Measuring the Cost of Capital
Some Lessons from Access Pricing Regulation

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The process of access pricing regulation of industries such as telecommunications, gas and electricity transmission and distribution, airports has given rise to substantial public debate about the estimation of cost of capital in such industries[1]. For such an important topic, it is perhaps surprising (even allowing for the self interest underlying many submissions to regulators) that many important issues in cost of capital estimation are subject to such disagreement.

The objective of this paper is to provide an overview of some of the more important areas of debate, drawing upon recent research to inform that discussion and identify areas where significant uncertainty remains. In doing so, the focus is first upon the appropriate method for the calculation of the weighted average cost of capital (WACC), assuming that the cost of equity and debt (and other hybrid forms of financing) are known. Then, the determination of the cost of equity is examined, initially in the context of the Capital Asset Pricing Model (CAPM) and then with reference to alternative approaches found in theory and practice. This is followed by a brief discussion of issues involved in estimating the cost of debt, and some concluding remarks.

Calculating the WACC

The finance literature provides principles for calculating a WACC to apply to a business unit or project of a firm.

- First, the WACC should be one which reflects the systematic risk of the project or business unit's activities. If the systematic risk of these activities differs from that of the firm as a whole use of a WACC calculated for the firm will be inappropriate.
    - It will lead to either rejection of viable projects (if the firm WACC exceeds the project WACC) or acceptance of non viable projects (if the firm WACC is less than the project WACC).
    - If business unit performance is evaluated using the firm WACC, for example in an economic value added calculation, the unit's performance measurement will be biased.
    - If there is discretion in price setting, and the firm WACC is used in determining an appropriate price, the price set will be inappropriate
- Second, the WACC should be calculated using the leverage of the firm as a whole (unless, perhaps, the financial arrangements of the firm are structured in

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[1] The web sites of regulators such as the ACCC, IPART, etc provide a wealth of public documents in which cost of capital issues are discussed.

some way such that the providers of finance have some specific claim on the business unit).

The WACC formula

There are many alternative formulations of the WACC, each appropriate for discounting project or business cash flows measured in different ways. Most common is the standard textbook formula:

$k_o = k_e(E/V)+k_d(1-T)(D/V)$

which is used to discount cash flows after company tax, calculated *as if* the company were unlevered. In this equation returns are designated by (k) to represent the fact that the value of franking (tax) credits is not included in the calculation of return.

Unfortunately, such a formula does not allow for the role of dividend imputation wherein returns to equity holders also include tax (franking) credits. This concern led Officer (1994) to derive an alternative formulation

$$r_o^i = r_e \frac{E}{V} \cdot \frac{(1-T)}{(1-T(1-\gamma))} + r_d \cdot \frac{D}{V} .(1-T)$$

in which r_e and r_d represent the required (expected) returns of shareholders and debt holders respectively, and where r_e is defined as a "partially grossed up" rate of return on equity. In essence, it is the "traditional" rate of return (dividend cash flow plus capital gains) plus some proportion (γ) of the franking credits paid out with dividends. Such a WACC is applied to cash flows after company tax, calculated *as if* the company were unlevered.

Monkhouse (1996) demonstrates that the appropriate WACC expression for discounting cash flows calculated for an unlevered project (firm) after company tax under imputation can be written as:

$$k_w^c = \frac{E}{V} k_e^c + \frac{D}{V} r_d (1-T)$$

which is the standard WACC formulation. It can be seen that the difference between these two formulae lies in the measurement of the return on equity. The assumptions required (and thus sources of potential problems) for equivalence between the two approaches will be shown subsequently.

Monkhouse's approach does not assume that equity returns take the form only of dividends (i.e. he allows for expected return k_e to include both dividends and capital gains). In the special case where returns take the form only of fully franked dividends, so that $k^c_e = d/P$ and $t_f = T$, it is possible to write r_e as

$$r_e = \frac{d}{P} + \theta^d \frac{d}{P(1-T)} T = k_e^c \left[\frac{1-T(1-\theta^d)}{1-T} \right]$$

Rearranging and relabelling θ^d as γ we obtain:

$$k_e^c = r_e\left[\frac{(1-T)}{(1-T(1-\gamma))}\right]$$

In this very special case, note that we can rewrite Monkhouse's WACC equation as:

$$k_w^c = \frac{E}{V}k_e^c + \frac{D}{V}r_d(1-T)$$
$$= \frac{E}{V}r_e\left[\frac{(1-T)}{(1-T(1-\gamma))}\right] + \frac{D}{V}r_d(1-T)$$

This is precisely the WACC proposed by Officer.. Hence it is apparent that:

- This approach is applicable to cash flows calculated for an unlevered project / company after company tax
- γ refers to the valuation of franking credits by shareholders of that company – not for the market as a whole
- The model assumes that returns to equity holders take the form only of fully franked dividends, i.e. the company has a 100% payout rate.
- The model assumes that capital gains are subject to the same effective tax rate as other income

Among the problems which arise in applying such an approach, is that of deriving the appropriate tax rate to use in modelling. An alternative approach which has become favoured by some regulators is to use a "vanilla WACC" of the form:

$$\mathbf{r_o = r_e(E/V) + r_d(D/V)}$$

Such a WACC is applied to cash flows of the levered entity after tax (net of the value of franking credits). Because tax issues are treated in the cash flow determination, rather than in the cost of capital, parameters such as the average valuation of franking credits (γ) and the tax rate (T) do not appear explicitly. The benefit of such an approach is that explicit modelling of a varying tax position of the entity can be incorporated into the cash flow analysis, rather than requiring an assumption of a constant effective tax rate for inclusion in the WACC.

Leverage and the WACC

In calculating a WACC it is necessary to make an assumption about the degree of leverage. As leverage increases, the WACC (as traditionally calculated) will initially decline provided that there are tax or other benefits from increased debt financing. (In the case of the "vanilla WACC" there may be no change, depending on certain assumptions made – as outlined below). Beyond some degree of leverage, however, the WACC can be expected to increase as the possibility of financial distress or other factors become significant.

The WACC, and leverage, should be calculated using market values of debt and equity. In practice, given the lack of suitable data and the generally close relationship between book and market value of debt, book value of debt is often used in association with the market value of equity.

Where the WACC is being calculated for a particular business unit or activity within an organisation, the leverage figure used in the calculation should generally be that applicable to the organisation as a whole. The reason for this is that debt and equity are typically raised by "head office" (the company) and providers of finance have a claim against the company, not against the business unit as such. Even where debt finance is raised by a subsidiary, there will typically be parent guarantees. When head office allocates capital to business units it is an aggregate of funds, not some explicit combination of debt and equity. While it would be possible for head office to notionally divide funding to business units into some mix of debt and equity, this does not imply that those weights (rather than the weights for the company as a whole) should be used in a calculation of the WACC for that business unit. The reason is that providers of finance have a claim on the firm, not on the business unit.

The leverage figure used should be the "target" or "optimal" leverage figure (at which the WACC is believed to be minimised). In practice, determining the "optimal" leverage figure is difficult. Usage of an industry "norm" has some merit, on the grounds that firms on average will adjust towards the optimal capital structure for that type of business. However, drawing on overseas "norms" is problematic because international differences in taxation, law and institutional arrangements can lead to different optimal capital structures.

Regardless of which WACC concept is used values for the components of the equation are required. The next section considers issues involved in the estimation of the cost of equity, using the CAPM and other approaches.

The Cost of Equity

To estimate the cost of equity (r_e) it is common to use the CAPM:

$$\mathbf{r_e = r_f + \beta_e \, MRP}$$

so that values for the *risk free rate* (r_f), the *equity beta* (β_e), and *the market risk premium (MRP)* are required.

Rigorous modeling (albeit subject to some simplifying assumptions) of required returns under dividend imputation has been undertaken and published by Monkhouse (1993, 1996, 1997), and it is instructive to examine a slightly simplified version of Monkhouse's model. Monkhouse demonstrates that where equity returns (k^e) are measured as dividend cash flows plus capital gains (ie not including the value of franking credits), a theoretically correct CAPM can be written (in the simplified case where franking credits not paid out by the company have zero value) as:

$$k_e^c = r_f + \beta[E(R_m) - r_f] - \theta^d D' t_f$$

in which k^e is the expected return, r_f is the risk free rate, $E(R_m)$ is the expected return on the market – inclusive of the value of franking credits, θ^d is the utilization rate of distributed imputation credits, D' is the grossed up dividend yield of the company, and t_f is the level of franking (ranging from 0 in the case of an unfranked dividend to T (the corporate tax rate) in the case of a fully franked dividend). To understand the equation more fully, note that $D' = d/[P(1-T)]$ where d is the cash dividend and P is the share price. Also, θ^d is essentially equivalent to γ in the Officer approach. (θ^d varies from firm to firm depending upon the characteristics of its shareholders. In Monkhouse's model, the investor clientele is treated as exogenous, and the possibility of investor migration to firms with desirable tax features is not considered. The model also takes as an assumption that investors may only partially value franking credits – a strange assumption for a model built on rational behaviour – and assumes that the effective tax rate on capital gains is equal to the tax rate on other income).

The market risk premium $[E(R_m) - r_f]$ in Equation 9 refers to a "partially grossed up" market premium, i.e. R_m includes the valuation of franking credits distributed as part of the return on the market. The valuation of franking credits for the market as a whole can differ from the valuation θ^d applicable to the individual return r_e.

Rearranging, it is possible to write the CAPM for a "partially grossed up" return, corresponding to r_e as:

$$r_e = k_e^c + \theta^d D' t_f = r_f + \beta[E(R_m) - r_f]$$

Risk Free Rate

Finance theory suggests that a short term risk free rate of interest is applicable for the CAPM, since it is essentially a one period model. However, the CAPM is typically applied to valuation situations in which the cash flows are occurring over a long time frame. Hence, and because of the greater variability in short rates relative to long rates, practitioners typically use a long term rate, although the principle of "matching" might suggest the use of the different risk free rates applicable for cash flows at different points in time. One compromise is to use the current long term rate less the historical "long - short" risk premium to get an expected long run average of the short term rate.

Market Risk Premium (MRP)

It is commonly argued that the market risk premium (the expected return on equities in excess of the risk free rate) in Australia is in the order of 6-8 per cent p.a. There is little in the way of published research to justify this, with the main reference usually being the historical data produced by Officer (1992) which gave an average of 7.94 per cent p.a over the period 1882-1987. (However, Ball and Bowers, 1986, estimated an equity premium (relative to the Treasury Note rate) of 5.6 per cent p.a .for the period 1974-1985. For the shorter period, 1977-1985, they estimated a premium over10 year bond returns of 5.5 per cent p.a..) The value derived by Officer also accords with some of the evidence from overseas markets, notably the Ibbotson data for the USA. (Annin and Falaschetti, 1998 provide an overview of the Ibbotson methodology.) In a survey of US academic financial economists, Welch (2000) finds a consensus estimate of 7 per cent. However, for such an important concept in the application of the CAPM, there is surprisingly little evidence available to support the firm views often advocated on the appropriate value for the market risk premium.

There is a growing literature which has challenged the view that a market risk premium in the 6 - 8 per cent range is appropriate. One part of that literature (initiated by Mehra and Prescott, 1985) has argued that such a figure is too high to be compatible with financial market equilibrium for typical estimates of risk aversion. Another part of the literature has argued that the MRP historical estimates derived from the USA stock market experience are subject to the problem of "survivorship bias" making them unsuitable as estimates of forward looking MRP. (See, for example, Jorion and Goetzmann 1999). Other studies have examined data from earlier historical periods and derive significantly lower values than found in estimates based on twentieth century data. Finally, alternative calculations of the MRP both for the USA and Australia have produced lower values. Well known researchers Fama and French (2001) have argued that an MRP in the order of 3 – 4 per cent is appropriate. (See also Siegel, 1999). Claus and Thomas (2001) use analysts' earnings forecasts and the "residual income model" to estimate forward looking equity premia for several national markets and suggest that a value of three per cent or less is appropriate. Among factors which have been mentioned as relevant to a lower MRP than suggested by historical averages are such things as: lowering of security market transaction costs, incomplete diversification by investors in the past, changes to tax laws, changing turnover rates in financial markets, lower inflation.

For Australia, the operation of a dividend imputation tax scheme means that the MRP for use in the CAPM needs to refer to market returns which are inclusive of the value of franking credits. Davis (1998) used a dividend growth model which equates the expected return on equity to the sum of the prospective dividend yield (inclusive of franking credit value) plus the expected growth rate of real output and that of inflation. That calculation indicated that at that time a range of 4.5 to 7 per cent for the MRP may have been appropriate.

There is often comment made that historical estimates of the MRP are based on the premium over a long term bond rate and therefore that "consistency" requires that a long term bond rate be used as the risk free rate in the CAPM model. That assertion, while appealing at a surface level, needs to be treated with some skepticism. First, the CAPM is used to estimate required returns on risky assets over some time horizon based on a "forward looking" or *ex ante* MRP. The risk premium on risky assets needs to be considered relative to the risk free rate applicable to that horizon. Second, it is far from clear that similar "consistency" principles of matching of time horizons have underpinned the historical estimates of a MRP. For example, the standard estimates of the MRP, referred to in such commentaries, are based on a comparison of yield to maturity on 10 year bonds with one year holding period returns with equities. Given also the divergence of views on whether a geometric average or arithmetic average of historical data should be used (see Cornell et al (1997) for example), it becomes clear that a significant degree of judgment is required, rather than mechanical application of some historically determined number.

The Value of Franking Credits

Under the Australian dividend imputation tax system, it is necessary to take account of the value of franking credits (in either or both the cost of capital or "cash flow" modelling). A common approach to doing so has been to make an assumption that franking credits are not fully valued by the market, and choose some value for γ, the parameter representing the value of franking credits. It has become commonplace that the figure of 0.5 is used. Note that in the "plain vanilla" WACC approach, this parameter does not directly affect the WACC figure (although it is potentially relevant to the leverage adjustment in deriving an equity beta from an asset beta), but affects the cash flow calculations.

Support for a 0.5 valuation has come primarily from dividend drop-off studies. Essentially, the approach adopted is to estimate the ex-dividend day price drop / capital loss of ($P_t - P_{t-1}$) relative to the size of the dividend including the value of franking credits ($D + \gamma F$). Then a "no-arbitrage" argument is used to imply that the value of the dividend should equal the capital loss on the ex-div day, and the unknown γ can then be estimated. A similar approach, but based on a model of trading equilibrium with heterogenous traders, can be found in McDonald (2001) who studies equilibrium pricing of stocks around ex-dividend dates in Germany between 1994 to 1998 when the tax regime in operation was very similar to the Australian dividend imputation system.

However, such an approach to deriving an estimate of the value of franking credits is difficult to justify. McDonald, for example argues that "approximately one-half to two-thirds of the value of the dividend tax credit is reflected in prices of German stocks and equity derivatives" with tax risk from dividend capture strategies by domestic investors being his preferred explanation of why the share price drop-off rate is not equal to the full value of the dividend plus associated tax credit. He cautions however, that "[w]hile it is tempting to use the ex-day estimates in this article to measure the degree to which the imputation credit is capitalized…caution is required…". He makes this statement referring to the work by Poterba (1986) who studied two classes of common stock issued by the one company in the USA, one paying cash dividends and the other paying equivalent dividends but in the form of stock which were subject to preferential tax treatment as capital gains. He found no difference in the prices of the two stocks relative to their dividend streams, but significant differences in their ex-div drop off ratios. There are also a number of international studies which have demonstrated dividend drop off ratios significantly below unity which are not necessarily due (in one case not possibly due) to tax factors [2].

[2] In the February 1998 *Journal of Financial Economics*, Bali and Hite illustrate that much of the dividend drop off evidence in the USA can be explained by the simple fact that dividend amounts are different from the minimum share price tick size ($0.125). Since the share price drop following a dividend amount not equal to the minimum tick size could be expected to be equal to the nearest smaller tick size, drop off rates below unity can be expected even when capital gains and dividends are taxed equivalently. Likewise, in the same issue Frank and Jagannathan show that the drop off ratio in the Hong Kong market is in the order of 0.5 even though there are no applicable taxes. They are able to explain a drop off ratio below unity by developing a model involving long term traders, noise traders,

A recent published Australian study by Walker and Partington (1999), suffers from less data problems than other dividend drop-off studies[3], and concludes cautiously that "Using the average drop-off ratio for trades, gamma is 0.96, and using the average drop-off for events, gamma is 0.88" (p293). Lally (1999, p 40) after surveying the relevant literature suggests that "an estimate of U [his symbol for γ] close to 1 seems justified". A more recent study by Chu and Partington (2001) examines the price differential between shares entitled to a forthcoming franked dividend and shares in the same company which are not entitled to such a dividend (issued, for example, as part of a rights issue). They find that the price differential implies a value of franking credits close to unity, although the small sample size reduces the precision of such an estimate.

Estimating Beta

The CAPM is typically used to estimate the cost of equity capital and requires an estimate of the equity beta of the company. Such an estimate can be derived from the observed historical relationship between returns on the stock and the market, where this is available, or can be approximated by reference to equity betas of comparable companies. (Here comparable refers to companies engaged in similar business activities and thus likely to have similar underlying systematic risk). That approximation needs to allow for possible differences in leverage between the comparator companies and the company under consideration. Where the comparator companies are from a different country, the approximation will be less precise because of differences between the relevant market portfolios (against which covariances are being measured) and tax differences.

An alternative approach which is sometimes used is to examine the economic and financial fundamentals of the company. This involves analysing such characteristics as operating leverage and costs, product demand etc., to assess the extent to which returns on that activity will covary with overall economic activity. A difficulty with such an approach is that theory provides little guidance on the appropriate method for converting such information into an estimate of an "asset beta". For example, the market determined rate of return over any period will also reflect (in addition to current cash flows) the extent to which the asset has been revalued due to a change in the underlying discount rate and thus the present value of expected future cash flows. If changes in discount rates have any systematic component (such that changes in the discount rates for the asset and for the market as a whole are correlated) this will affect the beta of the asset.[4] Another practical problem concerns the fact that the "beta" to be calculated relates to the covariance of the rate of return on the activity with the rate of return on some aggregate of risky assets, typically proxied by the equity market. However, the equity market is itself a leveraged position on the stock of income producing assets in the economy which are financed by both debt and equity. Thus, for example, suppose it were deduced that the beta of returns on activity A was 0.6 when measured relative to economic activity, and that the beta of returns

market makers and allowing for bid –ask spreads.

[3] Walker and Partington use the fact that there are some trades of company shares on a cum-div basis during the ex-div period, and calculate the difference in price between those trades and contemporaneous ex-div trades to estimate a "drop – off" ratio.

[4] See Campbell and Mei (1993).

on the aggregate stock of assets when measured relative to economic activity was 1. Since the aggregate stock of assets is financed partially by debt , and taking 50 per cent as a realistic, although perhaps slightly high, estimate of leverage, the beta of returns on the equity market relative to economic activity will, because of the leverage effect be in the order of 2. The beta of asset A then measured against the equity market (which is the conventional measure) will be in the order of 0.3.

In adapting such estimates from overseas countries to the Australian situation for use in the CAPM, the analyst is faced with the difficulty that several CAPM models can be found in the literature. One cause of this lies in the question of whether the CAPM is to be applied by assuming a domestic capital market segregated from overseas markets, or by assuming a fully integrated world capital market, or by assuming some intermediate view. In practice, the CAPM and WACC models adopted in Australia are domestic models which attempt to incorporate some of the relevant international influences on asset pricing in Australia through the treatment of the imputation tax system. There are various ways in which a beta estimate for an overseas comparator company relative to the world or foreign capital market could be converted into a beta estimate for the Australian company relative to the domestic capital market. For example, the conversion process could, on the basis of particular assumptions about the appropriate CAPM model, involve adjusting the beta estimate to reflect the covariance between the Australian and overseas capital market or to reflect a different level of risk (volatility) of the Australian market.

Beta and Leverage

In using comparators, it is necessary to take account of the fact that the comparator companies may have different leverage. Hence it is necessary to "delever" and "relever" the beta estimates. There is no universally correct leverage adjustment process for converting between a beta for equity in a levered company and a beta applicable to an unlevered company (commonly referred to as an asset beta). To derive a formula, assumptions must be made about such things as patterns of operating cash flows over time, capital structure policy over time, and risk characteristics of any tax shields arising from debt. Differing formula may also be derived depending on whether it is assumed that there is any tax benefit arising from debt financing or not.

The leverage adjustment is independent of whether the "vanilla WACC" or a "standard post-tax WACC" is used. The critical determinant is the assumption made about uncertainty associated with the tax shields. Some regulators have used the "Monkhouse" formula which is as well justified as any of the other alternatives available. In practice, the differences arising from using the different approaches are relatively small.

One approach commonly used is to assume that the gain to leverage from corporate taxation is not offset by features of the personal tax system such that:

$$\beta_u = \beta_l / (1 + (1 - T_c)(D/E))$$

Aternatively it may be assumed that there is some offset to leverage gains from the nature of the personal tax system such that:

$$\beta_u = \beta_l / (1 + (1 - GL)(D/E))$$

where a figure between zero and T_c is used for the gains from leverage adjustment factor (GL). If, for example, it is believed that imputation tax credits are fully valued such that company tax is fully offset by reduced personal tax payments, GL would be set to zero.

These formulae assume a debt beta (see below) of zero. If it is assumed that the beta of debt is nonzero and that there is no personal tax offset to the gains from leverage a formula which can be used is of the form:

$$\beta_l = \beta_u + (\beta_u - \beta_d)(1-T_c)D/E$$

In the case of an imputation tax system, Monkhouse (1997) has derived a leverage adjustment formula (his equation 21) which can be written in the form:

$$\beta_{equity} = \beta_{unlevered} + (\beta_{unlevered} - \beta_{debt})\ (D/E)[1 - r_d T_c(1-\gamma)/(1+r_d)]$$

(Here, γ represents the valuation of franking credits and it is assumed that all imputation credits are distributed – although Monkhouse allows for the possibility of less than full payout).

As Monkhouse demonstrates, the *levered asset* beta will be different from the *unlevered* beta, because of the tax benefits from leverage (if franking credits are not fully valued) and impact of tax cash flows on systematic risk of cash flows to equity and debt holders. In this derivation, Monkhouse assumes that the company maintains its leverage ratio at the target value and follows the Miles and Ezzell approach which assumes that the first tax shield is certain, but subsequent tax shields are uncertain. An alternative approach is to assume that the debt tax shield is uncertain in all periods. In this case, a leverage adjustment (in the case of a zero debt beta) of the form

$$\beta_{equity} = \beta_{unlevered}\ (1 + D/E)$$

is obtained. The difference arises from the different assumption made about the uncertainty of tax shields.

Cost of Debt (r_d)

Corporate debt will normally have a yield to maturity in excess of the risk free rate on government debt with equivalent promised cash flows (eg same maturity and coupon rate). This reflects the effect of credit risk considerations and possibly liquidity differences, and the margin can vary over time due to such things as changes in credit ratings. It is difficult, however, to attribute much of this differential to a systematic risk element, as is done when some analysts attempt to "back out" a debt beta estimate by inserting the differential in a CAPM equation. The reason is that the yield to maturity refers to promised cash flows rather than expected cash flows assuming that the asset is held to maturity. While over short holding periods, the mark to market return on a corporate bond may vary significantly, so also will the mark to market return on a long term risk free bond. These returns will be highly correlated, and thus have similar betas, unless there is a strong systematic component of credit spreads.

The cost of debt is a component of the WACC and the figure used should be a "forward looking" estimate – one which relates to the cost of issuing new debt. For this reason, direct use of historical funding costs is not appropriate – although by appropriate comparison with overall trends in comparator rates, some relevant information may be gained. For example, the current yield on debt outstanding could, in principle, be compared with the yield on a risk free government bond portfolio of securities whose characteristics and purchase dates matched the securities in the corporate's debt portfolio. If the credit risk of the corporate had not changed over time, the difference in the yields of the two portfolios would provide an indication of the interest margin which the corporate needs to pay.

Typically, a corporation will access a variety of debt sources. While, in the absence of other considerations, an optimal financing structure would see the marginal explicit costs of all types of debt equalised, other factors are also relevant. For example, higher priced debt might be occasionally issued in certain markets to diversify debt sources for risk management purposes or to build up market presence for future issues in that market. Alternatively, explicit cost of certain types of debt may appear low, but it may be that market depth is such that larger issues into that market may not be possible without substantially increased promised yields. For these reasons, it is not appropriate to place too much emphasis on the cost of any one source of debt as indicative of the precise cost of a corporate's overall debt financing. Rather, such information may give a ball park estimate.

To estimate the cost of debt, a common approach is to examine the spreads over Government Debt prevailing in the market place for borrowers of a particular credit rating. While these are based on yields to maturity (rather than expected returns), for highly rated borrowers they may provide a good approximation of the cost of debt.

Debt Beta

The rate of return on corporate debt may involve systematic risk, such that in a levered firm, debt holders take on some part (and equity holders a correspondingly lower part) of the systematic risk of the entity (assets) as a whole. The *debt beta* represents the systematic risk of debt, and will enter into the derivation (via a leverage adjustment) of an equity beta from an underlying asset beta.

There are considerable difficulties in determining an appropriate value for a debt beta.

- First, it is not correct (as sometimes done) to "back out" an estimate from a CAPM equation of the form:
  $$r_d = r_f + \beta_d \text{ MRP}$$
  by substituting the yield to maturity for r_d. The reason is that the CAPM refers to *expected* returns, while the yield to maturity is a *promised* return which will be higher due to the probability of default.
- Second, there is no clear guidance from theory as to the holding period which should be assumed in deriving a debt beta estimate. The return on a bond held to maturity will have no systematic risk for that horizon unless default is correlated with market returns for that horizon (since the cash flows on the debt

security are otherwise non stochastic[5]). Alternatively, for a short horizon, the holding period return on a long term fixed rate corporate bond may covary with market returns. However, since long term risk free bonds will exhibit similar covariance of holding periods returns, the yield to maturity difference between these two assets cannot be attributed to a systematic risk component. Similarly, for short term debt or floating rate bonds, there will be no systematic risk arising from movements in market interest rates over a short term horizon.

While it would appear that there is some systematic risk associated with debt securities, there is limited advantage in incorporating a non zero debt beta in the leverage adjustment process. The one danger is that if an equity beta has been provided using historical data for a levered company, an assumption that the beta of debt is zero will tend to lead to understatement of the asset beta.

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[5] There will be some stochastic element for a coupon paying bond due to the reinvestment risk associated with the coupons.

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