UK WATER COST OF CAPITAL AND GEARING: WHAT IS THE RELATIONSHIP?

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EXECUTIVE SUMMARY

There is a perception amongst a proportion of the financial community, and by some city analysts in particular, that financial restructuring with the replacement of equity by debt can significantly reduce the cost of capital for UK water companies. Some city estimates have suggested that a move from 50% gearing to 80-90% gearing can reduce the cost of capital for UK water companies by around 1-2%. This view contrasts with 'traditional' corporate finance theory, based around the work of Modigliani and Miller, that views capital structure as largely irrelevant in determining the market value of a company and hence its cost of capital.

The relationship between the cost of capital and gearing is important for regulation. At the Periodic Review 1999, Ofwat concluded that a gearing level of 45-55% would represent an appropriate capital structure for a water company over AMP3. It is important to understand clearly whether the cost of capital can be reduced by gearing up above this level and whether prices at future Periodic Reviews should be based on a more highly leveraged capital structure.

In this paper NERA examine theoretical and empirical evidence of the relationship between gearing and the costs of equity and debt for UK Water Companies taking into account factors such as the ability of UK water companies to benefit from corporate debt tax shields, the importance of personal taxes, non-tax costs such as capital allowances, and market evidence on liquidity premia in debt markets. We do not consider changes in the cost of capital that could come about as a result of the use of structured finance techniques.

The following table sets out our central estimate of the *relationship* between gearing and the post tax WACC and pre tax WACC for UK Water plc over a range of gearing of 25%-75%.[1]

[1] Estimates of the equity risk premium, asset beta, risk free rate and tax should be taken as 'illustrative' only. These parameters have not been explicitly considered in this paper and do not necessarily represent NERA's 'best estimates' or 'Preferred Values'.

Summary Table
Impact of Change in Gearing on WACC – NERA Central Estimate

Gearing (D/(D+E))	25%	50%	75%
Real risk-free rate (r_f)	3.00%	3.00%	3.00%
Equity premium (ERP)	5.00%	5.00%	5.00%
Asset beta (β_{asset})	0.50	0.50	0.50
Tax	0.25	0.25	0.25
Equity beta (β_{equity}) – NERA estimates	0.65	0.94	1.81
Cost of equity post-tax – NERA estimates[1]	6.23%	7.69%	12.06%
Assumed Credit Rating	AA	A	BBB+
Debt premium (DP)	1.00%	1.25%	1.75%
Cost of debt (=r_f + DP)	4.00%	4.25%	4.75%
Post-tax WACC – net of debt tax shield	**5.42%**	**5.44%**	**5.69%**
Post-tax WACC – gross of debt tax shield	**5.67%**	**5.97%**	**6.58%**
Pre-tax WACC	**7.23%**	**7.25%**	**7.58%**

[1] *'NERA Preferred' calculated as average M-M and Miller post tax CoE.*

It is useful to distinguish the effect of increased gearing on the post tax WACC and pre tax WACC separately.

The table shows that NERA's central estimate of the Pre tax WACC increases slightly from 7.23% to 7.58% over a range of 25% to 75% gearing. This slight increase in the cost of capital at 75% gearing can be explained to be a consequence of the fact that an increase in debt share has increased the riskiness, and hence cost, of both equity and debt and this more than offsets the effect of debt being cheaper than equity and the benefits of the debt interest tax shield.

Sensitivities are considered in this paper to the assumptions we have made in this central case scenario. We show, however, that even if we make less aggressive assumptions regarding the *rates* at which the costs of debt and costs of equity change with increased gearing (which can still be justified by the empirical and theoretical literature) that any reduction in the implied pre tax cost of capital would, at most, be marginal.

Our prediction that the pre tax WACC does not change significantly as gearing increases is consistent with the Competition Commission's findings in their analysis of the cost of capital for the Sutton and East Surrey Water and Mid Kent Water appeals, where they concluded that:

> *"We considered the cost of capital on a number of different assumptions about the debt share but, as shown in Table 8.4, the tax adjusted cost of capital on our assumptions varies little with the debt share. This is because, on our assumptions, the effect of a higher debt share in reducing tax is largely offset by increased risk, which raises the cost of equity and debt."*

Our findings and those of the Competition Commission contrast, however, with the approaches that have recently been adopted by regulators such as Ofgem (RECs 2000, NGC 2001, TransCo 2001)), CAA (BAA 2001), and ORR (Railtrack 2000) who have recently assumed high levels of gearing in their WACC determinations, above the levels of gearing of the companies at the time of the price determination, on the presumption that high levels of gearing are consistent with an efficient capital structure and lower WACC.

It is relevant to also consider the post tax WACC gross of debt tax shield since Ofwat set allowed returns using a post tax WACC at the 1999 Periodic Review, with a separate allowance for taxes. Under this methodology any attendant tax savings as a result of increased leverage will be passed on to customers at the next review. Past then, shareholders of water companies do not keep any increased tax benefits of debt financing. As the table shows the post tax WACC gross of debt tax shield increases by nearly 1% over the range of gearing of 25% to 75%.

Our prime conclusion is a simple one: even if typical gearing levels in the industry rise from around 50% to 75% by the time of the next Periodic Review, Ofwat would not be justified in setting lower allowed pre tax returns through, for example through a re-weighting of their estimates of the 1999 cost of debt and cost of equity. Rather the effect of higher gearing on the variability of equity returns and on the cost of debt would imply that any reduction in the pre tax cost of capital caused by higher levels of gearing would be, at most, marginal.

Should Ofwat choose to adopt the same post tax WACC price setting methodology at AMP4, then the allowed post tax WACC gross of debt tax shield would need to increase, to compensate for lower tax payments as a result of the corporate debt tax shield, to ensure that the level of (implied) allowed pre tax returns stayed constant.

1. INTRODUCTION

The purpose of this note, commissioned by Water UK, is to examine the impact of alternative gearing assumptions on the WACC in the context of the UK Water Industry. The paper is structured as follows:

- Section 2 provides some context by looking at contrasting views within the water industry, City analysts and external commentators on the effect of changes in capital structure on the WACC. In particular, we highlight differing opinions regarding the WACC of "thin equity" models and the WACC of "conventional equity" structures.
- Section 3 reviews theoretical literature that examines the impact of changes in capital structure on valuation and the WACC.
- Section 4 reviews empirical evidence of the impact of changes in capital structure on the CAPM beta parameter and the costs of capital of utility industries in particular.
- Section 5 presents numerical examples to examine the impact of gearing on the WACC under alternative assumptions regarding changes in the cost of equity, the cost of debt and perceived bankruptcy risk.
- Section 6 presents conclusions.

2. "GEARING UP": DOES IT LEAD TO A LOWER COST OF CAPITAL?

There is a perception amongst a portion of the financial community, and some city analysts in particular, that financial restructuring with the replacement of equity by debt can significantly reduce the cost of capital for UK water companies. Schroder Smith Salomon Barney (SSSB), for example, have produced analyst notes that assert that the "thin equity" financial structures have a lower cost of capital than the traditional financial structures by something in the region of 1-2%.

> *"…the proposed financing structure will set debt to equity of 90:10 in the New SW [Southern Water]. This compares to 50:50 used by Ofwat in setting the cost of capital for Southern Water. We calculate that this will reduce the effective cost of capital by 1.6% to 3.47% real."*[2]

A crucial assumption made by SSSB in their analysis is that the cost of equity remains relatively invariant to changes in gearing.

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[2] "Scottish Power", SSSB, November 2001.

SSSB further assert that the benefits of refinancing will accrue to customers in the long term since Ofwat is likely to base its tariffs on the lower cost of capital at subsequent review periods meaning that "*companies that have not restructured probably will not be able to meet Ofwat's targets*". The risk that Ofwat will set a lower cost of capital at future reviews to reflect the perceived lower cost of capital of the thin equity structures has also been cited by rating agencies.[3],[4]

This view that gearing up can reduce the cost of capital appears to be a primary motivating factor behind the restructurings that have occurred. The first discussions of this were in the context of the Glas deal although most of the companies that have moved towards thin equity models (Mid Kent, Sutton and East Surrey, Brockhampton, and most recently Anglian Water) have been quoted as saying along these lines.

> *"Glas Cymru, said the transaction would allow the company to reduce its cost of capital to just over 4% compared with a 6.5% industry threshold set by the regulator"*[5]
>
> *"Central to the reduction in the cost of capital [for Glas] was the removal of all equity and the switch to a 100% debt-financed structure of far higher leverage…"*[6]
>
> *"…there are financial restructurings that aim to lower the cost of capital by allowing for more debt financing, which is cheaper than equity, thus making it easier to invest"*[7]

Not everyone is in agreement, however. It should also be remembered that there are many other companies that have not followed suit in increasing leverage significantly and some have publicly rejected the "thin equity" models on the basis that the benefits to shareholders are not significant enough. In May 2002, Pennon ruled out the idea of securitising its water business because it would not create additional value. In May 2002 Kelda also drew a line under their lengthy refinancing efforts, as they concluded that the benefits to shareholders were limited.

Not all city analysts share SSSB's view that thin equity structures reduce the cost of capital significantly. Lehman's, for example, are more cautious:

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3 At the IEA Conference of May 2002, S&P noted that a key risk for water companies going forward was "(*E)rosion of cost of capital*", meaning that if highly leveraged structures proved to be a success, then Ofwat may reduce the industry WACC in line with the lower cost of capital estimates being quoted for the thin equity structures

4 "*If it turns out that DCC has found an innovative way of financing the regulated business that delivers a lower cost of capital, its advantage would probably be eroded over time, since there would be pressure on the rest of the industry to follow suit*", Moody's p.11, Dwr Cymru (Financing) Limited Pre Sale Report.

5 Financial Times, May 3, 2001.

6 "Reflections on Glas – A comparison with traditional water bond finance", RBOS Fixed Income, April 2001

7 "Corporate Restructuring: Journey or Destination", Keith Tozzi, Chief Executive, Swan Group, June 2002.

> *"We have consistently argued against 100% debt financing…debt may not always be much cheaper than equity for capital intensive utilities"*[8]

Lehman's also make the important distinction between reductions in the cost of capital that come about as a result of an increase in gearing *per se*, which they are sceptical about, and reductions in the cost of capital that come about as a result of "*the protections for financiers that are put in place around the income stream from the regulated business*", which they are more open about. In this paper we do not consider changes in the cost of capital that could come about thought the use of structured finance techniques.

Formal analysis by UK regulators of the relationship between the WACC and gearing is rare. At the PR99, Ofwat stated that "*financial projections underpinning price limits assume that companies will achieve, on average, gearing levels of about 50% over the period of the price limits*" and the WACC was accordingly calculated on the assumption of 50% debt. However, in their reports on SESW and MKW, the Competition Commission analysed how the WACC for these companies would change under different gearing assumptions and concluded that the WACC actually increased as gearing increased:

> *"We have assessed the cost of capital under three assumptions about debt share: 25, 35 and 50%. ...(T)he WACC increases with the debt share because an increased debt share increased the riskiness and hence cost of both equity and debt and this more than offsets the effect of debt being cheaper than equity"*[9]

Other regulators Ofgem (RECs 2000, NGC 2001, TransCo 2001)), CAA (BAA 2001), ORR (Railtrack 2000) have taken the opposite view to the Competition Commission and have recently assumed high levels of gearing in their WACC determinations, above the levels of gearing of the companies at the time of the price determination on the presumption that high levels of gearing are consistent with an efficient capital structure and lower WACC.[10]

Overall, it is clear that there are a number of differing views about what effect gearing up has on the WACC although there is often an absence of analytical rigour behind the arguments being put forward. In the next section we examine recent finance literature and seek to relate the evidence to the current context of the UK Water Industry.

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8 "Water Utilities", October 2001, p.11, Lehman Brothers

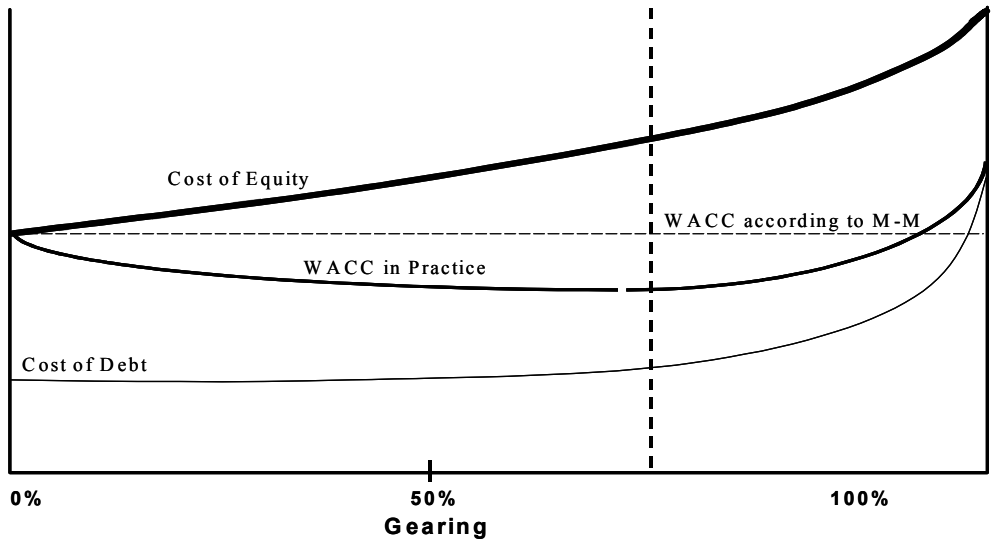
9 p137 Mid Kent Water, Competition commission 2000.

10 For example, Ofgem (2001) assumed a capital structure for TransCo of 62.5% even though at the time of the determination TransCo's gearing (net debt/RAV) was only 41%.

3. WHAT DOES THE FINANCE LITERATURE SAY?

Amongst the most popular theories of capital structure is the 'trade-off' theory which predicts that increasing gearing from low levels first decreases the WACC as a result of the debt interest tax shield but that, at a certain point, the expected value added by the interest tax shield is offset by the expected present value of the increased costs of financial distress include: direct bankruptcy costs (eg. court costs) but also indirect costs associated with high levels of gearing such as monitoring of restrictive covenants, low liquidity of trade credits etc.[11] The trade-off theory is illustrated below:

Figure 3.1
Trade-Off Theory of Capital Structure



The trade off theory predicts that the relationship between gearing and WACC will be influenced by two factors. First, the higher the corporate tax rate, the greater the decline in the WACC for each initial step increase in gearing as a result of the debt interest tax shield. Second, since bankruptcy risk is essentially a function of business risk, the trade off theory predicts that those companies with comparatively low business risk, such as water utilities, will be able to sustain higher levels of gearing before the expected bankruptcy costs outweigh the benefits of the corporate interest tax shield.

A fundamental assumption of the trade-off theory is that the cost of equity increases with increased gearing to reflect the fact that shareholders require a higher return to compensate for the increased financial risk as the prior claim of interest costs on a firm's profits rise. The standard assumption in the literature, which originates with Modigliani-Miller (1963), is that the relationship between the cost of equity and gearing is as follows:

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[11] It is also argued that debt can affect the efficient operations of the business: at high levels of debt managers become more preoccupied with meeting interest payments than making good operating decisions.

MM formula: $\beta_{equity} = \beta_{asset} (1+(1-T_c)*(D/E))$ (1)

where Tc is the corporate tax rate, D represents a company's debt, E represents a company's equity.

In recent years, a number of theories of capital structure have developed that suggest that the level of optimal gearing might not be as high as that predicted by the trade off theory. Perhaps the most important theory originates with Miller (1977) who proposed that the value of debt tax shields *can* disappear altogether when both personal and corporate income taxes are considered. This theory is based on the assumption that there are different personal tax rates on interest income across the economy. As the level of debt in the economy rises then firms and individuals with higher tax rates on debt would have to be attracted into the market for holding debt.[12] The Miller "equilibrium" predicts that the relationship between the cost of equity and gearing is as follows:

Miller formula: $\beta_{equity} = \beta_{asset} (1+(D/E))$ (2)

The following table shows the impact of gearing on beta under the two theories based on an asset beta assumption of 0.5, which is a reasonable illustrative assumption for a UK water company.

Table 3.1
Impact of Gearing on Beta

Gearing (D/(D+E))	Equity Beta (MM equilibrium)	Equity Beta (Miller equilibrium)
0%	0.50	0.50
10%	0.54	0.56
20%	0.59	0.63
30%	0.65	0.71
40%	0.73	0.83
50%	0.85	1.00
60%	1.03	1.25

Assumptions: T_c=30%

The table shows that the equity beta implied under the Miller equilibrium is higher than under the MM equilibrium. This implies that the cost of equity will be higher under the Miller equilibrium for any given gearing level.

[12] An example of this situation is where the marginal personal tax rate from stock income is lower than marginal personal tax rate on bond income. This can be possible for a number of reasons such as different classes of marginal investors in bonds and stocks which may be driven by institutional factors, the non-taxation of unrealised capital gains, the low tax bracket of recipients of dividend-paying stocks and the non-taxable status of several institutional investors

The Miller (1977) theory is aggressive in that it predicts that the whole amount of the debt interest tax shield will be offset by higher personal taxes, whereas a number of more recent studies have predicted that the amount of offset may be partial. A recent study by Graham (2002) suggests that personal taxes in the US offset 30-50% of the debt interest tax shield, meaning the relationship between beta and gearing lies between the two tabulated in Table 3.1 above.

Situations in which personal taxes can offset (or partially offset) the debt interest tax shield result when the marginal personal tax rate from stock income is lower than marginal personal tax rate on bond income. In the UK, reasons for this might include factors such as different classes of marginal investors in bonds and stocks, which may be driven by institutional factors; the non-taxation of unrealised capital gains; the low tax bracket of holders of dividend-paying stocks; and the non-taxable status of types of institutional investors (eg. pension funds). Following the recent change in the UK tax system with the abolition of imputation tax, the role of personal taxes in influencing optimal capital structure has become more apparent although the number of studies that have been undertaken to analyse their impact is limited. A reasonable assumption to make, though, is that personal taxes will offset the corporate tax advantage of debt finance to a similar extent as observed in the US classical tax system which recent studies have estimated at 30-50% of the corporate interest tax shield.[13]

A second reason why the WACC may not decline with increased debt as much as predicted by the conventional trade-off theory depicted in Figure 3.1 concerns the extent of non-tax costs such as capital allowances, an issue of particular relevance to the current context of the UK water industry. The effect of non-tax costs is that the effective tax rates (ie, the percentage of taxes paid in relation to regulatory profits) can be lower than the statutory rate in certain years, which reduces the value of the corporate tax shield. The water industry currently has significant capital allowances and is likely to have these well into the future as a result of large scale capital investment programmes. As a result, the tax advantage from debt is likely to be lower than for other companies.

Other theories originating with Miles and Ezzell (1980) have noted that the expected value of the corporate debt tax shield declines with increasing debt since as a firm increases its debt it becomes less likely that the firm will pay tax in any given state of nature. Again, this is important for the UK water industry where experience since privatisation shows significant year on year profit variability and more than the occasional instance of "exceptional" costs, meaning tax payments in any given year are uncertain.

The finance literature also notes that market liquidity plays an important role in capital structure decisions. In the context of the UK water industry, it has been well documented

[13] There are some subtle differences between the UK and US tax systems regarding the tax treatment of bond and stock income but the general tax rules regarding the non-taxation of unrealised capital gains, and tax exemptions offered for large institutions are similar.

that the cost of BBB rated debt and below is sometimes higher than appears to be justified on the basis of bankruptcy risk alone but that debt issues at these ratings often command a significant liquidity premium to compensate for low trading. Again this offsets any tax advantage from debt.

Related to the issue of market liquidity, a theory on optimal capital structure set out by Myers (1992) and analysed most recently by Baker and Wurgler (2002) builds on the pervasive empirical evidence of the inverse empirical relationship between debt usage and profitability. This theory asserts that capital structure is "*the cumulative outcome of attempts to time the equity market*". The theory is supported by empirical evidence that firms with high leverage are found on average to have raised debt when market to book ratios were below 1 and vice versa. Casual observation of the financing dynamics of the UK water industry and the relationship with Tobin's Q ratios lends support to this theory.[14]

From this brief review it is clear that optimal capital structure, and the relationship between gearing and the WACC, is a complex issue that may differ across companies and across time. As a general comment, the literature predicts that the main reason why increased gearing might lead to a lower WACC is as a result of the corporate debt tax shield but it also predicts that there are a number of factors that might offset the corporate debt tax shield such as personal tax effects, non-tax costs such as capital allowances, signalling effects and premia for reduced liquidity in debt markets. A detailed empirical study would need to be undertaken to examine the relative sizes of these effects for the UK water industry, although we have highlighted a number of reasons why these effects are likely to be more than insignificant. In particular, we believe that the structure of the personal tax system in the UK, the existence of large scale capital allowances and uncertainties over future profitability in the UK water industry, the existence of liquidity premia for low grade debt, and additional transaction/agency costs of debt finance are all important factors and would likely limit the ability of water companies to achieve a lower WACC through "gearing up" to high levels of debt.

One prediction that is largely non-controversial in the finance literature is that the cost of equity increases with gearing to compensate shareholders for increased expected volatility of earnings. To this day, the two main theories concerning the precise relationship between the cost of equity and gearing are attributed to Modigliani-Miller (1963) and Miller (1977) and are as shown in the equations (1) and (2) above. The other main theories of capital structure discussed in this section result predict a relationship between the cost of equity and gearing that lie between the predictions of these two models.[15]

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[14] See NERA Paper, "Evidence on the Cost of Capital for UK Water: An Analysis of Market to Asset Ratios", NERA June 2002.

[15] In his book on the cost of capital, Patterson (1995) notes: *"Two main theories relating debt usage to value have been developed in the financial literature, the Modigliani-Miller (MM) model and the Miller model…(I)n addition a number of models have been suggested that elaborate on these and that, in general result in effects that lie between the predictions of the main models".*

A nice summary of the predictions of finance theory on the relationship between gearing and the WACC, relevant to the context of the UK water industry, comes from Morin's (1994) textbook on regulatory finance:

> "*In the final analysis, finance theory provides limited guidance on what a company's capital structure should be precisely…(A)s a practical matter, the effect of capital structure on total weighted average cost of capital is likely to be minor over the range of capital structures usually found in the utility industry*".

Overall, it is hard to find any theoretical support from the finance literature to back some City claims that the WACC for UK Water could be reduced by 1-2% by gearing up. In the next section we examine relevant empirical evidence on the relationship between gearing and the WACC.

4. EMPIRICAL EVIDENCE

Perhaps the most persuasive empirical evidence comes from an examination of actual financing decisions of utilities over a period of time. If it were clear that increased leverage reduced the cost of capital for utility-type companies then it would be expected that this would be reflected in observed capital structures of utility companies over time.

The following table sets out empirical data on average gearing levels for utility companies, across different investment grade ratings. The table shows there are a wide range of gearing levels across different industries but that generally the gearing levels lie in the range of 40-60% for good investment grade ratings.[16]

Table 4.1
Median gearing ratios for a sample of global companies (%)

Company	**Rating**						
	Aa1	**A1**	**A2**	**A3**	**Baa1**	**Baa2**	**Baa3**
Electric utilities (transmission and distribution)	60	58	43	51	41	70	60
Electric utilities (vertically integrated)	38	46	50	52	55	50	57
Water utilities	51	-	50	57	48	-	-
Gas (local distribution)	53	41	51	56	64	56	-
Gas (pipelines)	-	-	59	54	52	69	-
Telecoms	27	77	43	37	41	37	56

Source: Moody's Investor Services (2001), 'Financial Ratio Medians for Global Investment Grade Corporates', January.

[16] There is also not a clear relationship between gearing and credit ratings, partly because of the diversity of business risk across companies

Examination of the capital structures of US companies, where access to liquid debt markets is easiest, also provides interesting results. Evidence from Valueline shows that the average gearing levels for water utilities (16 companies) in the US at January 2002 is around 40%. For the electricity industry (30 companies) average gearing levels are around 54% while for gas companies average gearing levels are around 40%.[17] For the US market as a whole, out of 7254 companies in the ValueLine database, the average gearing level is 22%.

In the US there is good reason to suppose that utility companies might have higher debt levels than those observed in the UK owing to the more stable nature (ie. lower risk) of their regulatory systems and competitive framework, and more liquid capital markets.[18] If higher debt levels were less expensive for these companies, it would be straightforward for companies to raise their ratios and US regulators would approve more highly leveraged capital structures. But, on both counts, this has not happened.

Empirical studies that attempt to differentiate between theories of optimal capital structure have been numerous but largely inconclusive. Patterson (1994) reports that "*There does appear to be a positive relationship between [Company Value] and the amount of debt used by a firm, at least up to some prudent level…but the evidence is not able to differentiate between competing theories*".

Other studies have looked more directly at the impact of changes in capital structure on the cost of equity.[19] Copeland and Weston (1993) and Morin (1994) provide a summary of the empirical evidence on the effects of changes in capital structure on beta estimates. Morin concludes that:

> "*the evidence strongly favors a positive relationship between leverage and the cost of equity which is consistent with the Modigliani-Miller proposition. However, there is still some controversy over the acceptance of the linear formulation…(S)ome investigators believe the relationship is curvilinear, others believe it is linear but has a slope of less than R-i.*".

The following table summarises empirical studies that look specifically at the impact of increased leverage on beta by comparison to the predictions of Modigliani and Miller.

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[17] The highest gearing levels in the US are for the automobile and truck industry which shows an average 66% gearing ratio.

[18] It is also unlikely that many US utilities would have capital allowances as great as that observed in the UK Water Industry.

[19] The effects of changes in capital structure on beta are difficult to test empirically. Often changes in capital structure are made simultaneously with new investment decisions and changes in business profile, making it difficult to separate out the financial impact on firm value from other effects.

Table 4.2
Effect of Gearing on the Cost of Equity: Empirical Evidence

	Result Change in cost of equity (bp) for each 100bp increase in D/(D+E)
Theory	
Modigliani-Miller 1963[1]	62
Miller 1977	237
Evidence	
Mehta, Moses, Deschamps and Walker (1980)	109
Gapenski (1986)	72
Brigham, Gapenski and Aberwald (1987)	117
Copeland and Weston (1995)	160
Graham (2002)	130

[1] *Consistent with corporate tax rates at 1963. With current corporate tax rates the MM theory predicts an increase in the CoE of around 150bp for each % increase in debt/(debt + equity) .*

In summary, although some of the studies are relatively dated it can be seen that they all predict a strong positive relationship between gearing and the cost of equity. Of the studies that have been undertaken, it can be seen that they estimate that the cost of equity changes by around 100-200bp by each % point change in D/(D+E). Generally, the studies that have been undertaken show a relationship between the cost of equity and gearing that lies in the middle of the predictions of the formulas by MM (formula 1) and Miller (formula 2) as set out above.

Based on these studies and the predictions of MM and Miller, what this means is that should the water industry increase its gearing from 50% to 75%, over the period of AMP3, then the cost of equity will be predicted to increase by around 3-5%.

5. NUMERICAL EXAMPLES

We now draw together our analysis of theoretical and empirical evidence of the relationship between gearing and the WACC by setting out our best estimate of the *relationship* between gearing and the post tax WACC and pre tax WACC over a range of gearing of 50%-75%. The lower bound of 50% debt is chosen as it represents the capital structure assumed by Ofwat at PR99; the upper bound of 75% debt is chosen as it represents more recent capital structures being chosen by some companies within the industry.[20]

[20] Some companies eg, SESW have higher gearing levels than 75%. For others, capital markets have argued that 75% senior debt represents an upper limit.

The following three important assumptions are made in 'NERA's central scenario:

1. We assume the cost of equity increases with gearing according to the average of the MMequation (1) and Miller equation (2):[21]

   NERA formula: $\beta_{equity} = (\beta_{asset} (1+(1-T_c)*(D/E)) + \beta_{asset} (1+(D/E)))/2$ (3)

2. We assume the cost of debt increases with gearing to reflect increased bankruptcy risk. We have assumed that at 75% gearing, the cost of debt will be consistent with BBB+ ratings whereas we have assumed that at 50% gearing the cost of debt will be consistent with single A ratings. Market evidence suggests that average costs of debt will increase by at least 25bp for each rating notch. We adopt a conservative assumption that at BBB+ the costs of debt for UK Water Companies will be 0.5% higher than the costs of debt at A.[22]

3. We assume the effective tax rate is 25% consistent with significant capital allowances within the industry.

In addition we also present a 'NERA Less Aggressive' scenario where we assume that the cost of equity does not increase as fast as implied by formula (3) above with increased gearing. In the 'NERA Less Aggressive' scenario we use the MM formula (1) instead. In this scenario we also assume that the company can maintain a single A rating at 75% gearing.

Estimates of the equity risk premium, asset beta, risk free rate and tax should be taken as 'illustrative' only. These parameters have not been explicitly considered in this paper and do not necessarily represent NERA's 'best estimates' or 'Preferred Values'. They do not affect the general conclusions.

Table 5.1
Impact of Change in Gearing on Post Tax WACC – NERA Estimates

[21] This is consistent with assuming that the benefit of the corporate debt tax shield is around 50%.

[22] See NERA Paper for Water UK: "Bankability and Financial Ratios" for a discussion of the relationship between the cost of debt and gearing.

	NERA Central Estimate			Less Aggressive Scenario
Gearing (D/(D+E))	25%	50%	75%	75%
Real risk-free rate (r_f)	3.00%	3.00%	3.00%	3.00%
Equity premium (ERP)	5.00%	5.00%	5.00%	5.00%
Asset beta (β_{asset})	0.50	0.50	0.50	0.5
Tax	0.25	0.25	0.25	0.25
Equity beta (β_{equity}) – NERA estimates	0.65	0.94	1.81	1.63
Cost of equity post-tax – NERA estimates[1]	6.23%	7.69%	12.06%	11.13%
Assumed Credit Rating	AA	A	BBB+	A-
Debt premium (DP)	1.00%	1.25%	1.75%	1.50%
Cost of debt (=r_f + DP)	4.00%	4.25%	4.75%	4.50%
Post-tax WACC – net of debt tax shield	**5.42%**	**5.44%**	**5.69%**	**5.31%**
Post-tax WACC – gross of debt tax shield	**5.67%**	**5.97%**	**6.58%**	**6.16%**
Pre-tax WACC	**7.23%**	**7.25%**	**7.58%**	**7.08%**

[1] *For columns 1,2 and 3 calculated as average M-M and Miller adjusted. For column 4, calculated as M-M on assumption of 100% tax shield utilisation.*

It is useful to distinguish the effect of increased gearing on the post tax WACC and pre tax WACC separately.

With regard to the pre tax WACC, this table shows that NERA's Preferred estimate of the Pre tax WACC increases slightly from 7.25% at 50% gearing to 7.58% at 75% gearing. This slight increase in the cost of capital at 75% gearing can be explained to be a consequence of the fact that an increase in debt share has increased the riskiness, and hence cost, of both equity and debt and this more than offsets the effect of debt being cheaper than equity and the benefits of the debt interest tax shield.

In column 4, we show that even if we make less aggressive assumptions regarding the *rates* at which the costs of debt and costs of equity change with increased gearing, namely that the company was still able to maintain a credit rating in the single A category at 75% gearing; and that the change in the cost of equity as gearing increases is best represented by the MM formula (1), then our estimate of the reduction in the pre tax WACC between 50% and 75% gearing is small at only around 15bp.

It is relevant to also consider the post tax WACC since Ofwat set allowed returns using a post tax WACC, with a separate allowance for taxes at the PR99 and has not indicated that this approach will be changed at the next review. What this means is that any attendant tax savings as a result of increased leverage will be passed on to customers at the next review. Past then shareholders of water companies do not keep the tax benefits of debt financing. As the table shows the post tax WACC (gross of debt tax shield) actually increases over the range of gearing being considered, even under the aggressive scenario, which is a direct consequence of increased bankruptcy risk.

It is useful to compare NERA's analysis with an alternative example that shows the WACC declining significantly as gearing increases. The following example is taken from a city analyst note (which is typical of many other examples):

Table 5.2
Impact of Change in Gearing on WACC – A City Calculation

Gearing (D/(D+E))	**Case 1- Ofwat's calculation**	**Case 2- 90% gearing, unflexed cost of equity**	**Case 3 – 90% gearing, flexed cost of equity**	**Case 4 – 90% gearing, market cost of equity**
Real risk-free rate (r_f)	2.75%	2.75%	2.75%	2.75%
Equity premium (ERP)	3.50%	3.50%	*3.50%*	
Tax	0.3	0.3	*0.3*	
Equity beta (β_{equity})	0.75	0.75	*2.10*	
Cost of equity post-tax	5.4%	5.4%	10.0%	12.0%
Debt premium (DP)	1.75%	1.75%	*1.90%*	*1.90%*
Post tax cost of debt (=r_f + DP)	3.2%	3.3%	*3.3%*	*3.3%*
Post-tax WACC – net of debt tax shield	4.26%	3.47%	*3.93%*	*4.13%*

On the basis of this analysis, it is concluded that increased gearing could probably result in a costs of capital "*towards the bottom of the range quoted above, provided that structures are put in place that minimise the risk of the business and the cost of debt*".

The crucial differences between the assumptions made by NERA in Table 5.1 above and the assumptions made by in Table 5.2 above are as follows: (i) NERA assume that the cost of equity increases by 3-5% from an increase in gearing from 50-75% in accordance with the evidence presented in sections 3 and 4 above. By contrast, the preferred scenario assumes that the cost of equity does not increase at all with increased gearing; (ii) NERA assume that the cost of debt increases by 0.5% from 50% gearing to 75% gearing in accordance with current evidence from debt capital markets. By contrast, it is assumed in Table 5.2 above assume that the cost of debt would only increase by 0.2% from a bigger increase in gearing from 50% to 90%.