. Using a sample of US companies from 1982 to 2002, the researchers empirically found all four factors to be value relevant. Research and development is dealt with elsewhere in this section, and non-recurring charges are not relevant to this study, but both the growth strategy and sustainability are inherent risk factors associated with loss-making companies. Although these factors speak to the forecasts of cash flows rather than directly to risk, the loss-making status of the company results in more risk being attached to the achievement of these forecasts. It is this characteristic of loss-making companies which needs to be included in a model that focusses purely on cost of equity rather than valuation.

In a further study on financial analysts' earnings forecasts, Das (1998) explored the differences in their forecasting accuracy between loss making and non-loss-making companies using 1985-1993 US data. It was found that the upward bias for earnings forecasts was greater for loss-making companies, even after controlling for forecast horizon, year of forecast and industry. The researcher also reviewed a body of evidence that support this finding, including a study by Hwang, Jan and Basu (1996). Hwang, Jan and Basu's (1996) sample covered the years from 1976 to 1993, using companies for which forecasts were available in the Compustat database. The companies were classified as either loss making or profit making and the differences in the forecast errors made by analysts were examined. The forecast error was defined as the

⁸ For examples of research on this topic see Aleksanyan and Karim (2013); Burgstahler and Dichev (1997); Berger *et al.* (1996) and Barth *et al.* (1998).

difference between the average analysts' earnings forecasts and the actual earnings, scaled by the share price at the beginning of the year. Forecast errors were found to be significantly larger for loss-making companies. Many subsequent studies supported the above findings, an example being a study conducted in the Italian market by Cervellati, Della Bina and Giulianelli (2008), which found that analysts' forecasts are on average inaccurate, but that accuracy increases with company size, positive earnings, brokerage size, analysts' depth of experience with the company and the existence of a bull markets.

Liquidity

Liquidity is the ability to sell a significant quantity of shares at a relatively low cost and without major discounts to the market value of the asset. Liquidity does not influence the future expected cash flows of a company, but impacts the risk that an investor cannot convert an investment in a company into cash readily when needed. During the Global Financial Crisis, the price of illiquidity once again became very evident.

One of the earliest studies on the influence of liquidity on price was that of Amihud and Mendelson (1986), who studied the link between the bid-ask spread of shares and the return earned on shares on the NYSE for the period 1961 to 1980. The study found that the monthly excess return of a share with a 1.5% spread was 0.45% greater than that of a share with a 0.5% spread, but the monthly excess return of a share with a 5% spread was only 0.09% greater than that of a share with a 4% spread.

Brennan, Chordia, Subrahmanyam and Tong (2012) performed a study that measured the impact of illiquidity on returns, by comparing trading costs between shares listed on the NYSE between January 1984 and December 2008. This cross-sectional study of share returns assumed that the significance of illiquidity may differ between the sell and buy sides, which may account for the mixed results of previous studies. These researchers found that sell order illiquidity had a statistically more significant impact on returns than buy side illiquidity. The results held after controlling for factors that are known to contribute to returns, and it was estimated that a one standard deviation change in liquidity resulted in a 2,9% to 3,7% increase in expected return, strongly supporting the materiality of this factor for determining cost of equity.

The different proxies available for measuring liquidity was also discussed in the above paper, and are worth mentioning here. The bid-ask spread is the simplest and most widely used measure, but other options include the relationship between the size off the trade and the size of the price movement, the absolute return of the share over the dollar value of trading for the period, the relationship between price changes and order flows, and the extent to which returns reverse after high trading volumes (price sacrifices are assumed to be made in order to obtain liquidity).

A relatively new development in the measurement of cost of liquidity is the put option model. Chaffee (1993) theorised that if a person owns an illiquid share and that person purchases the option to sell (put) those shares, the investor has in essence converted the asset into a liquid asset, creating a theoretical way of calculating the price of liquidity. The price of that liquidity is the price of the put option on the asset. Chaffee (1993) developed this theory by using a European option, an option that can be executed at a

specific time in the future, and the Black Scholes (1973) option pricing model. Finnerty (2012) subsequently further refined the theory by using an average-strike put option.

Research and development

International Financial Reporting Standards (IFRS) prescribe the treatment of research and development costs as follows:

- Charge all research cost to expense. [IAS 38.54]; and
- Development costs are capitalised only after the technical and commercial feasibility of the asset for sale or use have been established. This means that the entity must intend and be able to complete the intangible asset and either use it or sell it and be able to demonstrate how the asset will generate future economic benefits. [IAS 38.57]

Similarly, advertising costs can only be capitalised in very limited circumstances, and the default treatment is as follows:

- “.....examples of expenditure that is recognised as an expense when it is incurred include ... expenditure on advertising and promotional activities.” [IAS 38.69]

As a result of the non-capitalisation of costs which have a high probability of creating future economic benefit, research and development and advertising could influence price differently from other expenditure, as this type of expense can be seen as an asset due to its ability to create future income, in contrast to normal expenditure which is undertaken to produce current income. This can influence the future earnings capitalised into the price, resulting in different valuations for companies with the same earnings.

Another possible characteristic of research and development is the risk involved in this activity. When looking at the IFRS requirement above, it is the need to prove that research and development will be able to generate future economic benefit that results in reporters often being unable to capitalise their cost. Because it is only the risk related impact of research and development costs which is relevant to this study, the literature examined below deals with the links between research and development and excess return, rather than the link between research and development and valuation ratios.

Using a sample of US public companies from 1975 to 1991, Lev and Sougiannis (1996) performed a study wherein earnings and book value were adjusted as though research and development cost had been capitalised. It was found that the percentage adjustment to book value was very significant, implying that book value and earnings are severely distorted by the amount of research and development costs. The value relevance of the income before adjustment and the income after adjustment was then tested, and it was found that the income which had been restated through the capitalisation of research and development costs was more value relevant than the unadjusted income for both price and future income. Finally, and most relevant to this study, a significant relationship between the amount of current research and development expenditure and future returns was found.

Chambers, Jennings and Thompson (2002) performed a study on all NYSE, AMEX-, and NASDAQ-traded companies over the period 1979–1998, and concluded that there was a positive association between current research and development expenditure and subsequent returns. In order to examine if these excess returns were caused by mispricing of shares or risk, they tested if 1) the volatility of returns over the ten years following the research and development expenditure, and 2) the variation between analysts' forecasts and actual earnings are correlated to the amount of research and development expended as *ex-post* indicators of either the risk to cash flows from research and development (proxy: volatility of returns) or mispricing of the share (proxy: forecast errors). The conclusion was that it is the additional risk of research and development to cash flows, rather than mispricing, that caused the excess returns observed.

In a similar study, Cifti, Lev and Radhakrishnan (2011) examined the possible reasons for the excess returns attributable to high research and development costs for a sample of US companies with positive research and development expenditure between 1979 and 1997. An attempt was made to distinguish between possible mispricing of shares due to the way in which research and development was reported and real excess return by adjusting for the average levels of research and development within the industry. Companies were classified into high and low intensity research and development categories, and it was found that the high intensity companies created excess returns after being adjusted for other risk factors.

2.2.2. Macro-economic factors

Much research has been done to show reliable associations between macro-economic variables and security returns (and therefore by implication the cost of equity). Although the cost of equity is in principle the level of return required for a specific level of risk, investors' perception of what returns are acceptable for certain levels of risk and *vice versa* may be different under different macro-economic circumstances.

Macro-economic factors can be divided into three categories, namely (1) factors which increase or decrease future cash flows, but do not influence the risk profile of the cash flows (these should in theory influence price, but not the cost of equity), (2) factors that influence the future cash flows and also the levels of risk attached to these cash flows (these may or may not influence price, but will influence the cost of equity), and (3) macro-economic factors that do not influence the cash flows, but influence the risk associated with the cash flows (hence influencing the cost of equity). For the purposes of the current study, a factor will need to influence the cost of equity, regardless of its influence on future cash flows. Identification of such factors is complicated by the fact that studies on the influence of macro-economic factors on price and returns would likely reflect both their impacts on cash flows, as well as on the cost of equity.

Monetary policy

Jensen, Johnson and Mercer (1997), Thorbecke (1997), and Bernanke and Kuttner (2005), amongst others, found a link between expansionary and restrictive monetary policies and share prices. Jensen, Johnson and Mercer (1997) compared the relevance of size and the book-to-market ratio to share returns on the NYSE and AMEX from 1965 to 1994, in both expansionary and restrictive monetary policy periods. It was found that the size and book-to-market ratio was only relevant during expansionary policy periods, and were not significant during restrictive periods.

Thorbecke (1997) compared monetary policy shocks to *ex-ante* share returns in the US market from 1953 to 1990. The study found that monetary policy changes indeed impacted return, and ascribed this partly to a decreased (increased) discount rate, and partly to the impact of lower (higher) interest payments on cash flows.

Bernanke and Kuttner (2005) subsequently extended the list of factors which are possible drivers for changes in returns. Using log-linear approximation to estimate which of the factors (expectations of future dividends, impact of real interest rates and impact on the expectation of excess return, *i.e.* the equity risk premium) had the biggest impact on the changes in the share prices, it was found that the impact on expected future dividends and the impact on expected excess returns had the largest explanatory power.

Gross domestic product

Flannery and Protopapadakis (2002) tested 17 macro-economic indicators in the US market for significant correlation with subsequent stock market returns. This was an event driven study, with the announcements of the 17 macro-economic indicators between 1980 and 1996 serving as the events. It was found that the balance of trade, employment related announcements (unemployment, non-farm employment), housing starts (private homes on which new construction was started) and real gross national product were significantly correlated with stock market returns. All the above are indicators of GDP growth.

A check was performed on this conclusion by comparing the volatility on announcement dates to non-announcement dates, but the results remained consistent. As a matter of interest, the indicators found to not significantly affect returns (at least in the US) were industrial production, personal income and sales.

Similarly, Ritter (2005) specifically studied the effect of GDP growth on share returns in Australia, Belgium, Canada, Denmark, France, Germany, Ireland, Italy, Japan, the Netherlands, South Africa, Spain, Sweden, Switzerland, the United Kingdom, and the United States. He found, as several other studies⁹ had previously,

⁹ Siegel (1998) found that from 1970 to 1997, the correlation between stock returns and GDP growth was 0.32 for seventeen developed countries, and 0.03 for eighteen emerging markets. Dimson, *et al* (2002) also examined stock market returns from 1900 to 2000 for 16 developed countries, and found that over long periods of time, stock market returns were negatively related to GDP growth rate.

that GDP growth is negatively, albeit weakly, correlated to returns. This study covered the period from 1900 – 2002, and the results held for the entire period.

Ritter (2005) argued that the weak relationship between GDP growth and share returns is the result of GDP growth not necessarily increasing the profits of a company, and that an increase in production is the result of higher utilisation of available labour and capital investment, but that this does not necessarily benefit the owners of capital in a competitive economy. This argument is supported by Krugman (1994) and Young (1995).

Flannery and Protopapadakis' (2002) study indicates that analysts believe that GDP growth influences future returns, as increased market volatilities were found on days when GDP growth numbers were announced. An over-reaction to the expected GDP growth would also account for the negative coefficient noted by Ritter (2005) for the returns against GDP growth. The upward adjustments to price regarding expected GDP growth would precede actual GDP growth, and as the impact is less than expected, prices are again adjusted downward. Another argument that would be dependent on an extremely efficient market is that the expectation of increased returns would be built into the projections of future cash flows well before these start to realise. This will result in gains in equity already realising when expectations rise, and not only when they become a reality, and thus lowering the returns during the period of growth, but increasing them prior to it.

Both of the arguments above rests on the inclusion of GDP growth in the growth in forward projections, leaving the effects on cost of equity unknown. However, similar to any high growth rate expectations, high expected GDP growth affects the risk that the projected growth will not realise. Therefore, in contrast to intuition, GDP growth may result in higher levels of risk and higher costs of equity.

The next consideration is whether to use forward looking GDP forecasts or actual GDP growth achieved. As the value of an entity is the result of an estimate of future cash flows, forward looking information has always had a bigger explanatory power than current information. Vassalou (2003) tested the impact that the inclusion of an additional factor (forward looking GDP forecasts) had on the accuracy of the Fama and French three factor model for the US market between 1953 and 1998. The study concluded that GDP forecasts were very significant for predicting stock market returns. The additional explanatory power of size and price-to-book value was in fact insignificant when they are incorporated into a model containing GDP forecasts as a factor. Fama and French did note, as later discussed in this thesis, that the returns earned by portfolios classified according to size and price-to-book value may well be the observable outcome of the market's efficient pricing of risk and future cash flow expectations (the drivers of return), as opposed to size and book value being the actual drivers of return. Thus, forecast future GDP growth might well be the underlying driver of the return earned.

Inflation

According to Fischer (1930) an interest rate is made up of the real interest rate and an expectation of inflation. This is referred to as the Fischer effect. This proxy for measuring inflation over the longer term has been tested by numerous studies, including, for example, Fama (1975). A number of studies¹⁰ has been performed since, and have confirmed this. This principle is currently used by a large number of the world's central banks, by making adjustments to the interest rate to target inflation.

However, there are also a large number of studies that suggest that the Fischer effect does not exist despite its general use. The negative relationship with share returns and inflation as recorded below has served to highlight the difficulty in proving the effect empirically. One of the possible explanations for this is the difference in time frame for the various studies (see Mishkin, 1992; and Omay, Yuksel & Yuksel, 2015).

Over a short horizon, inflation has been found to be associated with asset returns (as expected given the Fischer effect), but (unexpectedly and not consistent with the Fischer effect) often with a negative coefficient. For example, Bodie (1976) compared the returns of government single period bonds, which should only be exposed to a single risk, inflation, to a well-diversified portfolio of shares. The purpose of the study was to determine if shares are a good method to hedge against inflation risk, as is theoretically expected given that they are seen as a real asset. The real rate of return of the asset should be independent of inflation. The expectation would be that no correlation exists between the nominal rate of return and the inflation rate. The results of this study indicated that shares are not as effective a hedge as predicted by the theoretical model, and that inflation in fact has a negative correlation with real returns. Due to the controversial nature of the findings, the study was repeated in many variations. Fama and Schwert (1977), focussing on the period 1953 to 1971, similarly examined the ability of various asset classes to provide a hedge against inflation, and reaffirmed the results of Bodie (1976) that shares were a poor hedge for inflation, and that it was negatively related to share returns.

A more recent study that once again confirms this result was that of Yeh and Chi (2009), who tested the association between stock returns and inflation for 12 OECD countries (Australia, Canada, Finland, France, Germany, Ireland, Italy, Japan, the Netherlands, New Zealand, Spain and the United States) between 1957 and 2003. The purpose was not to find the negative correlation, but rather to test the various theories that explain this phenomenon. The findings supported the inflation illusion theory (that cash flow forecasts are not adjusted timeously, while discount rates are more responsive to inflation), and the tax shield theory (inflation erodes the real value of depreciation tax shields). During the course of the study, the significant negative relationship and returns was confirmed for the 12 countries.

¹⁰ See, for example, Geske and Roll (1983) Den Haan (2004), Omay, Yuksel and Yuksel (2015), Panopoulou & Pantelidis (2016) and Anari & Kolari (2016)

Opinions differ as to why this empirical phenomenon exists, as the theoretical expectation is that inflation is in the long run neutral to equity returns. Fama (1981) suggested that the short-term effect could be the result of a resulting slow-down in the real economy. The money supply influences inflation and interest rates, which in turn have an effect on the real growth in the economy, and all these factors together will dictate returns in the stock market. Inflation and real growth in the economy will influence cash flows, and inflation could also influence the cost of equity as a leading indicator of the risk of economic slowdown.

2.2.3. Behavioural finance factors

Market momentum

The Carhart (1997) four-factor model, is an extension of the Fama and French (1992) three-factor model. In addition to size and the price-to-book value ratio, Carhart (1997) included a momentum factor derived from the difference between the equally weighted twelve-month historical returns of high return companies and the equally weighted twelve-month historical returns of low return companies in a certain market. Carhart's (1997) study on the return of mutual funds, which was conducted on the US market between 1962 and 1993, showed a strong association between this measure of momentum and the return earned.

Lee (1998) proposed a model of the market which does not efficiently process information, and is prone to ignore bad news after a series of good news stories had been received, leaving the price artificially high during bull markets. This is a behavioural finance phenomenon. The model is then used to explain historical market boom and bust cycles.

Based on post-1870 US market data, Coakley and Fuertes (2006) documented that in a bull market, share prices can become detached from the normal fundamental drivers, only to be driven to equilibrium during the bear market. This could mean that the coefficients of all fundamental risk factors differ under bull and bear market conditions. It is important to note that the issue of market momentum is closely related to a lot of the macro-economic factors which have been included.

Market sentiment

A factor which is related to market momentum is market sentiment. The positive correlation between historical returns and short terms future returns, and the negative correlation with long term future returns noted by studies Fama and French (1988), Poterba and Summers (1988), and Lo and MacKinlay (1988), shows a direct relationship to momentum, but a number of studies have since been conducted to try and link the phenomenon to the primary behaviour which causes it. DeBondt and Thaler (1985) argue that the phenomenon of market momentum is caused by overreaction by market participants, who are alternately optimistic and pessimistic. This would be consistent with Kahneman and Tversky's (1979) behavioural finance theory.

A recent study on the Taiwan options market over the period 2008 to 2012 supports the view that market sentiment increases observable risk. Thus, Yang, Jhang and Chang (2016) tested whether the inclusion of

various financial and non-financial factors, including volatility, the put-call open interest ratio, and the catastrophic factor of earthquakes in risk hedging strategies, improved the performance of the hedges. These researchers found that the put-call interest ratio that was chosen as a proxy for market sentiment improved the effectiveness of a hedging strategy significantly.

2.3. Comparative studies

To the author's knowledge no directly comparative studies were undertaken, but a summary of similar studies follows. These studies all made use of implied cost of equity calculations in some form to check the association of the implied cost of equity with certain factors. The difference between those studies and this study is the use of target prices rather than market prices, to focus the research on the factors associated with analyst estimates rather than market prices.

Gebhardt *et al.* (2001), derived a method of calculating implied cost of equity using the Residual Income Valuation model. They then used this method to calculate the implied cost of equity as detailed in 2.2, using market prices, for all US companies between 1979 and 1995. They found that the implied cost of equity was associated with the book to market value ratio, the long-term growth rate of the company, the dispersion of analysts' forecasts and industry membership.

Gode and Mohanram (2001) did a study on US firms between 1985 and 1998, calculating implied cost of equity using the Ohlson, Juettner and Nauroth (2000) method and market prices. The number of analyst that follow a company, earnings volatility, return volatility (beta) and leverage were significantly associated with the implied cost of equity.

Some studies were done to examine if a single factor had an association with an estimate of implied cost of equity calculated using the market price. These include Attig, Guedhami and Mishra (2008), Dhaliwal (2005), McInnis (2010) Chen, Chen and Wei (2011), Guedhami and Mishra (2009).

2.4. Conclusion

There are a large number of factors that have been shown to have some kind of relationship with either returns, cost of equity estimates, or the level of price multiples. The cost of equity is fundamentally an estimate of the return that would justify the risk inherent in the future cash flows. In an efficient market, this would imply that only factors that can be seen as an inherent indicator of future risk should prove significant when looking at the estimate of the cost of equity made by analyst.

The very existence of behavioural finance and the evidence of market efficiency not being complete, implies that factors for which it is difficult to derive a direct link to an inherent risk may be considered by analysts when estimating the cost of equity. A further reason for the inclusion of factors that may be difficult to directly link to risk factors is the fact that the results of historical testing of factors that have a significant

influence on returns is known to investors, and may be considered when considering the cost of equity, despite no obvious link to risk.

The wide array of variables and inconsistent relationship with returns is indicative of the complex and interlinked system that determines equity prices. The exact interaction between the factors are also not known, and the interaction between factors may not necessarily simply be cumulative. In a similar vein, the correlation between factors can be observed, but it is difficult to say which one is cause and which one the effect, or whether both are the result of a risk which is not included in any testing or model.

The next chapter deals with the collection of the data as well as the selection of the sample to ensure its relevance to the testing.

Chapter 3: Sample and Data

As mentioned previously, this study attempted to test a large number of factors for their significance against the implied cost of equity as derived from analyst forecasts, and therefore a large enough sample was required in order to ensure statistical robustness. In addition, company-specific and macroeconomic data, as well as data on analyst forecasts, had to be found, and was thus compiled from multiple sources. In this chapter, both the sample selection process and issues surrounding the data used in this study will be discussed.

3.1. Sample

The population on which this study was based consisted of companies listed on the New York Stock Exchange (NYSE), with their primary listing in the United States. The reason for this choice was the depth of the US market, as well as the regulatory framework under which companies are required to report in that country, which allows for a large enough statistical sample from which to obtain statistically robust results.

All companies listed on the NYSE as at 18th April 2016 was used as the starting point from which to draw the sample used in this study. Unfortunately, the database from which this list was obtained, Standards & Poor's Capital IQ, does not store historical information on the constituents of stock exchanges. As a result, all companies that had been listed during the testing period but were delisted before the above date, were effectively excluded from the sample. To assess the possible extent of survivorship bias, a list of all delistings in the period was obtained. From this list, those companies which were not followed by analysts were eliminated. Considering all the selection criteria described below, only 161 company quarters (or 3% of the final sample) of these delisted companies would have qualified for inclusion if sufficient information was available. Therefore, the impact of survivorship bias on this study is thought to be negligible.

The initial sample consisted of all the companies for which the IBES database had analyst forecasts available over the sample period. The period covered by the study was 2006 to 2015. The test period was set at ten years to produce a large enough sample to support a statistically valid outcome. Furthermore, to keep the results relatively recent and relevant, only data from 2006 onwards was collected, despite IBES data being available since 1984. The final date was set at December 2015, as the information for this study was collected in the first quarter of 2016. The quarterly reporting required by the Securities and Exchange Commission¹¹ and the New York Stock Exchange (NYSE) results in regularly updated company financial information that can be incorporated into revised forecasts and estimates of cost of equity. Thus, analyst forecast data could be obtained as reported at quarterly intervals. Furthermore, every quarter thus represents a separate

¹¹ The U.S. Securities and Exchange Commission (SEC) is an independent, federal government agency responsible for protecting investors, maintaining fair and orderly functioning of securities markets, and facilitating capital formation. In this context they require quarterly reporting from listed entities of their trading results.

estimate of cost of equity. The data used in this study was thus both time-series (40 consecutive quarters), and cross-sectional, resulting in the use of mixed effects panel regression approach.

3.1.1. Recursion and adaptation value

This study involves the determination of the implied cost of capital for companies listed on the NYSE, under the assumption that analysts implicitly value them nearly exclusively on a going concern basis (*i.e.* implicitly using the discounted cash flow methodology). It therefore should only be companies valued fully on this basis which should be included in the sample. Although most valuation methodologies are based on the assumption that the value of a company is derived from its discounted cash flows (dividends or earnings), this assumption may not be fully correct for all companies. According to the real option valuation theory, first suggested by Myers (1987), if the going concern assumption is yielding a lower value than other value realisation options, rational shareholders will revert to these other realisation options, and these options have economic value. These options include abandonment and sale of assets.

A number of studies (see, for example, Aleksanyan & Karim, 2013; Burgstahler & Dichev, 1997; Berger *et al.*, 1996; Barth *et al.*, 1998; and Collins *et al.*, 1999), have attempted to test this theory in relation to pricing of shares. Barth *et al.* (1998) used a sample of 396 US companies that filed for bankruptcy between 1974 and 1993 to test the assumption that as financial health decreases, the explanatory power of book value (as proxy for the abandonment option) on market value increases. For each of the five years prior to the bankruptcy event, the relative explanatory power of the income and book values were tested. As the companies came closer to bankruptcy, the explanatory power of book value increased, indicating that the fair value of the balance sheet assets eventually becomes more relevant than income in price determination.

A complimentary research design by Burgstahler and Dichev (1997) took a sample of companies from the Compustat database between 1976 and 1994, and divided them into categories according to effective bond ratings (used as a proxy for financial health), to evaluate the levels of explanatory power of book value in pricing across the categories. The study found that the explanatory power of book value indeed increased as financial health deteriorated. Part of the explanation for this is that the balance sheet is a representation of the liquidation value of the business, while the income statement is an account of the assets' ability to produce income in a going concern environment. Therefore, as the company approaches a default event the explanatory power of the book value will increase. Similarly, Collins (1999) tested the relative price importance of earnings and book value for profit making companies *vs.* loss making companies on the Compustat database between 1975 and 1992, and found that book value was much more relevant for loss making companies than for profit making companies. The evidence therefore indicates that for companies where the adaptive value (using assets in another manner than running a business) exceeds the recursive value (using the assets to run a business), the cost of equity is less relevant for the determining the market value, as the present value of the future cash flows does not contribute significantly to the valuation of the firm.

Using the option theory to identify data points to be included in testing allows for the elimination of companies for which cost of equity is possibly not fully relevant, which would negatively affect the robustness of the determination of the cost of equity implied in analyst forecasts. The inclusion of the companies that are valued by the market on the adaptive value could also result in unstable results over time. Thus, during economic downturns, as the financial health of companies deteriorate and the value of the adaptive put option on assets increases in value, the number of companies for which cost of equity is highly relevant decreases, skewing results if they remain in the sample. Therefore, in this study, an attempt was made to limit the sample to only those companies where the market valuation was considered to be nearly exclusively based on a recursive (*i.e.* going-concern) basis.

Burgstaler and Dichev (1997), who developed the adaptive and recursive model, used book value as a proxy for the adaptive value. The assumption was that all companies with a price-to-book value ratio below one are probably exclusively valued using the adaptive value, and that tangible book value provides a measure of the value of the company's resources, independent of how the resources are currently being used. If the value independent of the asset's use exceeds the value in use, the assets will be valued independent of use.

Barth (1996) also argues that the balance sheet is a proxy for the abandonment option value because accounting standards require the impairment of all asset values that exceed the market value.

To limit the companies in the sample to those nearly exclusively valued using the recursive value, all companies with a price to tangible book value of below one were eliminated.

3.1.2. Exclusions from the sample

The first exclusion from the sample was based on the theory outlined in the previous section. Thus, all companies with price-to-book value below one were eliminated. This resulted in the elimination of 28 338 of the original 80 520 company quarters.

Next, companies with less than 90% of their activities in the US, estimated by the segmental proportion of sales, were excluded from the sample. US macro-economic data was used in the testing and companies with significant exposure to other economies would be exposed to different macro-economic factors. This resulted in the exclusion of 25 703 company quarters from the sample.

Companies in the financial sector, including insurance companies, banks, consumer finance companies and thrift and mortgage companies, are in essence conduits for capital, and therefore various metrics, such as gross margins, EBITDA margins, debt-to-equity ratios and ROEs, are either not meaningful, or are not expected to be indicative of the same level of risk as for a trading company. Therefore, all companies in the financial sector that remained in the sample, as identified using the primary industry classifications in the S&P Capital IQ system, were also excluded from the sample.

In a similar manner, all remaining investment vehicles (*i.e.* those listed under the capital markets industry classification), were excluded as, once again, a number of the factors tested in this study are only meaningful

in a non-investment vehicle. Furthermore, the fair value accounting employed by most of these companies exclude any possibility of fundamental analysis. Also excluded were Real Estate Investment Trusts (REITs), which represent investments in property, as they have different indicators of risk and operational efficiency to non-investment vehicles.

Company quarters with negative sales and negative or no gross profit margins were also excluded, as these do not appear to be true trading companies. A small number of data points were also excluded due to returning an error from the Standard and Poor's database for an EBITDA margin. These are real estate development and financial services companies, for which the EBITDA margin is not relevant. The number of company quarters excluded for all margin and sales exclusions is very small, at 100 company quarters. These are likely to be companies in the early stage of trading.

Because of negative equity some of the debt-to-equity variables in Standard and Poor's Capital IQ database were indicated as "Not Meaningful". In a similar manner, the return on equity was denominated "Not Meaningful" for some companies. In addition, a small number of companies had negative research and development numbers, most likely the result of writing back of prior year expenses, and were thus excluded. All the above data points (less than 20) were thus excluded.

A larger exclusion was in cases where two years' worth of trading information were not available, which resulted in a company not having a two-year volatility measure at a given reporting date. This removed a further 769 data points from the sample. Similarly, 97 data points were removed due to a lack of trading prices six months prior to the reporting date, making it impossible to calculate the market momentum variable.

The methodology applied in this study for the calculation of the implied cost of equity, which uses two consecutive forecasted earnings per share numbers, has two drawbacks. Firstly, when eps_2 is less than eps_1 , the formula cannot be solved. The portion of the sample for which this is true thus needed to be excluded, removing a further 1045 data points.

The second drawback is that the methodology assumes that the growth between eps_1 and eps_2 is representative of the longer-term growth, but if it is not the determination of the implied cost of equity gets distorted.

In order to try and identify data points that were potentially affected by this distortion, the difference between the predicted long-term and the short-term growth (the latter proxied by the difference between analyst predictions of from eps_1 to eps_2) was used¹². The distribution of this variable (difference in growth rates) is significantly skewed, with a long negative tail. The median value was -2%. The median value implies that analysts tend to predict a high growth period for companies initially, followed by normalised growth in the medium term. If one assumed that immature companies initially experience high growth, which

¹² All numbers required for this calculation were obtained from IBES.

increases the number of companies with initial high growth, and mature companies should not necessarily have a higher likelihood of high growth in the current period *versus* the medium term, a combined median of -2% makes sense. It was decided to eliminate the 10% of the sample consisting of the most extreme values. The elimination was done asymmetrically, in order to limit the skewness of the final sample.

Table 3-1: Reconciliation of sample exclusions

Factor	Company years excluded ¹³
Original company quarters available	80 520
Geographical exclusion (<i>i.e.</i> insufficient US exposure)	25 703
Recursive and adaptive options (Price to tangible book value below 1)	28 338
Forecast or target price not available	15 291
Banks	850
Investment companies	591
Consumer finance companies	127
Real Estate Investment Trust (REIT)	838
Insurance companies	594
Thrifts and mortgage finance	218
Sales negative or nil	35
Gross margin is negative	14
EBITDA margin is not applicable	24
Gross profit is 100% and EBITDA is 0%	27
Debt-to-equity is marked not meaningful	7
Return on Equity marked not meaningful	9
Research and development costs negative	10
Volatility nil	769
EPS 2 less than EPS 1	1 045
Excluded due to long term growth differing significantly from growth between EPS 1 and EPS2 (Incorrect implied cost of equity estimate)	637
Excluded due to lack of data for market momentum calculation	97
Final sample	5 246

¹³ If the exclusion were performed in a different order, the number of exclusions for each of the categories would have differed, but the total number of exclusions would have remained the same.

3.2. Data

All company specific data used was obtained from Standard & Poor's Capital IQ database. The majority of US listed companies have reporting periods that coincide with quarter ends, and the SEC requires companies to release their 10-Q¹⁴ filings 45 days after the end of the quarter. Data was therefore extracted on the next working day after the 15th of the second month in the quarter, *i.e.* 15 February, 15 May, 15 July and 15 October, to allow most entities to report their previous quarter results, and for analyst estimates to be revised accordingly. This also serves to ensure that a material period would not have passed from both the posting of results and the forecasts being made by analysts, eliminating the time value of money as a significant factor in the calculation, *i.e.*, there was no need to escalate earnings forecasts and target prices by the cost of equity.

Macro-economic data was obtained mainly from the US Federal Reserve System. All forecast data was obtained from IBES by means of Thompson Reuters DataStream. The definition show below is the definition as supplied by the data source.

Table 3-2: Data fields and data sources

Short description	Data identifier	Source	Definition
Price-to-tangible-book value	IQ_PTBV	S&P Capital IQ	Share Price/TangBV: Share price is determined based on the closing share price on the date indicated TangBV: Book value of common equity less goodwill less other intangibles
Primary geographical segment	IQ_GEO_SE G_NAME	S&P Capital IQ	Largest reported segment in the current reporting period
Beta calculated over 2 years	IQ_BETA_2Y R	S&P Capital IQ	Two year beta is the slope of the 104 week regression line of the percentage price change of the share relative to the price change of its benchmark. The benchmark is the S&P 500 for all U.S. shares.
Total revenue	IQ_TOTAL_R EV	S&P Capital IQ	Revenues + total of other revenues
Dividend yield	IQ_DIVIDEN D_YIELD	S&P Capital IQ	Latest annualised dividend per share/latest day closing price

¹⁴ The SEC form 10-Q is a comprehensive report of a company's performance that must be submitted quarterly by all public companies to the Securities and Exchange Commission. In the 10-Q, companies are required to disclose relevant information regarding their financial position.

Gross margin	IQ_GROSS_MARGIN	S&P Capital IQ	Gross profit/Total revenues
EBITDA margin	IQ_EBITDA_MARGIN	S&P Capital IQ	EBITDA/Total revenues EBITDA: Total revenues – total operating expenses + depreciation and amortisation
Effective tax rate	IQ_EFFECT_TAX_RATE	S&P Capital IQ	Income tax expense/EBT inclusion of unusual items
Cost of goods sold	IQ_COGS	S&P Capital IQ	All costs of goods sold
Selling, general and admin expenses	IQ_SGA_SUPPL	S&P Capital IQ	Selling, general and admin expenses
Beta that has been both financially and operationally unlevered.	Unlevered beta	Calculated from S&P Capital IQ data	$(IQ_BETA_2YR / (1 + (1 - IQ_EFFECT_TAX_RATE) * IQ_TOTAL_DEBT_EQUITY))) / (1 + (IQ_SGA_SUPPL / IQ_COGS))$
Total debt-to-equity	IQ_TOTAL_DEBT_EQUITY	S&P Capital IQ	Total Debt/Total Equity Total Debt: Short term borrowings + current portion of long term debt + current portion of capital lease
Net income	IQ_NI_COMP ANY	S&P Capital IQ	Net income per IFRS
Return on equity	IQ_RETURN_EQUITY	S&P Capital IQ	Earnings from continuing operations/average equity
Research and development costs	IQ_RD_EXP	S&P Capital IQ	IFRS disclosed line item Research and Development costs
Absolute volatility calculated over a two year period.	IQ_PRICE_VOL_HIST_2YR	S&P Capital IQ	The annualised standard deviation of weekly log-normal price returns over the past two years
Average daily value traded in USD	IQ_VOLUME	S&P Capital IQ	Average daily value in USD over that last 180 days
Proceeds from share repurchases	IQ_COMMON_REP	S&P Capital IQ	All proceeds from share repurchases of common equity in the last 12 months
Dividends paid	IQ_COMMON_DIV_CF	S&P Capital IQ	All dividends paid in the last 12 months on common equity

Dividends paid and share repurchases combined	Pay-out ratio	Calculated	$\frac{((IQ_COMMON_REP) + (IQ_COMMON_DIV_CF))}{(IQ_TOTAL_REV)}$
Long term growth forecasts made by analysts	LTG MEAN ESTIMATE	IBES	Long Term Growth Forecasts are received directly from contributing analysts, and are not calculated by IBES. While different analysts apply different methodologies, the Long-Term Growth Forecast generally represents an expected annual increase in operating earnings over the company's next full business cycle. In general, these forecasts refer to a period of between three to five years.
The target price set by analysts	TARGET P MEDIAN	IBES	A median analyst prediction of a share's future price, generally over the 12 months following the release date
The earnings estimated for the first year in the forecast period	FY1 EPS MED EST	IBES	The median EPS estimate is commonly known as the "consensus forecast". Median earnings per share for FY1 (the next fiscal year end to be reported), is the value that falls in the middle of the defined range of estimates when arranged in ascending order. That is, the value within the sample that has an equal number of estimates both greater and less than itself. If the sample has an equal number of estimates, it is the average of the two middle values.
The earnings estimated for the second year in the forecast period	FY2 EPS MED EST	IBES	The median EPS estimate is commonly known as the "consensus forecast". Median earnings per share for FY2 (second fiscal year end to be reported) is the value that falls in the middle of the defined range of estimates when arranged in ascending order. That is, the value within the sample that has an equal number of estimates both greater and less than itself. If the sample has an

			equal number of estimates, it is the average of the two middle values.
Ratio of puts to calls	Put/Call Ratio	Chicago Board Options Exchange (CBOE)	Historical index volume from November 1 2006 through May 31 2012, and is based on cleared volume as reported by the OCC. ¹⁵
Risk free rate	PX_LAST - USISDA03 Index	Bloomberg	Three year US Treasury bill swap rate index
Forecast GDP growth	GDPPOT	Federal Reserve Economic Data	Real Potential Gross Domestic Product, in billions of chained 2009 dollars, quarterly adjusted
M3 money supply	MABMM301	Organization for Economic Co-operation and Development - Main Economic Indicators - complete database	Estimated M3 money supply. All cash money supplies, certificates of deposit, time deposits, savings deposits and mutual funds. This includes both individual and institutions.
Actual GDP growth	GDP	Federal Reserve Economic Data	Seasonally adjusted annual GDP; is the market value of the goods and services produced by labour and property located in the United States.
Inflation	CPIAUCSL	Federal Reserve Economic Data	Quarterly average, seasonally adjusted Consumer Price Index for All Urban Consumers: All Items
Ratio of gross margin to EBITDA margin	Gross margin/EBITDA margin	Calculated from S&P Capital IQ data	The gross profit percentage divided by the EBITDA profit percentage

¹⁵ The equity derivatives clearing organisation.

EBITDA margin trend	EBITDA Difference	Calculated from S&P Capital IQ data	The difference between the EBITDA profit margin in the current period and the average EBITDA profit margin in 5 preceding periods.
Gross margin trend	Gross Profit Difference	Calculated from S&P Capital IQ data	The difference between the gross profit margin in the current period and the average gross profit margin in 5 preceding periods.
EBITDA margin in comparison to peers	Q EBITDA Difference	Calculated from S&P Capital IQ data	The difference between the average EBITDA margin of all the companies with the same industry categorisation (in that quarter) as the company and the company's EBITDA margin
Gross margin in comparison to peers	Q Gross Profit Difference	Calculated from S&P Capital IQ data	The difference between the average EBITDA margin of all the companies with the same industry categorisation (in that quarter) as the company, and the company's EBITDA margin
Market momentum	Market momentum	Calculated from S&P Capital IQ data	The difference between the share price six months ago and at the date of measurement in percentage.

Table 3-3 below shows the minimum, maximum as well as first to third quartile values for the various variables used. The data does have some significant outliers, but the outliers were small in number relative to the full sample and were relevant, and thus the outliers were retained.

Table 3-3: Descriptors of data

Variable	Minimum	1st quartile	Median	3rd quartile	Maximum
Risk free rate (%)	0.45	0.83	1.21	3.60	5.44
Forecast GDP growth (%)	1.00	1.31	1.58	1.90	2.26
M3-to-GDP (%)	0.492	0.519	0.585	0.641	0.676
Volatility 2 year (%)	10.66	23.06	31.25	41.49	69.08
Return on equity (%)	-6.2	8.8	13.1	19.0	34.2
Beta 2 year	-0.223	0.794	1.118	1.483	2.509
Long term growth (%)	0.0	8.6	12.0	15.5	25.9
GDP growth (%)	-0.700	0.100	0.500	0.800	1.200
EBITDA margin. /Gross margin (%)	-0.178	0.364	0.539	0.778	1.396

EBITDA difference (trend) (%)	-2.94	-0.61	0.16	0.96	3.31
Unlevered beta	-0.073	0.012	0.028	0.070	0.156
Sales (USD million)	54	1201	2795	8517	19467
Dividend yield (%)	0.000	0.000	1.393	2.589	6.443
Gross margin (%)	1.75	21.00	31.28	46.24	84.08
EBITDA margin (%)	-12.6	10.1	15.8	25.9	49.6
Debt-to-equity (%)	0.0	0.20	0.49	0.89	1.92
Market momentum (%)	-0.926	-0.084	0.061	0.201	7.000
Inflation (%)	-0.70	0.20	0.60	0.90	1.50
Q Gross profit difference (%)	-30.17	-7.59	0.00	7.87	31.05
Q EBITDA difference (%)	-16.5	-3.9	0.0	4.5	17.1
Put call ratio (%)	0.813	0.877	0.924	0.976	1.103
Value daily traded (USD millions)	0.025	9.571	28.391	97.339	228.585
Pay out (%)	0.000	0.008	0.028	0.048	0.107
Gross profit difference (%)	-2.80	-0.55	0.17	0.96	3.21
Research and development as % of sales	0.000	0.000	0.000	0.000	0.392

For the binary variable denoting if a company is loss making or profit making, 258 were loss making and 5085 were profit making.

The histograms of the data in Appendix 1 show that not all variables used were normally distributed. The macro-economic factors that have a limited number of observations (40) each, appear to be randomly distributed. A number of the financial indicators such as dividend yield are log-normally distributed, which is expected. Some of the factors, such as the 2 year beta, are approximately normally distributed.

The normal distribution of input data is not a requirement for mixed effect models, nor is it a requirement for the the data set to be balanced, *i.e.* that the data has no missing values. This approach's ability to result in a robust model is measured by the normal distribution of the residuals in the final model.

Table 3-4: Correlation between independent variables

	Unlevered Beta	Two year beta	Sales	Dividend yield	Gross margin	EBITDA margin	EBITDA margin / Gross margin	Debt-to-equity	Return on equity	% research and development.	Two year volatility	Risk free rate	M3/GDP	GDP growth	Forecast GDP growth	Inflation	Q Gross margin difference	Q EBITDA margin difference	Ball bear	Value daily traded	Pay out	Gross profit difference	EBITDA profit difference	Long term growth	Market momentum
Unlevered Beta	1.00																								
Two year beta	0.23	1.00																							
Sales	-0.09	-0.11	1.00																						
Dividend yield	-0.17	-0.33	0.09	1.00																					
Gross margin	-0.01	-0.08	-0.10	-0.08	1.00																				
EBITDA margin	-0.13	-0.04	-0.09	0.03	0.71	1.00																			
EBITDA margin / Gross margin	-0.19	-0.03	-0.05	0.19	-0.05	0.56	1.00																		
Debt-to-equity	-0.39	-0.06	0.08	0.26	-0.14	0.06	0.24	1.00																	
Return on equity	-0.03	-0.01	0.09	-0.03	0.08	0.13	0.07	0.09	1.00																
% research and development.	0.12	-0.01	-0.03	-0.16	0.32	-0.01	-0.22	-0.18	-0.01	1.00															
Two year volatility	0.20	0.54	-0.14	-0.34	-0.02	-0.04	-0.12	-0.15	-0.09	0.06	1.00														
Risk free rate	0.03	0.04	-0.02	-0.08	-0.03	-0.03	0.00	-0.03	0.05	-0.03	-0.11	1.00													

	Unlevered Beta	Two year beta	Sales	Dividend yield	Gross margin	EBITDA margin	EBITDA /Gross margin	Debt-to-equity	Return on equity	% research and dev	Two year volatility	Risk free rate	M3/GDP	GDP growth	Forecast GDP growth	Inflation	Q Gross difference	Q EBITDA difference	Bull bear	Value daily traded	Pay out	Gross difference	EBITDA difference	Long term growth	Market momentum
M3/GDP	-0.04	-0.07	0.03	0.05	0.03	0.01	-0.02	0.06	-0.05	0.04	-0.07	-0.89	1.00												
GDP growth	0.04	0.07	0.00	-0.10	0.01	0.01	0.00	-0.02	-0.03	0.00	-0.05	-0.09	0.16	1.00											
Forecast GDP growth	0.01	0.00	0.00	-0.10	-0.03	-0.03	-0.02	0.00	0.06	-0.04	-0.37	0.81	-0.55	-0.09	1.00										
Inflation	0.03	0.03	-0.01	-0.09	-0.01	-0.01	-0.01	-0.02	0.00	-0.02	-0.06	0.31	-0.37	0.32	0.19	1.00									
Q Gross margin difference	0.00	-0.04	-0.11	-0.04	0.77	0.56	-0.07	-0.10	0.06	0.09	-0.02	-0.02	0.02	0.00	-0.01	-0.01	1.00								
Q EBITDA margin difference	0.00	-0.01	-0.08	-0.06	0.59	0.77	0.31	-0.04	0.17	0.03	0.00	-0.01	0.00	0.00	-0.01	-0.01	0.74	1.00							
Bull bear	-0.02	-0.06	-0.01	-0.02	-0.01	-0.01	0.01	0.02	0.04	-0.01	-0.21	0.22	-0.13	-0.15	0.40	-0.21	-0.01	-0.01	1.00						
Value daily traded	-0.14	-0.07	0.56	0.09	0.14	0.17	0.11	0.03	0.15	0.17	-0.11	-0.01	0.01	-0.05	-0.01	-0.03	0.03	0.08	0.03	1.00					
Pay out	-0.05	-0.16	0.11	0.35	-0.07	-0.11	-0.03	0.07	0.12	-0.01	-0.22	0.04	-0.03	-0.14	0.06	-0.07	-0.07	-0.06	0.11	0.12	1.00				
Gross profit difference	0.04	0.03	-0.01	-0.02	0.00	-0.01	-0.02	0.00	0.04	0.00	0.05	-0.01	-0.01	0.01	-0.04	0.00	0.02	0.00	-0.03	0.00	-0.08	1.00			
EBITDA profit difference	0.05	0.06	-0.01	-0.02	-0.02	0.25	0.25	-0.01	0.15	0.00	0.08	0.00	-0.02	0.02	-0.03	-0.02	-0.01	0.34	-0.03	0.00	-0.04	0.48	1.00		
Long term growth	0.17	0.27	-0.08	-0.37	0.08	-0.01	-0.13	-0.12	-0.01	0.11	0.30	0.05	-0.04	0.02	0.06	0.03	0.04	0.03	0.05	0.01	-0.18	0.06	0.07	1.00	
Market momentum	0.00	0.05	-0.02	-0.11	0.01	-0.01	-0.02	0.17	0.04	0.00	-0.07	-0.04	0.05	-0.04	0.06	0.14	0.00	-0.01	0.17	0.01	-0.05	0.00	-0.04	0.06	1.00

In general, the correlation between the variables are low. Unlevered beta and beta are positively correlated. As unlevered beta in this context refers to the business beta which was calculated using four factors, one of which was two-year beta, a correlation was expected between the two factors. The dilution of the correlation by the other reasonably uncorrelated factors of the debt-to-equity ratio, the operational leverage and the tax rate, was also expected. This also accounts for the unlevered beta's correlation to the debt-to-equity ratio.

The dividend yield was negatively correlated both with the unlevered and the two-year beta. The unlevered beta's correlation was the result of its correlation to the two-year beta. As both low dividend yield and larger volatility are characteristics associated with young, small and fast-growing companies, the correlation was not unexpected.

The two-year beta and volatility is highly positively correlated. As beta is the volatility of the share's price against the volatility of the market, while volatility is the absolute volatility of the share, there is an expectation that these two variables would be correlated.

In this context pay-out ratio referred to the ratio between the value of the share and the pay out of both dividends and share buybacks. As noted below in 4.4.3, the pay-ratio was considered as an alternative to the dividend yield as share buybacks have become an increasingly popular way to return capital to shareholders, and would be part of the return earned on the share. As such it was expected that the pay-out ratio and dividend yield would be significantly positively correlated. In turn then, the pay-out ratio was also related to the variables that the dividend yield was related to.

As can be expected gross and EBITDA margins were strongly positively related. All variables that were derived from either the EBITDA or gross margin variables show relationships with both. The only exception is the gross profit difference and gross profit trend over time. The gross profit variable was a lot more dispersed and larger than the EBITDA margin. However, the size and dispersion of the difference variable is similar to that of the EBITDA difference variable, which resulted in the dilution of the relationship.

Financial leverage (debt-to-equity ratio) was positively correlated both with dividend yield and the operating leverage (EBITDA margin/Gross margin). A relationship with operating leverage is logical, as the amount of operating leverage determines the amount of fluctuation in cash flows experienced by the entity, which also determines the amount of debt a business can enter into. Similarly, a business with strong cash flows can declare dividends and service debt, which explains the relationship between the debt-to-equity ratio and the dividend yield.

As the relationships in the previous paragraph are all the result of a relationship with variability in cash flow, it is not unexpected that all the variables, financial leverage, operating leverage and dividend yield are negatively related to the 2 year volatility.

The gross margin's positive relationship with research and development could be the result of higher margins being earned by more value add and higher risk enterprises, which would be the same enterprises involved in research and development. The correlation flows through to the operating leverage (EBITDA margin/gross margin) and financial leverage (debt-to-equity), considering their relationships with margins already being established, this is to be expected.

With macro-economic indicators representing a system with many interdependent factors, many factors are correlated, but it is hard to distinguish cause from effect. The M3-to-GDP ratio is strongly negatively correlated with the risk-free rate. Forecast GDP growth, as expected, is strongly positively correlated with the risk-free rate and negatively correlated with the M3-to-GDP ratio. Forecast GDP growth is also negatively correlated to the volatility of the market.

Inflation is as expected positively correlated with the risk-free rate, GDP growth and forecast GDP growth, and negatively correlated with the ratio of M3-to-GDP.

The indicator for the bull and the bear market is a put-call ratio, thus the larger the ratio, the stronger the bear market. The indicator is correlated with almost all the macro-economic indicators. These indicators include: market volatility, the risk-free rate, GDP growth, forecast GDP growth and inflation. Its strongest relationship is a positive correlation with market momentum. As market sentiment is one of the possible drivers of market momentum, this is expected.

Market momentum is positively correlated with debt to equity. As noted above, firms with strong cash flows can bear more debt. This strong cash flow may also result in some market momentum. Due to the debt to equity indicators correlation to dividends, market momentum is similarly correlated. Market momentum and inflation has a positive correlation. This correlation differs from the correlation between inflation and stock returns discussed in 2.2.2, as that is forward looking.

Value daily traded is used as an indicator of liquidity in this study. It is correlated to sales (an indicator of size), EBITDA margins, return on equity and % of research and development costs. As size is not related to margins or research and development, it is more logical that a higher amount of trading takes place in shares that have higher margins, returns on equity and research and development costs.

Long term growth is positively related to two-year beta and negatively related to dividend yield. Both volatility (beta) and high reinvestment rates (low dividend yield) are also indicators of young (high growth) companies. Due to beta's correlation to volatility and the pay-out ratio's correlation with dividend yield, these two variables are also correlated to long term growth.

Co-linearity in the model is dealt with by means of the Akaike Information Criteria stepwise elimination. The AIC measures the level of complexity of the model in comparison to the amount of information added by that variable to the model. If two variables are highly correlated, the added complexity of an additional predictor will not be justified by the amount of unique information brought to the model, and it will thus be eliminated.

This chapter described how data was selected to ensure that the data is applicable to the testing. The next chapter will discuss the methodology employed in this study. How the testing was performed is now described in the next.

Chapter 4: Methodology

4.1. Introduction

In this chapter, the three major steps of the study are discussed. The first step is the calculation of the implied cost of equity for the sample after all exclusions as described in the previous chapter. Next follows a discussion of how proxies were chosen for certain of the risk factors. Finally, the mixed, which was the model used to do the statistical analysis, is discussed.

4.2. Calculation of implied cost of equity

The first step in the process was to calculate the cost of equity implied in US analyst forecasts. In section 2.2 of the literature review, the possible methods for achieving this were discussed, and in section 2.2.1 the evidence of the efficacy of the different methods was explained. Botosan and Plumlee (2005), in a study that compared company risk factors with implied equity risk estimation methods to test for the efficacy of these methods at a firm level, found that the Easton (2004) method (which uses eps_1 and eps_2), as well as their derivation of it (which uses eps_4 and eps_5), displayed the best correlations with certain known proxies for company level risk. For this study, the Easton (2004) method was therefore selected, as it also requires a relatively small number of inputs and earnings-per-share data that is more widely available. Using an average to try and eliminate any bias, Attig *et al.* (2008) also found the Easton method to have a 93% correlation with the average of all five the methods utilised in Botosan and Plumlee (2005).

The Easton Model is expressed as follows:

$$r = \sqrt{\frac{(eps_2 - eps_1)}{P_0}} \quad \text{Eq. 4.1}$$

Where:

P_0 = current, date $t = 0$, price of share

r = expected rate of return, and $r > 0$ is a fixed constant

eps_1 = expected earnings per share for period 1

eps_2 = expected earnings per share for period 2

The limitations of this methodology is two-fold. The first is that a value for implied cost of equity cannot be calculated if the eps is expected to decline between year 1 and year 2 (*i.e.* $eps_2 < eps_1$). The second limitation is that when the growth from eps_1 and eps_2 is not representative of the long-term growth, the second condition of the model, that the Δagr (change in abnormal earnings) should be nil, is violated. Both limitations are noted by Botosan and Plumlee (2005) as motivation for their adjusted model using eps_4 and eps_5 instead. Although it is true that the forecasts for eps_4 and eps_5 are less likely to decrease, the forecasts

for eps_1 and eps_2 are much more likely to be accurate, as the current performance and trading conditions are known, and the accuracy of predictions decrease the further into the future the predictions are made. Furthermore, the inaccurate and unsolvable values were identified and eliminated, as discussed in 3.1.2, while no such measures can be taken to improve the accuracy of forecasts.

As the target price predicted by analysts is the estimated fair price in 12 months' time, it is strictly speaking the share price at $t = 1$. To calculate P_0 , P_1 needs to be discounted for one period using the cost of equity. This results in the following formula:

$$r = \sqrt{\frac{(eps_2 - eps_1)}{(P_1) * (1+r)^{-1}}} \quad \text{Eq. 4.2}$$

This formula can be rewritten as follows with r as the subject:

Step 1:

$$r = \sqrt{\frac{(eps_2 - eps_1) * (r + 1)}{P_1}}$$

Step 2:

$$r^2 = \frac{(eps_2 - eps_1) * (r + 1)}{P_1}$$

Step 3:

$$r^2 = -\frac{eps_1}{P_1} + \frac{eps_2}{P_1} + r \left(\frac{eps_2}{P_1} - \frac{eps_1}{P_1} \right)$$

Step 4:

$$0 = -\frac{eps_1}{P_1} + \frac{eps_2}{P_1} + r \left(\frac{eps_2}{P_1} - \frac{eps_1}{P_1} \right) - r^2$$

Step 5:

$$0 = \frac{eps_2}{P_1} - \frac{eps_1}{P_1} + r \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right) + r^2$$

Step 6:

$$\frac{eps_2}{P_1} - \frac{eps_1}{P_1} = r \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right) + r^2$$

Step 7:

$$\frac{1}{4} \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right)^2 - \frac{eps_1}{P_1} + \frac{eps_2}{P_1} = \frac{1}{4} \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right)^2 + r \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right) + r^2$$

Step 8:

$$\frac{1}{4} \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right)^2 - \frac{eps_1}{P_1} + \frac{eps_2}{P_1} = \left(\frac{1}{2} \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right) + r \right)^2$$

Step 9:

$$\sqrt{\frac{1}{4} \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right)^2 - \frac{eps_1}{P_1} + \frac{eps_2}{P_1}} = \frac{1}{2} \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right) + r$$

Step 10:

$$\frac{1}{2} \left(\frac{eps_2}{P_1} - \frac{eps_1}{P_1} \right) + \sqrt{\frac{1}{4} \left(\frac{eps_1}{P_1} - \frac{eps_2}{P_1} \right)^2 - \frac{eps_1}{P_1} + \frac{eps_2}{P_1}} = r$$

Eq. 4.3

This formula was used to calculate the implied cost of equity using analysts' forecasts of eps_1 , eps_2 and target prices as P_t . The equity risk premium is then calculated by deducting the risk-free rate from the cost of equity.

$$\text{equity risk premium} = r - \text{risk free rate} \quad \text{Eq. 4.3}$$

4.3. Use of analyst forecast and target prices

The majority of studies reviewed in this study associate various factors with market returns. In these studies, realised equity returns are assumed to be a proxy for the *ex-ante* cost of equity estimated by the market. This usage rests on the assumption that the market is efficient and that the *ex-post* returns are thus the result of an appropriate *ex-ante* estimate of risk. For these studies analyst predictions of future cash flows are normally used as a proxy for the market expectations of future cash flows.

The present study used analyst target prices, combined with analyst forecasts of cash flows, as the purpose is specifically to examine which risk factors appear to be considered by analysts when estimating target prices, rather than trying to establish which factors influence actual returns. This approach therefore does not assume that the market is perfectly efficient. Furthermore, it also does not ignore the so-called equity premium puzzle as first described by Mehra and Prescott (1985), which refers to the body of evidence that *ex-ante* cost of equity estimates tends to be a lot larger than actual returns.

It is also assumed that the link between analysts' target prices and forecasts should be stronger than the link between earnings forecasts and market prices, given that the target price is directly derived from the earnings forecast, allowing for a model with higher explanatory power.

The inputs into the implied cost of equity calculation used in this study were the median of analysts' forecasts and the median of analysts' target prices for US NYSE-listed companies, as published by IBES.

4.4. Justification for factors included in the regression model

In the literature review section, studies that found factors to be related to either returns, cost of equity or pricing multiples were reviewed in order to identify possible factors that could be related to the implied cost of equity premium estimate of analysts. These were identified to be the various drivers of risk, and as such these factors should be considered when estimating the cost of equity premium.

For some of the factors, different indicators can be used as proxies. For example, the liquidity of a share can be measured by the bid-ask spread, the traded volumes, or the volatility of the share price. The next section discusses the indicators that were selected in this study to serve as a proxy for a particular risk factor. Although this chapter serves as a description of the methodology to be used, it also, where appropriate, links back to the literature that was reviewed in order to provide context and justify choices made.

A regression methodology, described in Section 4.7, was then used to test these factors for significance against the equity risk premium, defined as the difference between the total cost of equity and the return of a risk free asset.

4.4.1. Beta

As discussed in Section 2.4.1, an alternative to using historic beta is to build the beta from the bottom up (see Damodaran, 2012). Per Damodaran, a company's beta comprises of the financial leverage of the company and the beta of the company (what we would normally call the enterprise, independent of funding sources or financial engineering), which in turn comprises of the operating leverage and the business beta. This pure business beta is in effect a reflection of the variability of the sales in relation to the market's movement. This pure business beta has been included in testing as an unlevered beta. The traditional financially de-levered beta has not been included, as both the components, market beta and the debt-to-equity ratio are already included in this study. To calculate the pure business beta the following formula was used:

$$\frac{\text{Financially unlevered beta}}{\left(1 + \left(\frac{\text{Fixed costs}}{\text{Variable costs}}\right)\right)} = \text{Pure business beta} \quad \text{Eq. 4.4}$$

The reason for including specifically the pure business beta is that one of the arguments against beta is that upside risk does not represent true risk to the investor (see Ang *et al.*, 2005) – in other words, an increase in market price is not detrimental to the asset owner. Losing more capital in a downturn than the market does, however, represents a risk, implying that only downside beta should be taken into account. The rating agencies, which are mainly focussed on downside risk, do however take cyclicity into account, which is what a pure business beta serves as a proxy for. Therefore beta, both levered and unlevered, were included in the regression test.

The unlevered beta was calculated using sales, general and administrative expenses as the fixed cost portion of the calculation and cost of sales as the variable cost portion of the calculation. The tax rate used was the effective tax rate of the entity for the specific quarter.

4.4.2. Size and price-to-book value

The well-known Fama and French models (1992, 2014) identify both size and price-to-book value as factors that explain the difference in returns between stocks. Despite the strong support in Fama and French's studies for P/BV as a determinant of return, it was not included as one of the independent factors in this study, as the purpose of the study was to establish the factors associated with cost of equity estimates implied by the target price and earnings forecasts. As noted by Christie (1987), price is a variable on dependent future cash flow and cost of equity (risk), so price will be unknown to the person estimating the cost of equity. In support of this argument, Fitzgerald, Gray, Hall, and Jeyaraj, (2013) noted that despite the attention the Fama and French models have received, investment companies and banks do not use the price-to-book value ratio to estimate cost of equity in order to value entities. This is logical, as a valuation technique that relies on a price-to-book value multiple implicitly relies on a price (which the person valuing the asset is trying to independently establish), *i.e.* you cannot use a multiple of value to establish value (see Fama & French, 2004).

Size is, however, included in the testing. Size can influence the risk profile of an entity in a number of ways. The larger an entity is, the better its ability to access the capital markets. Size is also a proxy for diversity of products and markets. Diversity of products and markets are defences against exposure to sudden shifts in specific markets and consumption, lowering the risk profile of the entity, which should in turn influence the cost of equity (Harbula 2009).

4.4.3. Dividend yield

Despite the large body of evidence reviewed in the literature section, dividend yield could have been excluded from testing on a similar basis as the price to book value metric. Dividend yield (like price to book value) is a ratio that is dependent on the price of a share., *i.e.* the price is the result of the risk assessment, and thus any ratio that includes price will have a significant relationship to the cost of equity, but this does not mean it is a fundamental risk factor that contributes to the assessment of risk.

Malkiel (2003) noted that, when interest rates are high, the cost of equity should theoretically also be high. This, in turn, results in low asset prices as a result of higher discount rates. Low asset prices result in higher dividend yields (if the absolute quantum of the dividend remains the same), but also higher returns in the future when interest rate decrease and asset prices increase as a result. When the cycle reverses and interest rates are low, asset prices are high and returns in the future will be low when the interest rate rise dividend yields are low. The dividend yield thus is not the cause of the level of cost of equity, but rather the result of interest rates that are the basis for determining the cost of equity.

However, as noted in the literature section, evidence exists not only of the connection between dividend yield and return, but also the impact of dividend announcements. For this reason, dividend yield was included as a variable for testing, but with the expectation that it would not hold sufficient unique information to be included in the final model.

More recently, dividends have often been replaced by share repurchases as a mechanism to return capital to investors. This was noted by Malkiel (2003) as a possible explanation for the weakening of the dividend yield as an indicator of future returns, which was noted by Fama and French (1988) and Campbell and Shiller (1988). In order to allow for this, dividend yield and the pay-out ratio, that combines dividends and share purchases in the twelve months prior to the quarter end, were tested for their association with the cost of equity premium.

4.4.4. Liquidity

In order to establish the proxies for liquidity to be tested, the option based approach of Chaffee (1993) and Finnerty (2012) was followed. To calculate the value of liquidity under this theory, the expected life of the option (period of illiquidity) and the volatility of the share price is required.

The expected option life represents the period it would take to liquidate an asset; in other words, the time that it would take to sell the shares that the investor holds. A proxy needed to be found for this period and the average dollar amount of daily traded value was used for this. The reasoning for this is that to compare liquidity between entities, one needs to find a proxy for how long it will take comparatively to liquidate an investment of identical size (in USD) in the shares. It is thus the value that is traded, rather than the number of shares that is most relevant.

Volatility is directly observable and the two-year volatility was used as a variable in the model. Dividend payments are already included in the model, in the form of the dividend yield. The two-year volatility was utilised as this is the period over which earnings forecast were used to calculate implied cost of equity. Thus, the proxies included for liquidity is the average daily traded value and the volatility.

4.4.5. Profit margins

The profit margin variables used as potential factors in this study were the following: (1) gross profit margin, (2) EBITDA profit margin, (3) gross margin/EBITDA margin, (4) gross profit difference (the difference between the gross profit margin in the current period and the average gross profit margin in the five preceding periods), (5) EBITDA difference (the difference between the EBITDA profit margin in the current period and the average of the EBITDA profit margin of the five preceding periods), (6) quarterly gross difference (the difference between the gross profit margin of the entity and the average of the industry in that quarter) and (7) quarterly EBITDA difference (the difference between the EBITDA profit margin of the entity and the average of the industry in that quarter).

The different indicators were meant to proxy different risk factors. The gross profit margin and EBITDA profit margin served as proxies for the company's ability to withstand economic downturns, depending on how large "cushions" of profit it had to absorb future pressure on sales and margins. All pricing multiples can be rewritten to include margins (see Bhoraj & Lee, 2002), thus supporting the inclusion in the tests.

The gross profit margin over EBITDA profit margin was meant to be a proxy for the company's operational leverage, as indicated in the beta sub-section of the methodology section, under the discussion of unlevered beta.

The gross profit difference and the EBITDA profit difference were meant to be proxies for the trend in margins, which in turn is a proxy for the competition in the sector and the company's competitive position within the industry, as well as the tendency for profit to mean revert (Fama and French 2000). The value relevance of both trend and level variables when dealing with earnings is supported by Cheng *et al.* (2013)

The margin of the entity when compared to that of the industry average in that quarter was meant to proxy the company's operational efficiency when compared to similar companies – thus its ability to earn higher returns than its competitors, or if not competitors, at least compared to companies with a similar risk profile. This approach follows that of Bhoraj and Lee (2002).

4.4.6. Market sentiment

In order to account for market sentiment as a factor, the ratio of put options to call options on the Chicago Board of Options Exchange was used as proxy. This ratio is a commonly used indicator of market sentiment by both academics and finance professionals (Bandopadhyaya & Jones, 2011). If the ratio exceeds one the market is classified as a bear market (as it contains more sellers than buyers), and if it is less than one as a bull market (as it contains more buyers than sellers). Due to the Chicago Board of Options Exchange only reporting the put–call ratio from 2007, the four quarters in 2006 do not have this information.

It is important to note that various macro-economic factors are already included in analysts' growth forecasts for companies. If the bull and bear market indicator is significant, even with the macro-economic and growth factors present in the model, it is the sentiment or behavioural finance driver that influences the perception of risk over and above the real macro-economic drivers.

4.4.7. Market momentum

As noted in Section 2.4.3 of the literature review section, market momentum has been shown to be a factor in the determination of the cost of equity (see Carhart 1997). Different indicators have been used to represent market momentum, with the most popular being market returns over a historical period. However, the historical period varies between studies. In Carhart's study the one-year returns were used to construct the different mutual fund portfolio tested for variation in returns. In the present study the proxy for market momentum was based on Jagadeesh and Titman's (1993) methodology. Jagadeesh and Titman

(1993) tested strategies of buying stocks that had performed well in the preceding period(s), and selling stocks which had performed poorly in the preceding period(s), using the data for the NYSE between 1965 and 1989. Three, six and twelve-month periods were used. The biggest excess return was recorded using a holding period of six months. This six months period was also utilised in the present study.

4.4.8. GDP growth

As indicated in Section 2.4.2, Flannery (2002) performed an event driven study investigating macro-economic announcements and their impact on the stock market. It was found that the balance of trade, employment related announcements (unemployment, non-farm employment), housing starts (private homes on which new construction was started), and real gross national product were significantly correlated with stock market returns.

The above indicators contain both leading indicators of GDP growth as well as indicators of current GDP growth. As the data in this study is drawn on a quarterly basis, there is time for some of the leading indicators to be interpreted and forecast GDP to be announced. Thus, for this study, the indicators which were included were current GDP growth and forecast GDP growth.

4.4.9. Monetary policy

To include the possible effect of monetary policy on the cost of equity premium, both the M3 money supply in relation to GDP and the risk-free rate was included as possible factors to be tested. These were chosen as they represent the main tools of government monetary policy.

4.4.10. Inflation

As the three year US Treasury bill swap rate index, which has been used as a proxy for the risk-free interest rate, was already included in the study, it was expected that either inflation or the risk-free rate would have limited additional explanatory power. As the risk-free rate is a combination of the real interest rate and inflation, it is likely to convey more information regarding risk than inflation and finally prove to be the most relevant. However, considering the large body of evidence related to inflation and the impact on returns, as well as the fact that contra-intuitively the coefficient of this variable is negative in previous studies (see, for example, Yeh & Chi, 2009, and Fama & Schwert, 1977), inflation was included in the initial testing.

4.5. Individual significance

Before constructing a model that includes all candidate predictors, individual predictors were tested to establish if they are sufficiently associated with the equity risk premium to warrant inclusion. The predictors

were evaluated using the guidance of the American Statistics Association, as outlined in Wasserstein & Lazar (2016). These guidelines require the evaluation of predictors using a variety of numerical and graphical summaries of data within the context of a study. For this purpose, p-values, standard errors and the visual representation of the probability distribution, were utilised in the present study. If the predictor as evaluated against these requirements appeared to add value to the model, it was included.

Each predictor was first regressed against the equity risk premium using least squares regression (eq. 4.65below)

$$R_{ij} = \alpha + \beta X_{ij} + \varepsilon_{ij} \quad \text{Eq. 4.5}$$

Where:

R_{ij} = implied equity risk premium for company i at quarter j

α = the intercept of the regression

β = the coefficient of the predictor X

X_{ij} = the value of predictor X for company i at quarter j

ε_{ij} = error term for company i at quarter j

The null hypothesis that R is not associated with X was thus individually tested for each candidate factor. A p-value of less than 0.05, for example, indicates a less than 5% chance that the null hypothesis cannot be rejected (*i.e.* that there is a 95% likelihood that X and R are associated).

A standard error is calculated as follows:

$$s = \sqrt{\frac{\sum(x-\bar{x})^2}{n-1}} \quad \text{Eq.4.6}$$

Where:

s = standard error

x = the value of each individual predictor

n = the number of individual predictors in the sample.

4.6. Mixed effects modelling

This study was conducted using mixed-effects modelling in S and S-plus (see Pinheiro & Bates, 2000). Mixed-effects models are derived from linear regressions, and the differences are explained below. Mixed effects modelling was chosen because of the characteristics of the data. 1. Each company is likely to have unique information considered in the determination of the cost of equity by the analysts, which is not

captured by the predictors. 2. Time-series correlation exists within the data for a single company. Both of these characteristics can be accommodated within a mixed effects model.

A simple linear model constitutes of one dependent and one independent variable (*e.g.* the well-known relationship between price and demand). Each of these could be the independent variable, also known as predictor and the dependent variable, also known as outcome. The predictor can either be numerical or categorical, and the method of solving it is known as least squares regression. This involves one outcome, one fixed variable, and one random variable (the residual). The estimates derived from a simple linear model are the intercept, the coefficient(s) of the predictor, and their standard errors. It is assumed that the outcome values are statistically independent of each other. Therefore, each outcome can be calculated by adding its residual to its fixed effect. Roughly speaking, this means that knowing the one, tells you nothing about the other. Effects which are not the result of the specified variables are then contained in the error term and can also be referred to as random effects. A general linear model (or multiple regression model) simply has more than one predictor, numerical and/or categorical, and can also be solved using the least squares method.

Mixed effects modelling is similarly a statistical method that allows for the quantification of relationships between a dependent variable and a number of independent variables, but taking into account certain random effects. When the data originates from specific known groups, then it is assumed that outcomes from the same group will be more similar than outcomes from different groups. These unknown correlations between outcomes from the same group must be specified in the model. This is accomplished by adding a so-called random effect for groups to the model. The estimation now requires not only the predictors (fixed effects) but also the variances of the random effects. The random effects are only of interest because they determine the correlations between the fixed effects and the outcome.

In the context of the current model, fixed effects were the influences of the various independent variables such as size, dividend yield, and return on equity, etc. on the cost of equity premium. Random effects are effects which are associated with groups of observations in the population. Logically, this modelling method makes the most sense when the population can be grouped into categories which are expected to have an unknown effect which is not included in the independent variables defined in the model. In the context of this model, this category was made up of the all the company quarters of a specific company - in other words, all 40 observations measured for a single company.

The unknown and random effect in this model would thus be the company individual risks, which are undefined. To be clear, if several companies share a risk factor which is not defined in this model, the effect of this risk factor would still be a fixed effect of those companies, and thus not taken into account when modelling the effects of the risks (independent variables) which are defined.

This modelling method enables the error factor in the model to be reduced because the effect of the unaccounted-for risks can be eliminated. This can be done, because it can be observed, due to the fixed

effect this unaccounted-for risk factors have on a group of observations (all the company quarters of a single company).

The simplistic way of achieving this is to model each group of observations separately, thus eliminating the random effect of the company's contribution. Alternatively, a predictor per company can be included in the modelling. The coefficient of the predictor included for each of the companies then in essence represent their random effect, which becomes a fixed effect. This however, also results in a variable needing to be incorporated for each company in the sample, which in the case of this model would mean an additional 400 variables would need to be incorporated.

Another characteristic of the model is the ability to incorporate known correlations between different data items in the sample. The mixed-effects model used for the analysis of data in the current study accounted for the correlation between outcomes in grouped or *spatial* data and for *time-series* data, where each observation has an integer-valued time variable associated with it. We define and estimate two different correlations between the pairs of observations from each company.

The groups are the different companies represented in the data. A simple covariance structure was used for the company random effects. The correlation between each pair of outcomes from the same company is the same. This correlation is reported as the two variances, the residual variance inside companies and the variance between companies. The correlation is calculated as variance between companies, divided by the sum of the variances inside (residual) and between companies.

The time-series for each company is indexed by the 1 to 40 quarters for which data is present. The current data consisted of many variables collected quarterly, starting with the first quarter of 2006 up to the last quarter of 2015. This implies that at most 40 data values for each of the companies was included in the sample. In time series analysis, it is assumed that each company will produce similar (correlated) outcomes at adjacent time points, rather than at points further apart. The simplest autoregressive-moving average time series of order one (AR(1)) was used. The order one means that we assume that each observation is correlated only to the one that is one quarter ahead of it, and the one that is one quarter behind it. This single correlation parameter is reported as phi (Φ).

The current study's goal was not to examine these correlations. The correlations were only needed to assess the statistical significance of the estimates as accurately as possible.

The modelling also allows for missing data points, which was especially helpful in this model, as some quarters for specific companies had to be excluded due to missing data elements. Typical examples of this included forecasts that were not available for the whole period for a specific firm, and unusable company-specific information such as negative debt-to-equity ratios in the case of negative equity in a specific quarter.

The model can be expressed as follows:

$$Y_{ij} = \beta_0 + \beta_1 * Predictor\ 1_{ij} + \beta_2 * Predictor\ 2_{ij} + \beta_3 * Predictor\ 3_{ij} + \beta_4 * Predictor\ 4_{ij} + \dots + \beta_p * Predictor\ P_{ij} + b_i + b_{ij} + \varepsilon_{ij} \tag{Eq. 4.7}$$

Where:

Y_{ij} = the predicted equity risk premium for company i at time j

b_i = random effects for company i

b_{ij} = random effects for company i at time j

β_0 = the intercept of the regression

β_1 = the coefficient of Predictor 1

Predictor 1 $_{ij}$ = the value of predictor 1 for company i at time j

ε_{ij} = error term for company i at quarter j

The random effects and error term is assumed to be normally distributed around zero. The assumption of a normal distribution of the error function, together with all the other estimates, will be tested in the final model.

The most simplistic version of the model requires the error term to have a variance of σ^2 and no correlation between the within group errors. The random effect for each company has a variance of σ_b^2 and no correlation between the between group (company) random effects. There is also no correlation between the error terms and any of the b_j random effects.

In the version of the model used in this study the assumption that the random effects are not correlated was relaxed, because in a time series adjacent observation will usually be correlated with each other. This requires the random term b_{ij} to be added to the model. The correlation between time-adjacent risk premiums was modelled using an autoregressive model, where the correlation between all values b_{ij} that are adjacent (in time) to each other are equal to ϕ (\emptyset). All other correlations, of random effects inside a specific company, that are more than one quarter away from each other, are assumed to be zero.

Maximum likelihood ("ML") function was used to estimate the coefficients of the predictors, the error variance, the per company variances and the autoregressive correlation, defined above. Maximum likelihood is a statistical method, where the probability of encountering a given observation is maximised by estimating all the unknown parameters in the model.

The likelihood function is proportional to the probability of observing a specific value y , given all the parameters in the model. The probability is based on the combination of normal distributions specified in the model. There are many more observations (and hence statistical degrees of freedom) than parameters in the model, and a variety of possible solutions (sets of estimates of all the parameters) can usually be derived. Complicated mathematical optimization techniques are used to estimate all the parameters in such a way that the likelihood is maximised, while satisfying the assumptions of the estimates. Hence the name maximum likelihood. Should the assumptions be invalid, then a sensible solution of the likelihood will not exist, so that a model that describes the observed data well, is an indication that all the restrictions were

satisfied. If the solution does not fit the observed data well, something is wrong. Often the distributional assumptions.

4.7. Akaike Information Criterion

Initially the risk premium was modelled as a function of each predictor separately. The predictors which were statistically significant at the 95% confidence level (*i.e.* had model p-values of below 5%) were selected to be candidates in the final model. A model was then created that contained all candidate predictors, and an Akaike Information Criterion (“AIC”) value was calculated for this model. The Akaike (1973) information criterion is calculated as follows:

$$AIC = 2k - 2\ln(\hat{L}) \quad \text{Eq. 4.8}$$

Where:

k = the number of parameters in the model

\hat{L} = the maximised value of the likelihood function for the model

When judging a model fit by log likelihood, the model fit should never deteriorate with the addition of another predictor. An increased log likelihood indicates a better model fit. However, a good model should also be parsimonious (*i.e.*, describe the outcome as well as possible, with as few predictors as possible). The AIC criterion therefore is the log likelihood, penalised by the number of parameters (or, strictly speaking, the degrees of freedom).

A stepwise method was used to select the final model from the candidate model using the AIC criterion. First the AIC of the model that included all the candidate variables was calculated. Then the AIC was calculated for all possible models with one predictor removed. The model with the highest AIC with one predictor missing is then selected. The AIC of the model with all the predictors is then compared to the model with the highest AIC with one predictor missing, and if the model with one predictor missing has a higher AIC than the model with all the predictors, the model with one predictor missing now becomes the standard model (*i.e.* the predictor is eliminated). This process is repeated until the most parsimonious model is obtained.

The current chapter described how the model was constructed using the Easton (2004) method of calculating implied cost of equity, the relevant proxies for specified risk factors and mixed effects modelling. In the next chapter the results of this process is discussed.

Chapter 5: Results and analysis

Chapter 5 is divided into three sections. The first section discusses the results of the implied equity risk premium calculation. The second portion discusses the results of the individual risk factor regressions against the equity risk premium, and which were excluded from the mixed effects modelling. Finally, the last section discusses the results of the mixed effects modelling, which incorporated only risk factors which in the abovementioned simple regressions had shown an individual significance of 95% or above, and the optimisation of the model using Akaike Information Criteria. The final model is then reported.

5.1. Estimated equity risk premiums

In this study, the average implied equity risk premium across the full sample as calculated using the methodology of Easton (2002) was 7.41%, but there are significant outliers at the upper end of the spectrum. The median of the sample was 6.95%, which is slightly above the upper range of historical studies on the US equity risk premium. The range of historical estimates is very wide, ranging from Dimson, Marsh and Staunton's (2006) estimate of 6.5%, to Gode and Mohanram's (2003) estimate of 1%. Damodaran (2016) shows that these variations in estimates are the result of differences in the period over which the premium is measured, as well as the methodology used to calculate the premium.

Two reasons why this study's estimate could be higher than historical estimates are: (1) that financial companies, which are often very large companies with resulting lower cost of equity, were excluded in this analysis (see Fama and French, 1995) and that companies with price-to-book values below one were excluded. As the valuation is given a floor by the adaptive value, the discounted cash flow value would be below this value. By using a price higher than the value that would be obtained from a discounted cash flow methodology using the correct risk adjusted cost of equity, a lower implied discount rate is calculated (if earnings remain the same and price increases, the cost of equity must decrease).

5.2. Statistical significance of individual independent variables

Table 5-1 below reports the statistical significance of the association (as p-values) between the equity risk premium and the individual predictors. This is reported in order to, along with visual representation of the data, identify those factors that do not have a high enough level of significance for inclusion in the final model.

Table 5-1: Individual p-value estimates

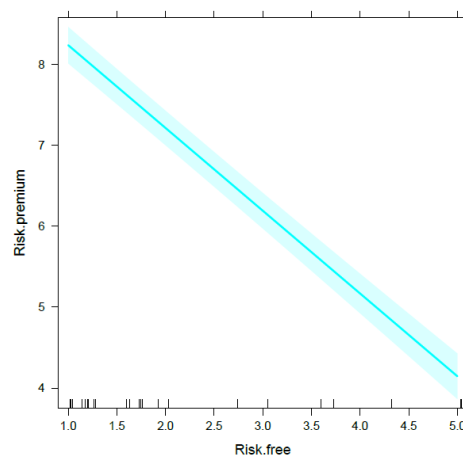
Predictor	Coefficient	SE	p-value
Risk free rate	-1.022	0.033	0.0000
Forecast GDP growth	4.076	0.163	0.0000
M3-to-GDP	21.58	1.11	0.0000
2-year volatility	0.064	0.004	0.0000
Return on equity	-0.025	0.004	0.0000
Net earnings negative	-1.100	0.167	0.0000
Two-year beta	0.540	0.102	0.0000
Long-term growth	0.020	0.006	0.0006
GDP growth	0.111	0.041	0.0067
EBITDA margin/Gross margin	-0.488	0.203	0.0160
EBITDA difference	0.012	0.006	0.0266
Debt-to-equity	0.002	0.001	0.0566
Market momentum	0.1554	0.090	0.0856
Inflation	-0.5845	0.3773	0.1214
Daily value traded	-0.001	0.001	0.1723
Research and dev. as % of sales	-2.847	2.771	0.3043
Gross margin	-0.002	0.002	0.3106
Q EBITDA difference	0.002	0.003	0.3781
Pay-out ratio	0.979	1.199	0.4140
Unlevered Beta	0.189	0.244	0.4374
Bull/Bear market indicator	0.206	0.356	0.5627
Gross profit difference	0.005	0.011	0.6492
Sales	0.000	0.000	0.8108
Quarterly gross profit difference	0.000	0.002	0.8475
EBITDA margin	0.000	0.00262	0.9594
Dividend yield	-0.001	0.043	0.9797

The findings with regards to the various factors tested for in the model are discussed in the sections that follow. In each section the strength of the relationship between the specific risk factor and the cost of

equity premium is shown - the narrower the 95% confidence band around the estimate, the stronger the relationship between the predictor and implied cost of equity premium. In addition, at the bottom of each graph a “sample mat” is depicted, which shows the sample distribution across the range of values for that factor. The confidence band will always become wider when fewer sample observations exist.

5.2.1. Risk-free rate

The coefficient is -1.022, indicating that an increase in interest rates is associated with a reduction of the implied equity risk premium. The p-value of close to nil indicates a high statistical significance, and the light blue band around the line estimate in the graph indicates a small probability distribution. This result corresponds to the findings of Bernanke and Kuttner (2005), as reported in the literature review Section 2.4.2. Their study identified the cause of the excess returns in the month of an unexpected interest rate reduction. They identified one of the factors to be an expectation of future excess returns. Future excess returns were measured by them using equity risk premium. Their results were consistent with the coefficient of the risk-free rate variable found in this study. These results are further in agreement with those of Marston and Harris (1993), who used growth forecasts from analysts and market prices to calculate the implied equity risk premium on a forward-looking basis. These authors found that equity premiums vary over time, being greater in low interest rate environments, which is the equivalent of lower equity risk premiums in higher interest environment as stated above. They also point out that this is in line with the observed spreads on corporate bonds in low interest rate environments.

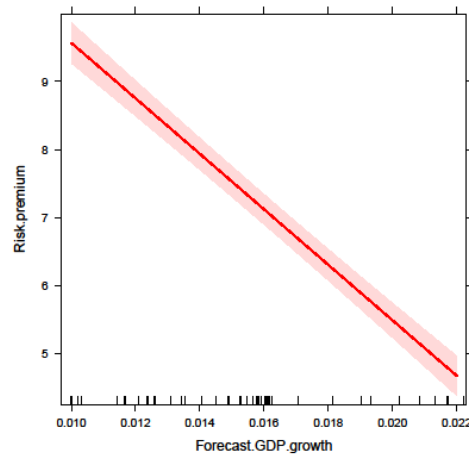


Graph 5-1: Risk-free rate plotted against the implied equity risk premium

5.2.2. Forecast GDP growth and actual GDP growth.

The GDP indicators noted in 2.3.2 to have a significant association can be interpreted as being either forward looking or current. To account for both possibilities, both were tested for significance.

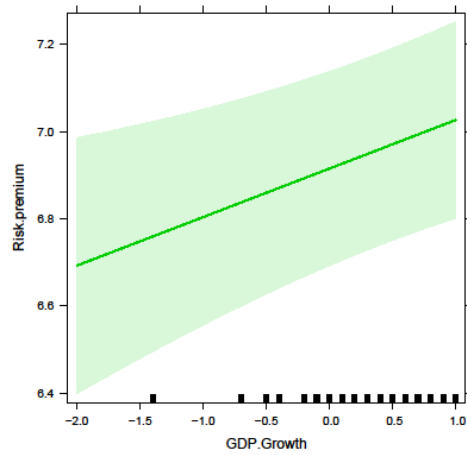
The coefficient of the forecast GDP is -4.08, indicating that a lower cost of equity is estimated when high GDP forecasts are made. GDP forecasts will have an impact on the forecast cash flows, independent of any impact on the inherent risk (cost of equity) of the cash-flows. The p-value associated with this variable in the regression is for all practical purposes zero. The standard error is 0.163 on the estimate of -4.08, indicating a small probability distribution. As noted in the literature review, most relevant prior research has found that GDP is negatively, albeit weakly, associated with returns (Ritter, 2005), which supports this study's findings. The relationship is most probably stronger due to the lack of unexpected events that form part of return studies.



Graph 5-2: Forecast GDP growth plotted against the implied equity risk premium

Current GDP growth has a coefficient of 0.111. The relationship here is not weak (the p-value is 0.0067), but the probability distribution is wide. This is clearly in opposition to the results for the forecast GDP, which as discussed above is in line with findings in return studies.

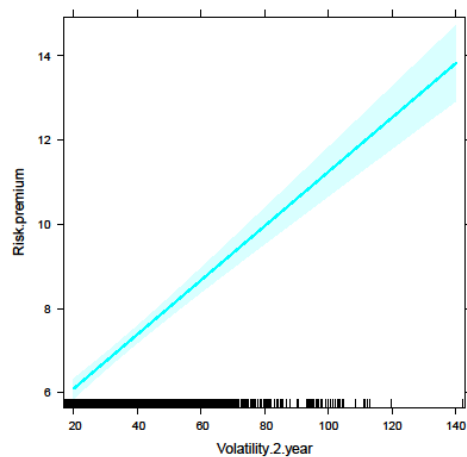
Although the relationship between forecast GDP growth and returns may be understandable, the relationship between current GDP growth future returns are not so direct. GDP growth is however known to be mean reverting (see Ang *et al.* 2006). Analyst may thus have an expectation for growth to revert to lower levels when it is high, increasing the risk.



Graph 5-3: GDP growth plotted against the implied equity risk premium

5.2.3. Volatility and Daily Traded Volume

As mentioned before, Finnerty (2012) uses the value of a put option as a proxy for the price of liquidity, as a put option converts an illiquid asset to a liquid asset. Volatility and daily traded value were therefore included as proxies (as discussed in section 4.4.4) for the factors that are needed to calculate the put option values of shares, as per Finnerty (2012). Two-year volatility proved to be statistically significant, while the daily traded volume did not. Volatility had a p-value of practically nil, while the daily value traded had a p-value of 0.17. Since the put option formula is especially sensitive to volatility, it is logical that both the significance and coefficient (0.064) of the volatility variable should be larger than that of the daily traded value (-0.001). The probability distribution of the volatility factor is also quite small.

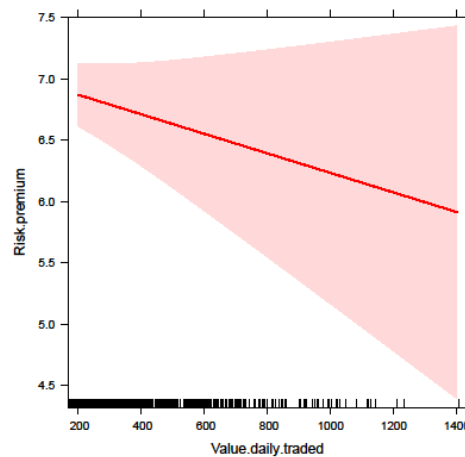


Graph 5-4 Two-year volatility plotted against the implied equity risk premium

The coefficient of volatility is positive (0.064), indicating a higher equity risk premium when volatility is higher, which is also logical. This result is also in accordance with Finnerty's (2012) tables depicting percentage marketability discounts against different levels of volatility and restriction periods, which indicates that the marketability discount increases significantly as volatility increases.

The Daily Traded Value variable, which was this study's chosen proxy for the time it takes to liquidate a holding, has an extremely small coefficient (0.001), but the negative sign is consistent with the logical explanation that the higher the Daily Traded Volume, the lower the risk. It is also consistent with Finnerty's (2012) discount tables, showing a decrease in the discount as the time it takes to liquidate the holding decreases. The impact of the time to liquidity in the Finnerty (2012) tables is less significant than the volatility. The probability distribution is also very large for this factor.

The sample is limited to companies with consensus forecasts on IBES, which by their nature would be larger and more widely traded companies, implying a relatively high level of liquidity for all the companies in the sample. There may not be enough variation in the liquidity of the sample to result in the daily value traded having statistical significance within this sample.



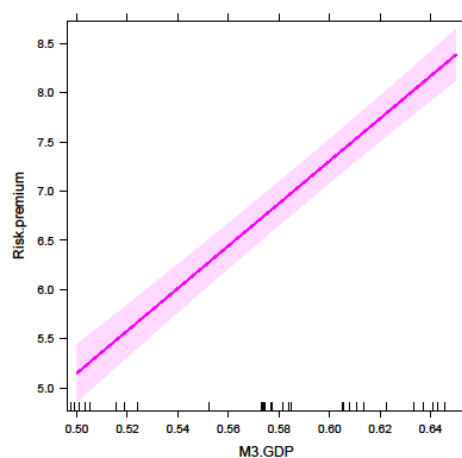
Graph 5-5: Average value daily traded plotted against the implied equity risk premium

5.2.4. M3-to-GDP

Both Thorbecke (1997) and Bernanke & Kuttner (2005) identify a link between an increase in returns and a positive shock from monetary policy announcements, which for the purposes of their studies was defined as non-borrowed reserves¹⁶ announcements and the announcements of federal funds rates¹⁷.

In this study, the M3-to-GDP ratio was used as an indicator for monetary policy, which is in accordance with Hsing (2011). Although highly statistically significant with a p-value close to zero, the coefficient of this factor in the regression is positive (21.58). This is counter-intuitive, as the expectation is that expansionist monetary policies will either result in the borrowing cost decreasing, thereby reducing the risk-free rate but leaving the risk premium unaffected, or that greater supply of capital could result in investors having a higher tolerance for risk, thus lowering the equity risk premium.

Even though the results are counter to both the intuitive arguments, these results are consistent with the results of Bernanke and Kuttner (2005), which were noted in the risk-free rate section. An increase in risk free rate (indicator of demand) would normally correspond to a decrease in M3-to-GDP, and an increase in risk free rate resulted in a decrease in risk premium as noted in Section 5.2.1. For the results to be consistent, a decrease in M3-to-GDP should result in a decrease in risk premium, which is what the positive coefficient implies.



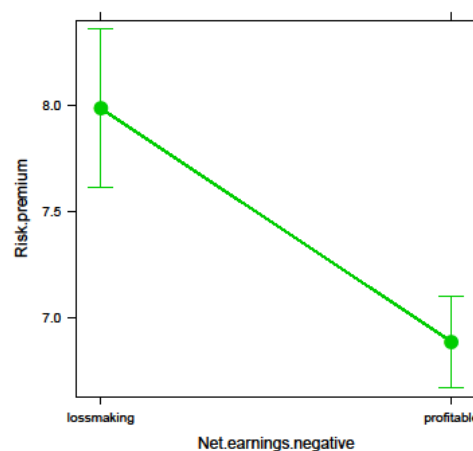
Graph 5-6: M3-to-GDP ratio plotted against the implied equity risk premium

¹⁶ Non-borrowed reserves refers to funds deposited by commercial banks at the federal bank, plus the commercial banks cash on hand, minus funds borrowed from the federal bank by the commercial banks.

¹⁷ The rate at which commercial banks lend money overnight unsecured to other commercial banks.

5.2.5. Positive *versus* negative net earnings

This factor is a binary factor indicating if an entity is profit making or loss making. The coefficient for a positive outcome was found to be -1.1, indicating logically that if the company is currently profit making, this lowers the cost of equity premium. This is also in line with the results of Collins (1999), who found that the significance of the level of earnings to the price of shares is different when companies are loss-making *vs.* when they are profit-making. The finding is also in line with findings of Das (1998), Hwang, Jan and Basu (1996) and Cervellati, Della Bina and Giulianelli. (2008), that the risk of earnings prediction errors is higher for loss making companies. This risk is then reflected by the higher risk premium. With a p-value of practically nil, the predictor is highly significant.

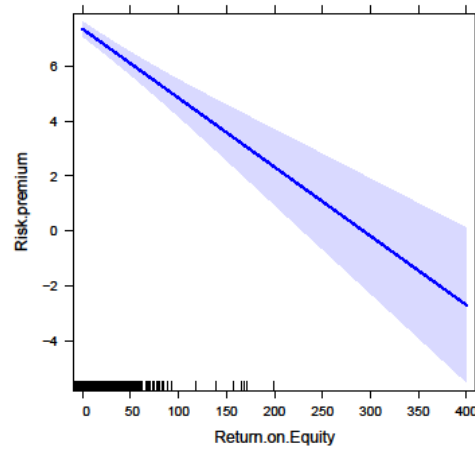


Graph 5-7: Profit making and lossmaking entities plotted against the implied equity risk premium

5.2.6. Return on equity

Return on equity was used by Borraj and Lee (2002) as one of the factors which can be used to determine pricing multiples if price is expressed in terms of book value, and as such was included in the testing. This factor was statistically highly significant with a p-value of practically nil. The impact of this variable is not as large, as indicated by its coefficient of -0.025. This implies that the higher the return on equity the lower the equity risk premium. This makes sense, as a high return on equity implies a lower investment in capital to earn a certain level of return.

However, if the market is efficient, capital invested in risky activity should result in a high return on equity for that activity, which would imply that an entity with high return on equity should have high cost of equity. However, in the case of return on equity this principle does not appear to hold true, and analysts appear to perceive high return on equity as being associated with a lower risk, rather than perceiving the high ROE as a reward for risk taken.



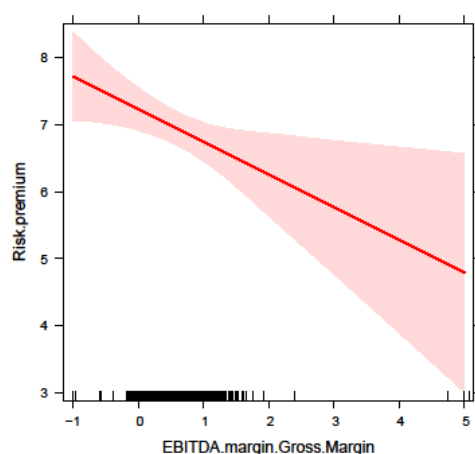
Graph 5-8: Return on equity ratio plotted against the implied equity risk premium

5.2.7. Profit margins

The signs of the coefficients of the various margin variables were not consistent, and their statistical significance within the model varied greatly, as is explained below.

With a p-value of 0.0160 the EBITDA profit margin over the gross profit margin is the most statistically significant of the profit margin variables, which is pleasing as this is the margin ratio which should in all cases contain relevant information given that operational leverage is significant to all entities. It is also one of the variables which most directly proxies risk, as the leverage (the actual risk) is quantitatively observable.

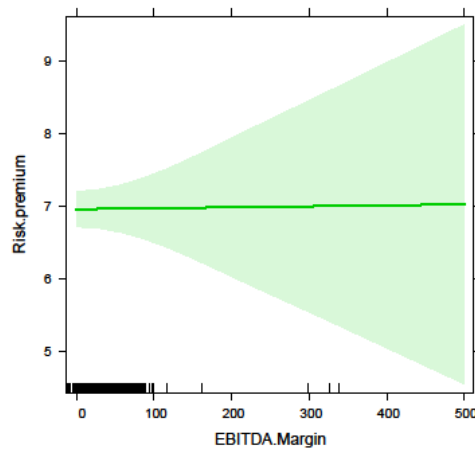
The coefficient of the variable is -0.488, which is consistent with expectations (*i.e.* lower operational risk lowers the cost of equity). Operational leverage is a component of beta, as discussed by Damodaran (2012) and in Section 4.4.2 of this thesis. The coefficient is in line with a higher beta equating to a higher level of risk.



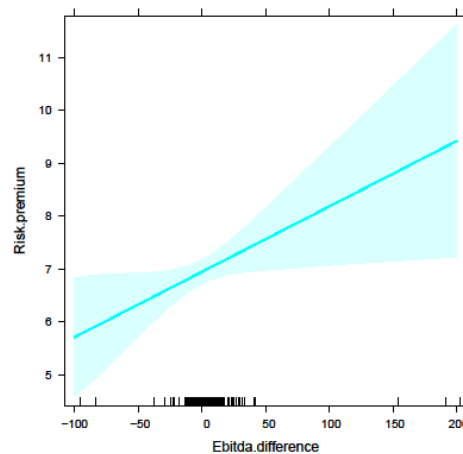
Graph 5-9: EBITDA to gross profit margin ratio plotted against the implied equity risk premium

The EBITDA margin itself is statistically highly insignificant, with a p-value of 0.95, and thus the result has little interpretive value. The EBITDA difference (*i.e.* the EBITDA margin trend), on the other hand, is significant with a p-value of 0.026. The coefficient of the EBITDA difference factor is 0.012, indicating that the higher the EBITDA margin in comparison to the company's historical margin, the higher the implied cost of equity. For the EBITDA difference, the probability distribution is relatively small in the region where the bulk of the sample lies. The coefficient of this variable is counterintuitive, but may be the result of an expectation of mean reversion of profitability as reported by 7 and French (2000). These authors found that the profitability of firms (measured as return on assets) reverts to the mean at a level of 38% per year in the US market between 1964 and 1996. They also found that profitability reverts faster the further

it is away from the mean. This would support the view that analysts see an increase in profitability outside the historical norm as temporary, and that this increases the risk to the future cash flows.

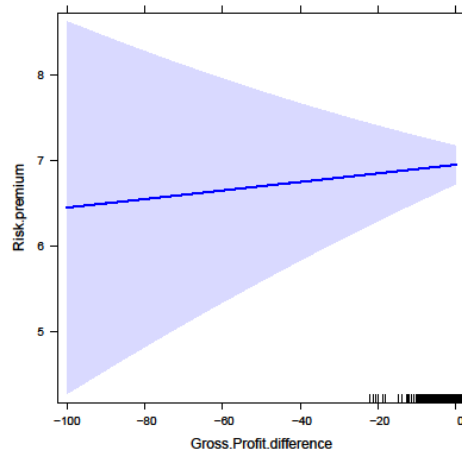


Graph 5-10: EBITDA margin plotted against the implied equity risk premium

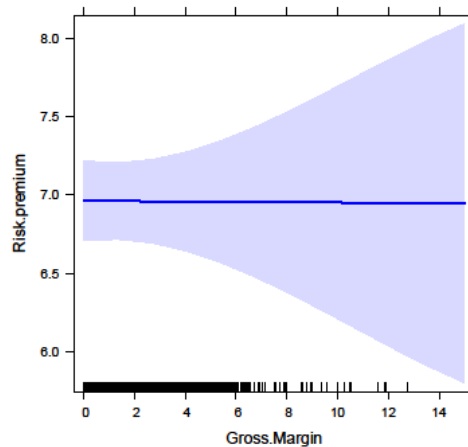


Graph 5-11: EBITDA profit trend plotted against the implied equity risk premium

The gross profit margin and the gross profit trend variables are both statistically insignificant with a p-values above 0.05. The gross profit margin has a p-value of 0.3106, while the gross profit trend has a p-value of 0.6492. Both these variables were excluded from further testing. The high p-values of the variables make interpretation of the coefficients difficult and the value of the interpretation limited. However, the gross profit margin's coefficient is -0.0002. The impact of the variable is thus extremely small, but a higher margin lowers the risk premium, which is logical. The gross profit trend variables coefficient is 0.005, which also has a very small impact, but is positive. This is in line with the EBITDA difference and EBITDA margin indicators.



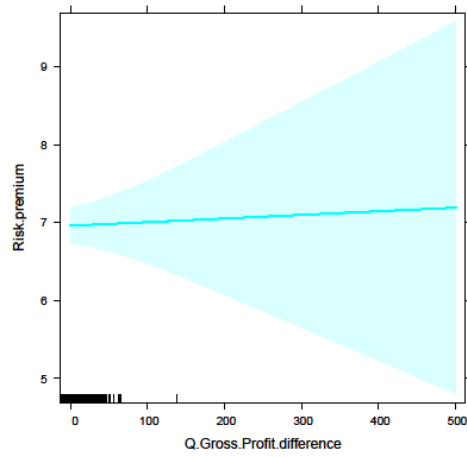
Graph 5-12: Gross profit trend plotted against the implied equity risk premium



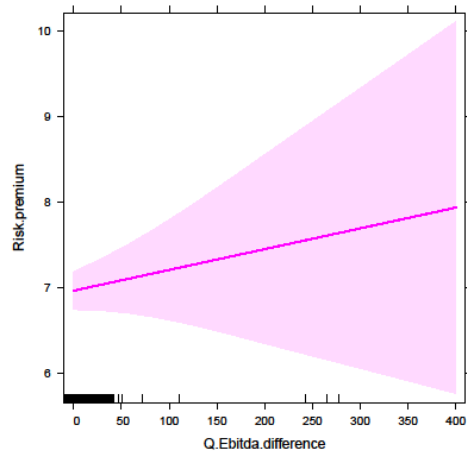
Graph 5-13: Gross profit against the implied equity risk premium

The quarterly gross profit difference and the quarterly EBITDA profit difference (the variables that compare the profit margin of the entity to the average of the profit margin of its industry) both have very high p-values (0.38 and 0.85) and were therefore not included in the final model, as they exceed the 0.05 level. Part of the reason why the statistical significance of these factors may be quite low is the limited number of companies in some industries in some of the quarters within the sample, which constrains the quality of information that can be obtained through the comparison of an entity's profit margins in the quarter to the average of the industry in that quarter.

Gross profit margins can also vary significantly between entities that have the same EBITDA profit margin, which drives the return on equity. Unsurprisingly, therefore, the quarterly gross profit difference proved to be very uninformative, with a very high p-value of 0.85. Both of the coefficients are very small (for gross profit practically nil, and for EBITDA profit 0.002), but positive, which is in line with the profit trend variables.



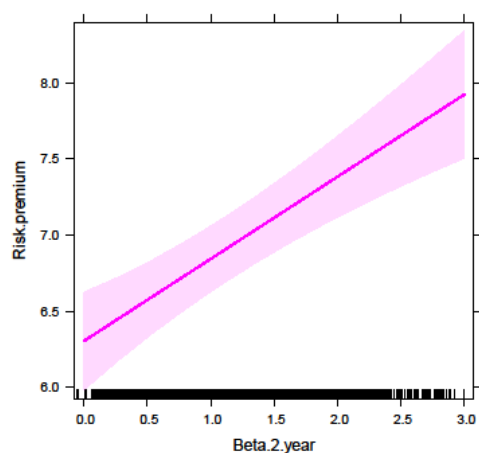
Graph 5-14: Comparative gross profit margin plotted against the implied equity risk premium



Graph 5-15: Comparative EBITDA profit margin plotted against the implied equity risk premium

5.2.8. Levered and unlevered beta

The two-year market beta (levered) has a very low p-value of practically nil, but with a slightly bigger probability distribution than some of the other factors. In line with the CAPM, an increase in beta results in an increase in risk premium. The coefficient is relatively large for this factor (0.540).

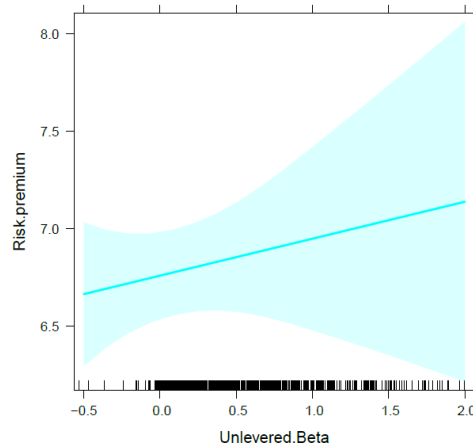


Graph 5-16 Two year beta plotted against the implied equity risk premium

As discussed in Section 2.8.1, both the two-year market beta and unlevered beta, which has been financially and operationally delevered to obtain a product beta, were included in testing. The unlevered beta proved to be less effective than the levered beta as a predictor of the cost of equity premium (p-value of 0.4374), and was therefore not utilised in the remainder of the testing of the model. The coefficient is positive (0.189), which is in line with the market beta and expectations. The reason for this is difficult to assess, but it was noted that the effective tax rates of the company vary significantly not only from period to period, but also from company to company. The US market is further characterised by highly differentiated levels of taxation paid by companies. Firstly, the companies are subject to both federal and state taxes, with rate of taxation varying between states. Furthermore, states woo businesses to settle in that particular state by negotiating significant tax breaks with entities. There is thus not always certainty at the time of reporting of what the tax charge would be, resulting in restatements, which can lead to tax rates greater than 100% in one year, following a negative tax rate in the prior one, or *vice versa*.

Debt-to-equity is another variable included in the deleveraging calculation which can have extreme values, as the equity is eroded by losses. Debt-to-equity values that are positive were included in the testing, as the outlier values were limited and it seemed more sensible to include all positive values, rather than establishing an arbitrary cut off point for what would constitute a reasonable ratio. The distribution of the data have been detailed in the data section.

Three factors thus probably combined to erode the meaningfulness of unlevered betas: (1) the effective tax rate outliers, (2) the debt-to-equity outliers and (3) the number of loss making entities, which resulted in non-meaningful values. An increased number of outliers and a decreased sample sized combined to make the unlevered beta less meaningful in the model than the levered beta.

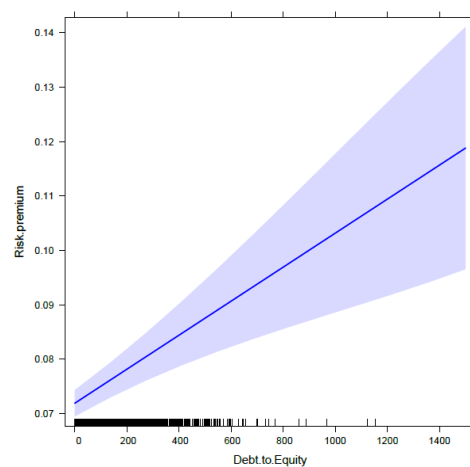


Graph 5-17: Unlevered beta plotted against the implied equity risk premium

5.2.9. Debt-to-equity

The coefficient of the variable is positive (0.002), which implies that a higher debt-to-equity ratio results in a larger equity risk premium. The positive coefficient is in line with the Miller and Modigliani (1961) principle that enterprise value does not vary depending on the capital structure of the entity (except for tax savings), implies that the higher the debt-to-equity level is, the higher the cost of equity is.

The higher p-value also makes sense as the underlying risk profile of the entity also contributes to the implied cost of equity, lowering the statistical significance of the relationship between debt-to-equity and the implied cost of equity.

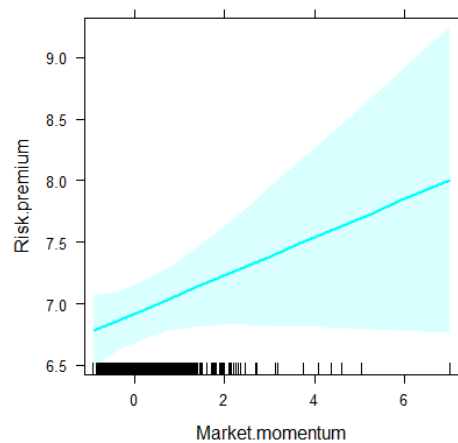


Graph 5-18: Debt to equity ratio plotted against the implied equity risk premium.

Because of the tight probability distribution, where the majority of the values occur, relatively low p-value and very small standard error (0.001), this variable was included in the next step of testing.

5.2.10. Market momentum

The co-efficient of the market momentum predictor is positive (0.1554), indicating that an increase in market price over the last six months results in a higher cost of equity estimate. This is in line with the findings of Fama and French (1998), indicating that a history of good returns will result in higher returns in the short-term. This is however followed by a period of lower returns.

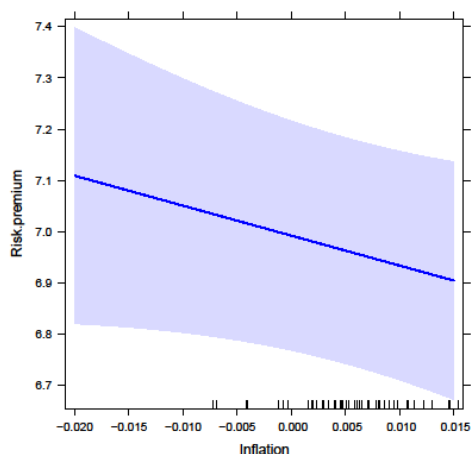


Graph 5-19: Market momentum plotted against the implied equity risk premium

The p-value of this variable is 8.6%, which is a relatively high p-value. However, the standard error is relatively small (0.090), and the probability distribution is relatively tight in the part of the graph where most of the values are situated. This predictor has been included in the final model.

5.2.11. Inflation

The coefficient of inflation in the regression against the implied cost of capital was negative (-0.5845), which is in line with observations of actual returns as discussed in the literature review section. As previously discussed theoretically, inflation should be included in the risk-free rate, and thus its influence should indirectly be incorporated into the final model in this way. Because the p-value of inflation was 0.1214, the standard error is large, and the probability distribution is wide, this factor was excluded from further testing.



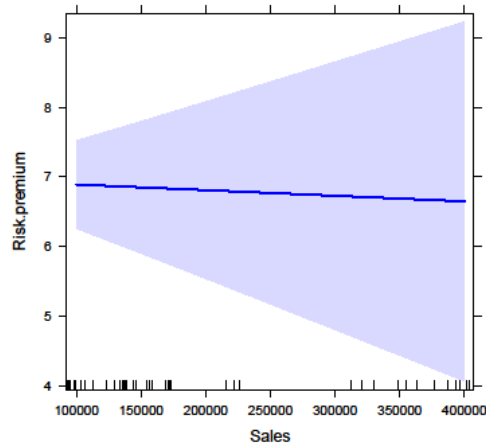
Graph 5-20: Inflation plotted against the risk premium

5.2.12. Company size

Considering the well-known Fama and French (1995) three factor model, which identified size and price-to-book value as the most significant predictors of returns, the low level of significance of the size variable is most surprising.

As discussed under the GDP section, one of the limitations of using returns studies to impute factors that influence cost of equity is that not all factors that influence returns influence what analyst consider when evaluating risk. Size may be one of these factors. The historic differences between cost of equity *ex-ante* and returns *post-ante* may be partially the result of these differences.

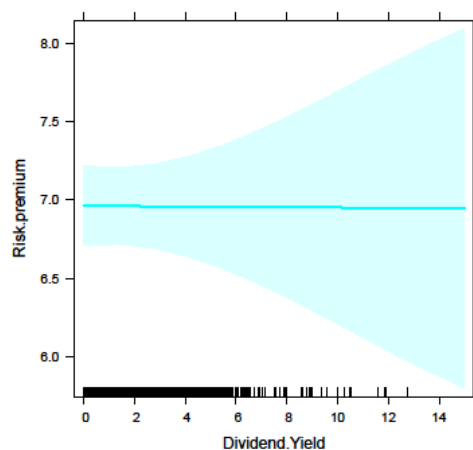
Alternatively, due to the need for IBES forecasts, which implies that the entity is covered by an approved analyst, the companies would all be relatively big. The risk differential between large and very large, may not be enough to make this factor significant.



Graph 5-21: Size plotted against the implied equity risk premium

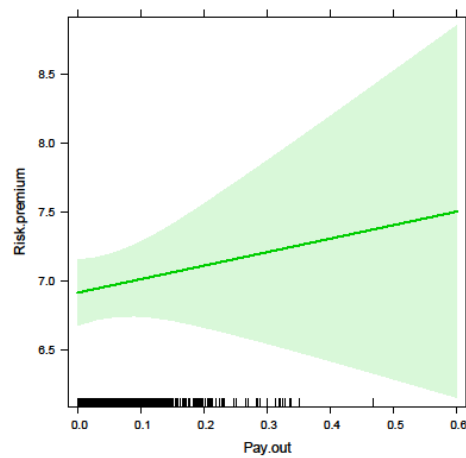
5.2.13. Dividend yield and pay-out ratio

The p-value of the dividend yield variable is very high (0.9797) and the probability distribution quite large. As discussed in the methodology, dividend yield is a ratio that is dependent on the price of a share. This results in a similar issue as that which affects the ratio of price-to-book value, *i.e.* the price is the result of the risk assessment, and thus any ratio that includes price will have a significant relationship to the cost of equity premium. However, this does not mean that dividend yield is a fundamental risk factor that contributes to the assessment of risk. Because of this, the fact that it appears as if it is not significantly related to the estimate of cost of equity made by analysts, despite its relationship to returns, is not illogical. The coefficient is -0.001, which implies a higher yield would result in a lower cost of equity, which is logical, but the statistical insignificance of the variable means the coefficient is not statistically relevant.



Graph 5.22: Dividend yield plotted against the implied equity risk premium

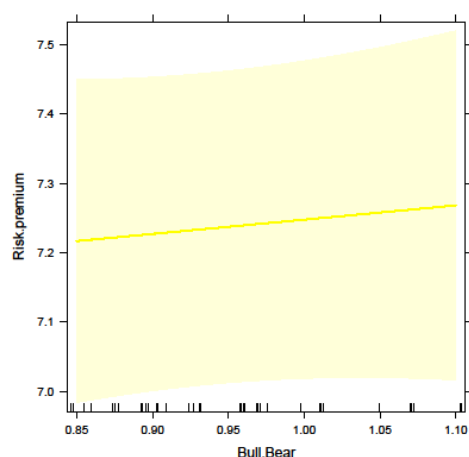
As the dividend yield has a relatively low level of statistical significance, the other suggested variable related to this risk, the pay-out ratio, should also be statistically insignificant in the simple regression. The pay-out ratio's p-value is 0.410, which is indeed statistically insignificant. The argument for using the pay-out ratio instead of dividend yield was that share buybacks are often used to distribute earnings in lieu of dividends (see Grullon & Michaely 2004). It appears that the inclusion of buy-backs has increased the statistical significance of the factor, but it remains too insignificant to be included in the final model. Interestingly, the coefficient of the pay-out ratio was positive (0.189), showing a positive association between implied equity risk premiums and higher pay-out ratios, which is counter-intuitive. However, the high p-value makes any interpretation meaningless.



Graph 5-23: Pay-out ratio plotted against the implied equity risk premium

5.2.14. Bull and bear markets

The coefficient of the bull and bear market variable is positive (0.206), implying that a higher puts-to-call ratio results in a higher implied equity risk premium. This is in line with expectations, as the equity risk premium should become higher the more bearish the market. However, the high p-value (0.56) associated with this factor in the model means that the coefficient is not sufficiently statistically significant for a meaningful interpretation. This is slightly surprising as the evidence is quite strong that a misperception of risk is created by market exuberance during bull cycles and the reverse in bear cycles (Coakley & Fuertes 2006). One possibility for this finding may be that professional analysts are more immune to behavioural phenomena than so-called day traders. Another possibility is that the put-call ratio used here may not be the best indicator for this risk, as a premium or discount to the cost of equity may only apply when the market starts gaining significant momentum in its bull or bear cycle, and not when it is somewhere between the two extremes. Given its low statistical significance, this variable was excluded in further testing.



Graph 5-24: The bull and bear market indicator plotted against the implied equity risk premium

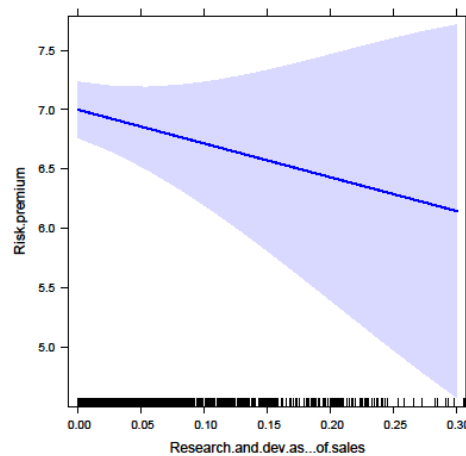
5.2.15. Research and development costs

The coefficient for research and development costs, expressed as a percentage of sales, is -2.8. This is not as expected, as according to the results of a study by Chambers, Jennings and Thompson (2002), a higher proportion of research and development cost relative to sales results in more earnings volatility and excess returns. The impact of research and development could possibly be accounted for in future cash flows rather than in the cost of equity, which would explain the lack of a significant relationship between it and the cost of equity. However, with a p-value of 0.30, this variable was found to have very low statistical significance in the regression.

Theoretically, the actual return of an asset is made up of the expected risk-related returns at the beginning of the period (the cost of equity), cash flow shocks, and discount rate shocks (see Bernanke & Kuttner 2005). If the additional cash flow that research and development gives rise to is systematically

underestimated by market participants, this could also result in a relationship with returns, but not with cost of equity. This, however, implies inefficiency in the market.

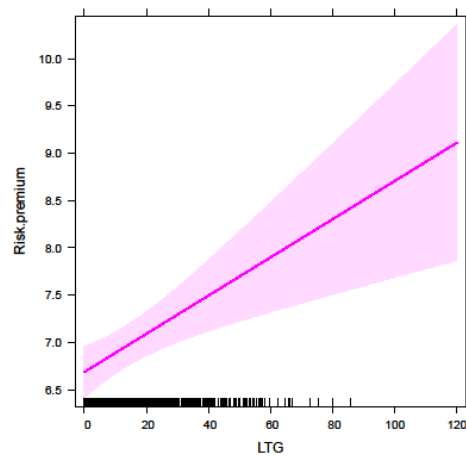
The other possible explanation for the above finding is that the research and development costs are much more relevant in some industries than in others, which can be confirmed by the fact that only about 25% of the company quarters in the data were associated with non-zero research and development costs. A possible way to eliminate this difference is to make industry a category in the mixed effects model. It may also then be possible to build in sector specific risks, such as research and development costs and commodity risk.



Graph 5-25: R&D cost as a % of sales plotted against the implied equity risk premium

5.2.16. Long term growth

The coefficient of long-term growth is 0.020, which implies an increase of long term growth results in an increase in the equity risk premium. This coefficient also proved to be statistically very significant, with a p-value of 0.0006. As noted in the literature section, the inclusion of long term growth rested largely on the fact that analysts overestimate earnings growth systematically when companies have high future growth, and the overstatement gets worse the higher the future growth is (see Gebhardt *et al.* 2001). As analysts are unlikely to focus on their own bias, this may simply be the result of high growth of early stage businesses.



Graph 5-26: Long term growth plotted against the implied equity risk premium

5.3. Akaike information criterion

After eliminating those variables which proved to be individually statistically insignificant (by evaluating the numerical and graphical summaries of the data), the next step in the process of constructing the model was to eliminate variables which contribute too much to the complexity of the model, without increasing the quality of the information the model produces. This was done by means of a stepwise elimination process using the Akaike Information Criterion. The value added by each variable was not directly related to the individual p-values, as the information criterion measures how much more additional information the variable brings to the model given the information contributed by the other variables. Three variables were eliminated, and are highlighted in italics in the table below, showing all the variables tested in the stepwise elimination.

Table 5-2: Predictors eliminated during AIC stepwise elimination

Predictor	Coefficient	Std Error	p-value
Risk free rate	-1.022	0.033	0.0000
<i>Forecast GDP growth</i>	<i>4.076</i>	<i>0.163</i>	<i>0.0000</i>
<i>M3-to-GDP</i>	<i>21.58</i>	<i>1.11</i>	<i>0.0000</i>
2-year volatility	0.064	0.004	0.0000
Return on equity	-0.025	0.004	0.0000
Net earnings negative	-1.100	0.167	0.0000
2-year beta	0.540	0.102	0.0000
Long-term growth	0.020	0.006	0.0006
<i>GDP growth</i>	<i>0.111</i>	<i>0.041</i>	<i>0.0067</i>
<i>EBITDA margin/Gross margin</i>	<i>-0.488</i>	<i>0.203</i>	<i>0.0160</i>
<i>EBITDA difference</i>	<i>0.012</i>	<i>0.006</i>	<i>0.0266</i>
Debt-to-equity	0.002	0.001	0.0566
Market momentum	0.1554	0.090	0.0856

The M3-to-GDP ratio was eliminated as a variable during the stepwise AIC elimination. Considering its high significance and small probability distribution, this is surprising, but the risk free rate and market momentum variables remained in the model, possibly conveying much of the information conveyed by the M3-to GDP ratio.

The EBITDA margin to gross profit margin variable was also eliminated. As return on equity implicitly contains the operating leverage and financial leverage, the additional information supplied by the variable may not have been enough given the complexity it adds to the model.

The EBITDA difference variable was eliminated. This variable is a variable that describes the trend of the EBITDA margin and the inclusion of the market momentum variable may capture a lot of the same trend.

The forecast GDP growth and GDP growth were then eliminated as variables. However, interest rates have a strong relationship to forecast GDP growth, thus it is possible that the risk free rate supplies the model with similar information as the GDP growth forecast and current GDP growth.

5.4. Model

The final model, presented below, excludes the variable effects of each company. Therefore, to recalculate the risk premium estimated by the model for a specific company, the variable effect attributable to the specific company should be added to the fixed effects detailed below. The t-values and p-values in the table below refer to the combined mode – *i.e.* what the values are in relation to the final values estimated by the model.

The final model includes four types of variables: one macro-economic variables (the risk-free rate); one margin related variables (a variable indicating whether the net margin is positive or negative) and two leverage/return related variable (the return on equity, which is a combination of operational and financial leverage and asset turnover (asset leverage)and the debt to equity variable), two growth/momentum variables (long term growth and market momentum) and finally two volatility measures - the two year beta and two year volatility, the one being a measure against the market; and the other an absolute measure of volatility.

The use of the Akaike Information Criteria to limit variables that contain the same information thus resulted in the variables in the final model being well spread between all the categories and very few having any correlations. The correlations below are not the same as the raw correlations, as the maximum likelihood function will result in different vectors from the least squares regression. The highest correlation is between the two-year volatility and the two-year beta, which is still low.

Table 5-3: Within model correlations between final predictors

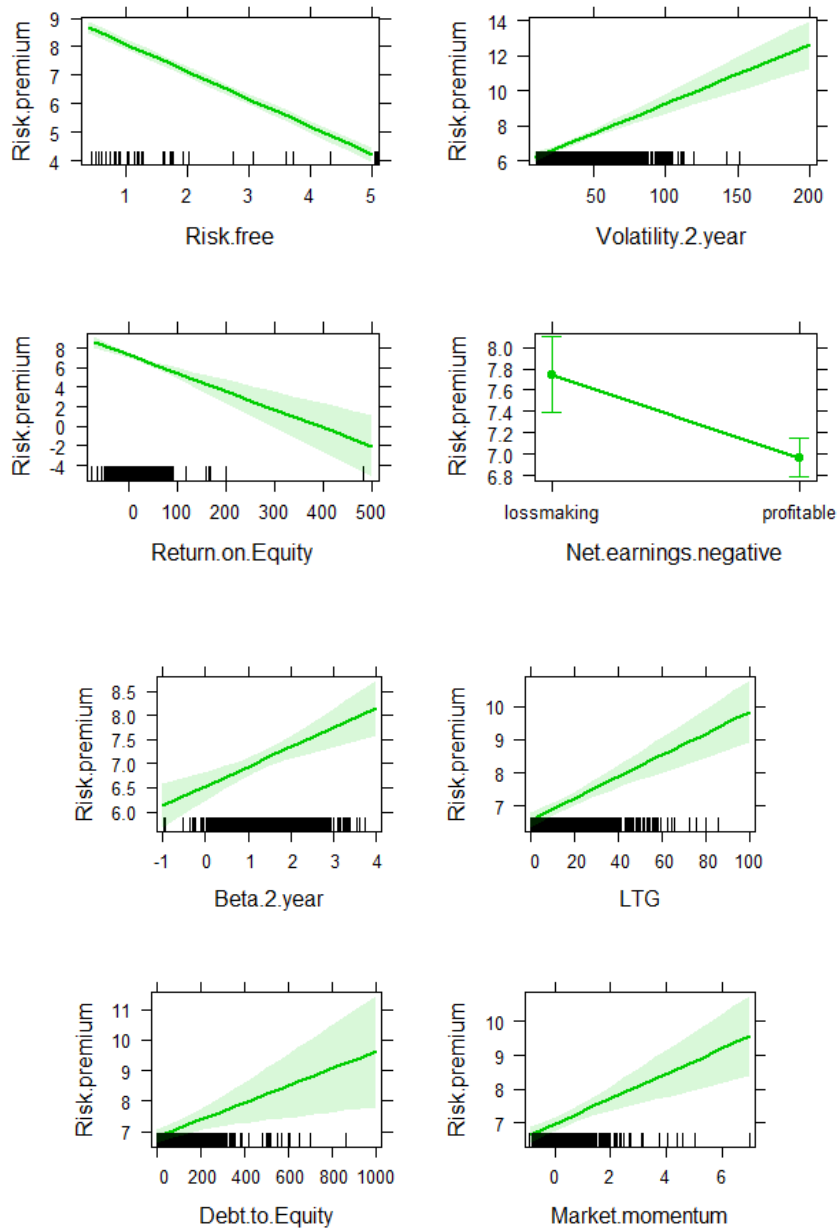
	Risk free rate	Two-year volatility	Return on equity	Net earnings profitable	Two-year beta	Long term company growth	Market momentum	Debt to equity
Risk free rate								
Two-year volatility	0.20							
Return on equity	-0.03	0.01						
Net earnings profitable	0.01	0.10	-0.30					
Two-year beta	-0.10	-0.35	-0.04	-0.01				
Long term company growth	-0.05	-0.08	-0.02	-0.02	-0.04			
Market momentum	0.06	0.18	-0.12	0.03	-0.03	-0.01		
Debt to equity	0.02	0.05	-0.02	0.07	-0.03	0.02	-0.02	

Table 5-4: The coefficients and statistical characteristics of the variables in the final model.

	Estimate	95% CI	p-Value
Intercept	7.47	(6.89 to 8.05)	< 0.0001
Risk free rate	-0.97	(-1.03 to -0.91)	< 0.0001
Volatility 2 year	0.03	(0.03 to 0.04)	< 0.0001
Return on equity	-0.02	(-0.03 to -0.01)	< 0.0001
Net earnings profitable	-0.78	(-1.10 to -0.45)	< 0.0001
Beta 2 year	0.40	(0.21 to 0.60)	< 0.0001
Long term growth	0.03	(0.02 to 0.04)	< 0.0001
Market momentum	0.37	(0.20 to 0.54)	< 0.0001
Debt to equity	0.28	(0.09 to 0.47)	0.0046

The graphs below show the relationship between the factors in the model and the implied equity risk premium, as well as the confidence distributions around the estimates. These may differ from the individual factor graphs, as the maximum likelihood function gives a different result than the individual models.

Graph 5-27-5-34 Relationship between final model variables and the equity risk premium



Monetary policy

The high t-value and low p-value of the risk free rate variable shows that it is very significantly related to the equity risk premium, and the probability distribution is also very narrow. The coefficient is negative (-0.97). It is one of the most influential variables in the model. This is in line with recent record high prices and returns for equity markets during quantitative easing. A one percent increase in the risk-free rate results in almost a 1% change in the equity risk premium.

Market momentum

1% higher returns in the last six months result in a 0.37% higher implied risk premium. High returns are thus related to higher cost of equity. Its significantly higher p-value supports the inclusion of the variable in the model, as it brings highly relevant information with a relatively high co-efficient.

Debt to equity

The debt to equity variable has a positive co-efficient of 0.28. The positive co-efficient indicates that a higher debt to equity gearing, which should represent a higher risk, results in a higher cost of equity premium. The relatively low co-efficient. The variable has the lowest p-value, but the value is still below 5% and the AIC stepwise elimination ensures that the addition of this variable improves the quality of the model.

Profit- or loss-making status of the company

The binary variable that distinguishes between profit and loss-making companies is highly significant, with a p-value of <0.0001 . It also has a high coefficient, affording it a strong association with the implied risk premium. Thus, if an entity is profit making, the implied equity risk premium is lowered by 0.8%.

Return on equity

According to the Du Pont model the return on equity is a combination of the net margin, debt-to-equity and asset utilisation of a company. As ROE incorporates so much information, it is not surprising that it is included in a parsimonious model. This information appears to be highly correlated to the implied risk premium in the context of the model, with a p-value of < 0.0001 . However, as with a number of the variables included in the model, the unique information contributed by this variable has a small impact. Thus, a 10% change in return on equity will result in a 2% change in the implied equity risk premium.

Beta

Beta was found to be related to the implied equity risk premium, but in line with a number of studies performed in the past (for example, see Brav, Lehavy & Michaely 2005), beta is a statistically significant (with a p-value of <0.0001) component of the equity risk, but not the only indicator of risk and determinant of the equity risk premium. The coefficient of 0.40 also shows the relatively low impact of this variable.

Volatility

The absolute volatility remained highly correlated with the equity risk premium, with a p-value of < 0.0001 . The coefficient of 0.03 is, however, relatively small in the context of the model.

Long term growth

The p-value of the long-term growth variable when combined with the other variables within the model declined from 0.0006 to <0.0001, when compared to the single regression against the implied equity risk premium. This indicates that the unique information this variable contributes after the macro-economic growth has been taken into account, has a very high level of statistical significance in explaining the variation of the implied equity risk premium. The coefficient is, however, small at 0.03.

5.5. Final model

Below is the final model.

$$\begin{aligned} \text{Risk premium} = & 7.47 \pm 0.97 * (\text{Risk free rate}) + 0.40 * (\text{2 year beta}) - 0.78 * \\ & (\text{Company is profitable}) - 0.02 * (\text{Return on equity}) + 0.03 * (\text{2 year volatility}) + 0.03 * \\ & (\text{Long term growth}) + 0.37 * (\text{Market momentum}) + 0.28(\text{Debt to equity}) \end{aligned}$$

Eq. 5.2

5.5.1. Time-series correlations

As noted in the methodology section, it was assumed that each company will produce similar (correlated) outcomes at adjacent time points. An autoregressive-moving average time series incorporating only the quarter immediately before and immediately after the observation was calculated. This time-series correlation is 69.7%, which is high as expected, and is the reason why this correlation needed to be specified in the model.

5.5.2. Error distribution

If a model is well specified and robust, the error terms will be normally distributed around a median of nil. In terms of data distribution, this is the only requirement to ensure a robust mixed effects model. The median of the errors in the table below is materially nil. The distribution is also materially symmetrical between Quartile 1 and Quartile 3.

The maximum value is significantly further from the median than the minimum. This is expected as the lower range of premiums on the cost of equity is bounded, as the cost of equity cannot be below the risk-free rate. However, the equity risk premium is not bounded on the positive side.

Table 5-5: Error distributions

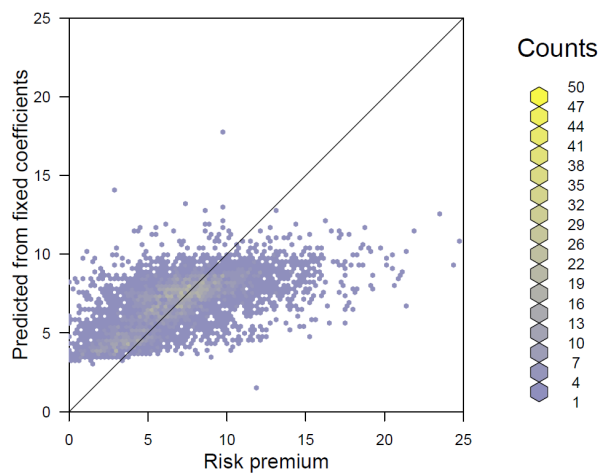
Standardized Within-Group Residuals:				
Min	Q1	Med	Q3	Max
-4.19	-0.45	-0.04	0.40	5.11

5.6. Comparison of model predictions to actual values

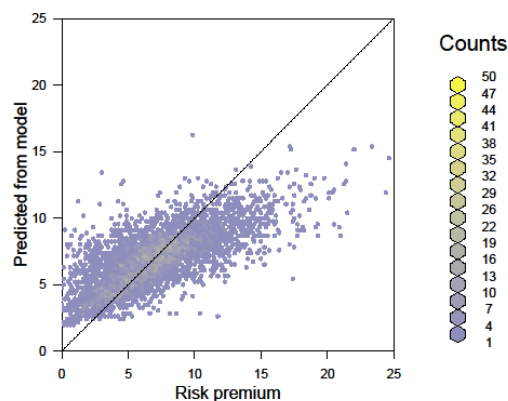
To show the model's ability to predict equity risk premiums, two separate graphs are shown below. The first shows the risk premiums predicted, within sample, by using the fixed effects only, *i.e.* ignoring the random effects that was calculated for each company, compared to the actual risk premiums.

The second graph shows the equity risk premiums predicted by the model, within sample, by using both the fixed effects and the company specific random effects.

The second would naturally show much more predictive power. The coefficient of determination is the squared correlation, expressed as percentage. In this case, 39,7% of the variation in risk premium can be explained by the estimated risk premium from the fixed effects only. The percentage increases to 62.4% when the random effects are included. If all the statistically significant predictors were left in the model, this percentage would be higher, but the model is much more complex and more likely to have correlation errors.



Graph 5-35: Actual risk premium compared to predicted premiums using only fixed effects



Graph 5-36: Actual risk premium compared to predicted premiums using fixed and variable effects

Table 5-6: The model's correlation and 95% confidence interval:

Pair		Correlation	95% CI		Coefficient of determination with 95% CI		
Predicted	Fixed only	0.63	0.62	0.65	40%	38%	42%
Risk premium	Predicted	0.79	0.78	0.80	62%	60%	63%
Risk premium	Fixed only	0.88	0.88	0.89	78%	77%	79%

The hypothesis that there is a significant non-zero correlation was tested, and the p-value was less than 0.0001 for all three pairs. Thus, the model produces estimates which are highly correlated with the actual implied equity risk premium.

Chapter 6: Conclusion

Analysts' ability to implicitly make a judgement on how risky that asset is, and what level of return is required to accept that level of risk, contributes significantly to the efficiency of the market. In a perfectly efficient market, an *ex-post* analysis of which factors drive return would allow analysts to estimate risk very precisely. However, the fact that markets are less than efficient and that not all relevant information is known at the date that the cost of equity is estimated, results in difficulties when trying to infer *ex-ante* cost of equity risk assessment from *ex-post* returns analysis. Thus, the assessment of risk in an equity investment remains the skilled judgement of analysts, which makes it practically valuable to understand what risk factors are significantly associated with the implicit judgement of risk. A parsimonious model of the implicit cost of equity estimated by market analysts allows other investment and valuation professionals to compare their estimates to the output of the model, and to have a better insight into what risk factors to consider.

This study, using the NYSE as focus, attempted to find which of the factors that, based on either empirical or theoretical grounds, are thought to affect estimates of the *ex-ante* cost of equity and/or *ex-post* returns, have significant relationships with the cost of equity premium estimates implied by analysts' forecasts. Although the study does not directly address the question of which factors are considered by analysts, which would have required a survey-type approach, it indirectly sheds light on which factors analysts possibly take into account when estimating the cost of equity premium, by testing the strength of the factors' association with equity risk premiums.

The study has three inherent limitations. The first is the use of the Easton method to calculate implied cost of equity. Although this method has relatively limited data requirements and the implied cost of equity estimated by this method has been shown to be strongly associated with other known indicators of risk, the fact that a significant difference between short and medium-term growth results in a misstated implied cost of equity has limited the outcome of this study. If sufficient data is available, this weakness can possibly in future be addressed using the Fitzgerald (2013) method as described in Section 2.2, but the efficacy and suitability of this method in the context of individual companies is not known, as to date it has only been tested in the context of index returns.

The second inherent limitation is the inability to identify all possible factors that are considered by analysts, and obtaining information for these. For instance, the use of corporate governance ratings could add information to the model. The large influence random effects have on the predictive power of the model, is an indicator that some risk factors are still unidentified.

The third limitation is the assumption that risk evaluation by analysts is both universal and consistent over time. Considering market inefficiencies and behavioural finance, this would be unlikely. Within these limitations, the findings of this study are as follows:

The first finding is that the risk free rate is strongly associated with the size of the implied equity risk premium. A large negative coefficient implies that the lower the risk free rate, the higher the equity risk premium. The research of Bernanke (2005) similarly finds that decreases in interest rates, result in increases in the excess return (equity premium). Thus, monetary policy does not just influence the risk-free rate, but also has a very significant influence on the equity risk premium.

The second notable finding is the lack of margin variables in the final model. Margins are, however, probably subsumed into the ROE variable. If ROE is high, the equity risk premium is reduced. If the market was highly efficient, higher ROE should indicate higher risk and higher cost of equity, but this does not appear to be the way in which these variables are interpreted by analysts. The fact that reliance is not placed on the CAPM principles is possibly not as surprising, considering the wide acceptance of the APT model, but the weight that this variable has is surprising.

The final finding is that there appears to be some differences between the factors considered by analysts when evaluating risk and the factors that have been found by researchers to be associated with returns, as was discussed in the literature chapter of this document.

In a 100% efficient market, the factors that influence return should exactly mirror those that influence cost of equity, except for new information that changes cash flow expectations or the risk profile of the cash flows. This does not appear to be the case as factors which have historically been shown to influence returns are not necessarily considered with the same significance in cost of equity estimates. It would be interesting to compare the influence of the same factors on the returns (taking into account changes in expectations) of the same sample of company trading quarters. Higher historical return on equity also lowers the implied equity risk premium. Thus, high historical returns are not mirrored in forward looking risk estimates.

The implication of these findings is that the efficient market theory does not appear to be relied upon by analysts when making risk assessments. This is possibly not surprising, as the role of an analyst is to some extent dependent on the market not being efficient.

6.1. Further research opportunities

6.1.1. Incorporating more behavioural finance factors

A form of behavioural finance is “herding”. Analysts are similarly susceptible to this behaviour. In Welch (2000) the researcher examined both the reaction to recent revisions and the current prevailing consensus of recommendations. He finds that revisions of recommendations by an analyst will statistically significantly influence the likelihood of the next two analysts revising their recommendations.

What herding could possibly support is the idea that the value information obtained from an analyst report that changes recommendation against the consensus is higher than one that follows the consensus. Instead of using the IBES consensus median forecasts, the cost of equity can be calculated using the forecast produced by the analyst that issued the change recommendation.

6.1.2. Improving the application of the adaptive option theory

The application of the adaptive option theory in this paper is a very basic application, and can be built on in a number of ways. The original Burgstahler and Dichev (1997) study created a model that calculated the market value of equity by using the value of the cash flows and the value of the option attached to the adaptive option.

The model is then expressed as follows:

$$MV(E, AV) = E[\max(cE, AV)]f(E, AV)dAVdE \quad \text{Eq. 6.1}$$

Where:

MV = market value of equity

E = Expected future earnings using the firm's current business technology

c = Capitalisation factor for earnings

AV = Adaptive value

The problem with using this information to improve the accuracy of the estimate, is that either the adaptive value or the capitalisation factor (cost of equity and method of estimating implied cost of equity) needs to be known in order to solve the equation.

The adaptive value can be estimated by taking the salvage value as calculated by Berger (1995), but the research would need to be repeated as it was done 20 years ago and with changes in fair value accounting and the rise of technology shares, the results could be significantly different. It may also be possible to follow an iterative process whereby the cut-off point in terms of price to book value is varied to maximise the explanatory power of the cost of equity estimate.

6.2. Using *post-ante* returns and comparing the weight of risk factors

Lastly, a further research suggestion is to compare the weightings and factors that are significantly related to the estimated cost of equity with the weightings and factors of *post-ante* returns earned. The factors and weightings of the cost of equity (the expected return given a certain risk profile) and actual returns (made up of the expected return as well as any unexpected changes in the risk profile and any unexpected changes in the forecast cash flow) should differ, but should largely overlap. Thus, in a fully efficient market these two values should be close to identical when corrected for surprises. The best comparison would be one that controls for unexpected events (changes in risk and cash flow projections) in the forecast period. The differences identified, may allow for a profitable trading strategy.

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Annexure A: Histograms of candidate data

