Measuring risk for cost of capital: The downside beta approach

Received (in revised form): 14th December, 2011

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Abstract The cost of capital is partly determined by a cost of equity which centres on the concepts of the 'capital asset pricing model' (CAPM) and, ultimately, beta. Beta traditionally assumes that risks are linear, but according to findings from behavioural finance, they are not; especially downside risks which are not reflected correctly in the traditional CAPM beta. In this paper, the authors discuss the down-market beta and its growing importance as an alternative to the traditional CAPM beta in computing cost of capital and making capital budgeting and valuation decisions. In addition, they demonstrate that equity rates based on CAPM betas can be quite different from those based on down-market beta, leading to significantly different value estimates. In their sample computations, valuations based on CAPM betas would lead to excessive value when there was greater downside risk and lower values when there was less downside risk.

KEYWORDS: valuation, downside risk, WACC, capital budgeting, dual beta

INTRODUCTION

By and large, behavioural finance studies have consistently found that economic decision-makers try to avoid 'pain', including that of disastrous economic loss. Business valuation analysts, corporate decision-makers, and investors try to include measures of risk in their calculations to help account for the possibility that a project might fail, a loan might not be repaid, or that an investment could lose value. On the other hand, these same analysts, investors, and decision-makers hope that their projects succeed beyond their expectations, that all their loans are repaid on schedule, and that various investments produce spectacular profits.

In a sense, both unexpectedly low profits and unexpectedly high profits are 'risk'. But the risk of losing money is generally a bad thing, while the risk of making extra profits is generally a good thing.

The Capital Asset Pricing Model (CAPM) estimate of beta, often used as a component of investment risk, is based on assumptions of symmetry such that the risk of losing money or the risk of making extra profits are viewed as equivalent.

This paper discusses the dual-beta model, which separately accounts for these two types of risk and provides an empirical analysis of how confusing the two types of risk can generate markedly different estimates of required return and, for the business valuation analyst, quite different computations of value.

The authors begin with a discussion of the importance of beta in computing the cost of capital and making capital budgeting and valuation decisions, and then discuss historically significant, but often forgotten, research that highlights the importance of separately assessing the risk of profits and losses. They then discuss the growing importance of the dual-beta model as an alternative. In the empirical section of this paper, the authors compute the equity component of the cost of capital using traditional beta and also a down-market beta estimated using a dual-beta model. They find that traditional beta underestimates equity risk about half the time, compared with the dual-beta estimate and that this can translate into large differences in present value computations. The paper concludes with several suggestions for practitioners.

CONTEXT AND LITERATURE

Investors, business valuation analysts, and corporate decision-makers are frequently faced with the problem of placing a current value on a future payment stream. Investors may be concerned with valuing a stock or mutual fund, corporate decision-makers may be concerned with evaluating a potential acquisition or new product line, and business valuation analysts focus on the current value of an ownership interest in businesses which may range from small personal service firms to large multinationals. In each case, however, there is usually a reduction of expected cash flows to present value.

CAPM in corporate finance

The challenge of forecasting cash flows is not the topic of this paper; rather, it focuses on the discount rate used to compute the present value of equity. In typical corporate finance and investment textbooks, the determination of this discount rate begins with the CAPM equation:

$$\left(r_j - r_f\right)_t = \alpha_j + \beta_j\left(r_m - r_f\right)_t + \varepsilon_t \tag{1}$$

in which the excess return (the risk premium) for stock j is linearly related to the excess return (the risk premium) of the market index. The slope of this line, β_j, or simply beta, is perhaps the most commonly used measure of equity risk. The intercept, α_j, is known as 'Treynor's alpha' and represents the sustained economic profit, if any, associated with the investment. In most cases, α_j is assumed to be zero.

With slight modification to (1), the more common equation for the equity discount rate is obtained:

$$r_{jt} = r_{ft} + \beta_j\left(r_m - r_f\right)_t + \varepsilon_t. \tag{2}$$

The riskless rate has added to it a systematic risk component, obtained by multiplying an equity risk premium by an estimate of beta. If there is any sustained economic profit, then one could add an estimate of additional alpha (α_j), if any. In such a case, the resulting equation would be:

$$r_{jt} = r_{ft} + \alpha_j + \beta_j(r_m - r_f)_t + \varepsilon_t. \qquad (2')$$

The CAPM has been found to be widely used in business settings for establishing a cost of capital for discounting purposes. Graham and Harvey[1] found that 73.5 per cent of financial executives they surveyed 'always or almost always use the CAPM' for estimating the cost of capital. Bruner *et al.*[2] found that 80 per cent of financial advisers they surveyed rely on the CAPM; they also found that at least 85 per cent of corporate representatives, and at least 90 per cent of financial planners they surveyed, view the α term as not a part of the CAPM calculation.

Adjustments to the CAPM

With a few exceptions, business valuation texts tend to disagree with the above consensus and routinely discuss firm-specific risk premiums and other added factors that are analogous to the term. Pratt *et al.*[3] are typical in that they present the simple CAPM and then identify a number of additional risk factors, premiums, and discounts that are used to manually adjust the CAPM estimate to obtain discount rates. Hitchner[4] discusses various general premiums to be added to the CAPM and states 'the final component of the discount rate is the risk specific to the company being valued and/or the industry in which it operates'. McKinsey & Company[5] proceeds straight from the CAPM to the weighted average cost of capital (WACC) estimate without other premiums, discounts, or firm-specific adjustments. At the other extreme, Trugman[6] discusses the 'build up method', essentially adding risk premiums to a version of the CAPM in which β_j is assumed to equal 1, as well as the CAPM with estimated coefficients and no additional terms. He then discusses (2) as 'CAPM for the closely held business' in which α_j is identified as unsystematic risk, a specific company risk adjustment, or perhaps a size adjustment.

However, whether one is looking at college texts or professional valuation references, the preponderance that were reviewed are planted firmly on a behavioural theory in which rational economic agents have preferences over the expected outcomes of their investments and also the variance of those outcomes. This is the standard 'modern portfolio theory' approach closely associated with Markowitz[7,8] and Sharpe[9].

Downside risk approach

At about the same time that Markowitz was developing mean-variance theory, an alternative was being developed, which has been termed 'safety first'. Rather than on the entire distribution of possible returns, focus was placed on the probability of disaster or downside loss. First modelled by Roy,[10,11] the 'safety first' criterion has led to an alternative approach to viewing risk and return and, consequently, discount rates and capital budgeting.[12] This alternative approach is the 'mean-semivariance' or 'downside risk' approach, which defines risk in terms of the distribution of possible unfavourable outcomes, instead of all possible outcomes. Semi-variance is the variance determined by the lower portion of a statistical distribution; in the 'safety first' paradigm, it is a measure of the spread of outcomes below a critical value. The square root of the semi-variance is the semideviation, just as the standard deviation is the square root of variance. Curiously, Markowitz also discussed a mean-semivariance approach, but chose to use mean-variance for computational reasons even though he grants that 'semi-variance is the more plausible measure of risk'.[13]

In 1970, focus groups of executives in eight industries exploring their definitions of risk found 'the executives' emphasis on downside risk indicates that their concept of risk is better described by semi-variance than by ordinary variance'.[14] In a companion paper Mao analysed a framework for making capital budgeting decisions based on specific probabilities of outcomes, but concludes that in practical applications 'to work out such a distribution will be very difficult indeed'.[15]

Soon after, a theoretical analysis of capital market values by Hogan and Warren[16] demonstrated that 'the fundamental structure of the "capital-asset pricing model is retained when standard semideviation is substituted for standard deviation to measure portfolio risk." ' This suggested that the computationally simpler CAPM type models could be revised to focus on downside risk rather than both upside and downside as measured by the variance. Presumably such revised models would better reflect the view of risk actually held by people.

Non-normal distribution

Development of capital budgeting, based on downside risk measures, slowed down following the 1979 demonstration by Nantell and Price: when the forecasted cash flows of the asset being valued and the returns from the overall market are related, following a bivariate normal distribution, then the equilibrium rates of return (discount rates) computed from the traditional CAPM or from the form using semideviation are equal and therefore there is little need to use semideviation methods.[17]

Intuitively, the normal distributions have a strong symmetry, so that if one knows the left-hand shape of the statistical distribution, one also knows the right-hand shape; the lower semideviation would be half the standard deviation and optimal behaviour with respect to one would be the same as the other. Unfortunately, asset returns series are not normally distributed but follow more complicated statistical distributions such that the probability of loss is not symmetric with the probability of gain.[18]

The investment performance literature actively discussed the impact of non-normality and downside risk, as in Sortino and Price;[19] and, in a series of papers, Estrada[20–22] developed applications of the downside CAPM (D-CAPM) and showed how that measure provides superior estimates of the cost of equity for purposes of present value computations of cash flows in developing markets.

Equity rates reflecting downside risk have also been tested using data from developed countries. An application to US stocks was performed by Post and Van Vliet,[23] who found that the model 'strongly outperforms the traditional ...

CAPM in terms of its ability to explain the cross-section of US stock returns.' The D-CAPM model was successfully applied to stocks on the London Stock Exchange and the Paris Stock Exchange in Artavanis *et al*.[24]

There is a conundrum. A wide range of academic research has confirmed that while the CAPM treats positive surprises (windfalls) and negative surprises (disasters) as equivalent risks, investors and business owners do not. The various measurements of alternative asset pricing models, based on downside risk, have generally proven superior to the symmetric CAPM in terms of their ability to explain the differences in equity returns across assets.[25] Theoretically the downside models provide a 'more plausible' approach to risk.[26] Statistically, they explain the differences in stock returns better than the traditional CAPM. But does it really matter to a business valuation analyst, corporate decision-maker, or investor which model provides the estimated beta, so long as one is provided? The authors provide an initial answer in the next section of this paper, focusing exclusively on down-market beta, in line with business owners' concern over downside risk.

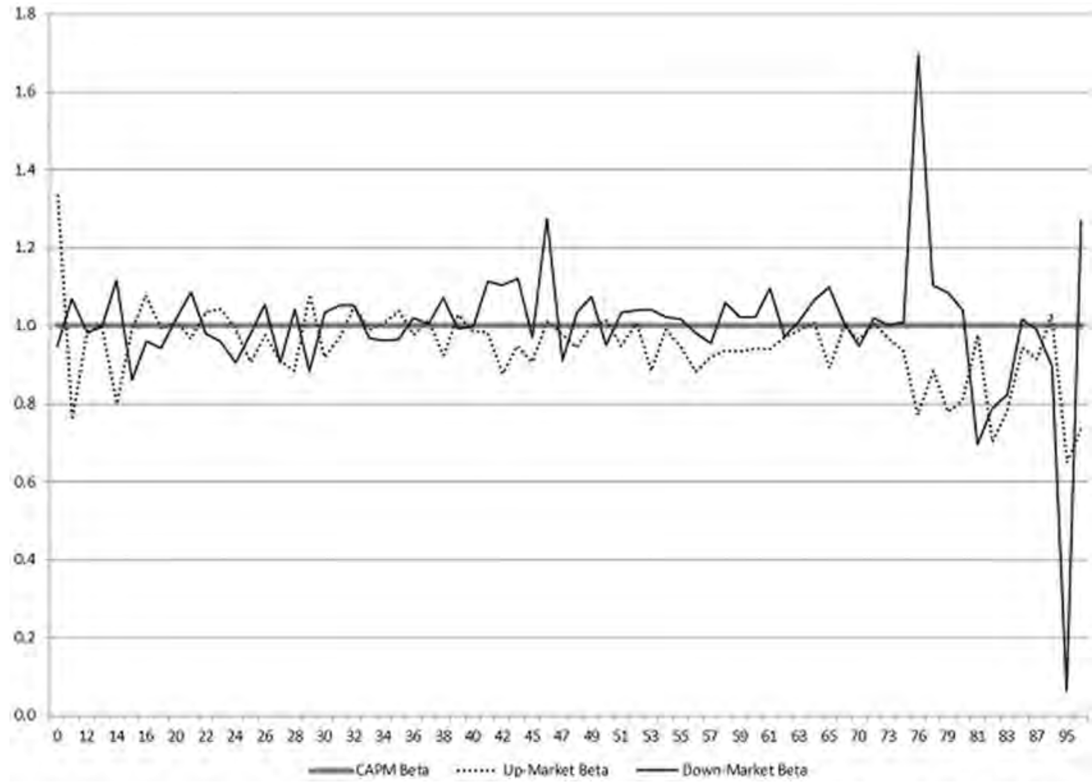
THE DUAL-BETA MODEL AND THE DATA

The version of dual-beta model addressed in this paper is more precisely an 'up-market/down-market' model in which separate model parameters are estimated for times when the market benchmark goes up and for when it goes down, as shown in equation (3).

$$(r_j - r_f)_t = \alpha_j^+ D + \beta_j^+ (r_m^+ - r_f)_t D + \alpha_j^- (1 - D) + \beta_j^- (r_m^- - r_f)_t (1 - D) + \varepsilon_t. \quad (3)$$

In this equation, the dependent variable is the asset return in excess of the riskless rate, the two intercepts are α_j^+ and α_j^-, for the 'up-market' and 'down-market' regime respectively, and $\beta_j^+(r_m^+ - r_f)_t$ is the product of the 'up-market beta' and the up-market excess return, and similarly $\beta_j^-(r_m^- - r_f)_t$ is the product of the 'down-market beta' and the down-market excess return. D is a dummy variable, which takes the value of 1 when the market index daily return is non-negative, and zero otherwise. The final term, ε_t, reflects the idiosyncratic information not proportional to either the up-market or down-market excess returns. For this paper, 'down-market' days are when the market went down and 'up-market' days are the others. Parameter estimates for β_j, β_j^+, and β_j^- were provided by MacroRisk Analytics, a commercial provider of these estimates, from their database as of 29th October, 2010 for 4,500 common stocks traded on the NYSE, NASDAQ, and AMEX. A graph showing average up-market and down-market beta values per unit of average CAPM beta, by 2-digit SIC code, is provided in Figure 1 — this is to illustrate that seldom would up- and down-market betas equal CAPM beta. Indeed, the authors found that they were lower than those based on the down-market beta about 48 per cent of the time. The down-market equity rates are an average of 7.4 per cent higher than the CAPM equity rates. For those cases where the down-market beta is greater than the CAPM beta, the down-market equity rates are an average of 23.9 per cent higher.

The next exercise is to actually construct 'equity rates' for each of the 4,500 observations as a user might in



Source: MacroRisk Analytics, data as of 29/10/2010

Figure 1: Average up-market and down-market betas per unit of average CAPM beta, by industry (2-digit SIC)

practice by taking a measure of the riskless rate and adding to it the equity risk premium scaled by the estimated beta. Certainly there are differences regarding the selection of these inputs (see, for example, Fama and French[27]). For this computation, the authors use 3.41 per cent as the riskless rate, based on the forecast values of the 10-year Treasury bond from the third quarter 2010 Survey of Professional Forecasters from the Philadelphia Federal Reserve, and 6.2 per cent as a representative expected equity premium. For each of the approximately 4,500 observed companies the authors compute

$$k_{js} = 0.341 + \beta_{js} * (0.0620) \quad (4)$$

where 's' refers to the style of beta being used (CAPM, up-market, down-market) and k_{js} is the estimated equity discount rate.

In Table 1, the authors show the average present values of a hypothetical earnings stream of US$100,000 per year for 10 years. The table gives the average results separately for those times when the down-market beta is no greater than the CAPM beta, when the down-market beta exceeds the CAPM beta, and overall without regard to which beta estimate is larger.

On average, using the CAPM beta or the down-market beta produced present values that were fairly close (US$629,817 for the average result using

Table 1: Sample impact of different betas on present value computations

	Present value of US$100,000 per year for 10 years		
	CAPM Beta (US$)	Down-market Beta (US$)	Up-market Beta (US$)
Down-market beta $\leq$ CAPM beta	609,229.20	646,446.19	609,196.34
Down-market beta $>$ CAPM beta	651,884.44	608,914.08	680,220.75
Overall average	629,816.81	628,331.27	643,476.36

CAPM beta and US$628,331 for the down-market beta). However, that average is based on over-estimated values about half of the time and under-estimated values for the other half. When the CAPM beta exceeds the down-market beta, it is being 'pulled up' by higher upside volatility; the relatively higher chance of profits is being misinterpreted as risk, resulting in too high a discount rate and consequently too low an estimated value. The average value was US$609,229.20 when using the CAPM beta, but would have been estimated as US$646,446.19 if only the down-market beta, reflecting downside risk rather than profit potential, had been used. Similarly, when the CAPM beta is lower than the down-market beta, there is a situation where the downside risk exceeds the upside profit volatility. Using the CAPM beta would have resulted in an overestimated average value of US$651,884.44 compared with the average of US$608,914.08 obtained using the downside beta. In those rare instances when the down-market beta and CAPM beta were practically the same, which the authors did not separately report, the estimated values would be essentially the same using any of the beta estimates. However, as graphically represented in Figure 1, this would be a rare event.

Table 1 reflects that about half the time a financial analyst using CAPM betas for estimating cost of capital would be overstating value and about half the time understating value; while overall 4,500 companies might cancel those errors, they certainly would not for any given analyst. In the Table 1 example, an average financial analyst using CAPM betas would be making approximately a 7 per cent error, but would not know in advance whether that was an error causing an overestimate or an underestimate of value. That error is readily corrected by using downside betas when computing cost of capital.

CONCLUSIONS

"Come to the downside ... we have cookies."

— paraphrase of a bumpersticker, *circa* 2010

That investors, analysts, and decision-makers do not value financial disasters and windfalls as equivalent risks seems a matter of common sense and has been confirmed repeatedly in the financial literature. A long tradition of considering 'safety first' and focusing on the risk of having losses, or having returns below some designated target, points to the use of downside risk measures. Commercial banks, with value-at-risk, and pensions and hedge funds, with return to semideviation ratios ('Sortino ratios'), have begun focusing on downside risk measures as part of their standard analytical practice.

For corporate treasurers, business owners, business valuation analysts, and investors without the resources of a large investment bank, the difference in estimated value caused by using CAPM betas, instead of downside betas, has not been widely understood.

This paper has demonstrated that equity rates based on traditional CAPM betas can be quite different from those based on down-market betas and can lead to significantly different value estimates. In the sample computations, valuations based on traditional betas would lead to excessive value when there was greater downside risk and lower values when there was less downside risk.

The authors do not believe this is the final word on the use of downside risk measures in business valuation. Much additional research remains to be done. The empirical work in this paper, while employing a broad sample of companies, reflects only one point in time. It is not yet known how these values change with the business cycle or credit conditions, or how alternative specifications such as the Fama-French three-factor model would work in a dual-beta formulation.[28] Even so, whether one uses commercially provided values, as used here, or one computes one's own with spreadsheet or regression software, down-market estimates of beta are readily available and can be used at least to provide an alternative calculation of value as part of model 'stress-testing'and perhaps to avoid substantial mispricing of businesses, projects, and investment assets.

Acknowledgments

The authors thank an anonymous reviewer for helpful suggestions, MacroRisk Analytics for providing data used in this paper, and Robert Neff, Sean Chasworth, and Nhat Ho for assistance and comments throughout this project.

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