OXERA

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ENERGY NETWORKS ASSOCIATION

COST OF CAPITAL UPDATE

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Executive Summary

- This paper updates previous analysis by OXERA for the Energy Networks Association (ENA)/Electricity Association on the weighted average cost of capital (WACC) for distribution network operators (DNOs). This previous work, completed in May 2003, concluded that the pre-tax cost of capital for DNOs was likely to be at least 7%, or 5.5% on a post-tax basis, for the 2004 distribution price control review (DPCR4).

- At the time the first paper was written, it was agreed that it would be necessary to update this assessment closer to the time when Ofgem would be making its final decision on this matter. This is the purpose of this paper. Specifically, it examines the market, academic and regulatory evidence that has emerged since the completion of the previous paper, in order to see whether the assessment of the WACC needs to be altered.

- The conclusions that have been reached on each of the components of the WACC, assuming use of the capital asset pricing model (CAPM) to estimate the cost of equity, are outlined in the table below.

Parameter	Low estimate	High estimate
Risk-free rate (%)	2.25	2.75
Equity risk premium (%)	3.0	5.0
Equity beta	1	1
Post-tax cost of equity (%)	5.25	7.75
Debt premium (%)	1.25	2.0
Pre-tax cost of debt (%)	3.5	4.75
Gearing (%)	50	50
Pre-tax debt, post-tax equity (%)**WACC**	4.38	6.25
Taxation adjustment	1.429	1.429
Pre-tax debt, pre-tax equity WACC (%)	5.50	7.91

- It can be seen that, on most of the parameters, there has been no change to the estimates provided in the previous paper. The mid-point of the range is just over 6.7% (pre-tax). However, in order to reflect the increasing investment requirements in the sector, the fact that evidence from the dividend growth model and from the recent equity issue by United Utilities is consistent with the upper end of the CAPM cost of equity range, it is recommended that a cost of capital of at least 7% is assumed for the purpose of the distribution review.

- On the risk-free rate, there is little evidence that the yields on government bonds have changed substantially over the period since the previous paper, while further regulatory precedence from the Competition Commission has supported the use of a premium over current yields when determining expected future rates.

- the ERP estimates are also similar to those used in the previous paper, although a further review of the academic evidence that has emerged in the period since the original document was prepared has highlighted the range of uncertainty regarding this parameter. As a result, although a mid-point estimate of 4% is retained in the WACC assessment, the spread has been increased to 3–5%, compared with 3.5– 4.5%. The mid-point of this

range remains slightly above the range implied by recent regulatory precedence—although, when adjustments made by the Commission are taken into account, it is shown that it has estimated ERP in the region of 3.75%. Empirical work demonstrates that average premia on equities have been above 5% during most of the twentieth century. However, there are a number of reasons to suggest that the use of such values may overstate the true *ex ante* risk premium, in particular due to unanticipated factors (especially inflation and stock returns) and changes in the market, including a reduction in transactions costs. However, there continues to be considerable evidence that stock markets are more risky than when Ofgem made its determination of 3-4% at the last review. Interestingly, Dimson, Marsh and Staunton have published an update to their previous analysis. This earlier analysis had driven Ofgem's and the Commission's adoption of an ERP at the lower end of range—of approximately 2.5%. Dimson, Marsh and Staunton's most recent analysis concludes that an appropriate value for the global ERP is between 3%, on a geometric averaging basis, and 5%, on an arithmetic averaging basis, consistent with a wider review of the evidence. .

- There has been no change to the gearing assumption used within the cost of capital calculation, for a number of reasons. First, the use of a higher gearing assumption, closer to that reported by Ofgem as the industry average, would be likely only to increase further the incentives on DNOs to gear up. This would seem perverse, given that elsewhere in the regulatory settlement Ofgem is seeking to reduce the incentives on companies to gear up. Second, as discussed in detail in the OXERA report for Ofwat, there are other reasons why a higher-gearing assumption may be inappropriate, such as the potential increase in systemic risk, or the fact that the private cost of debt may be lower than the social cost of debt, and that it would consequently be inappropriate for Ofgem to reflect this mispricing in its cost of capital calculation. Finally, as acknowledged by the CAA, and reviewed extensively in the OXERA paper on cost of capital for OFWAT[1], there is no theoretical or normative model that gives an unequivocal prediction as to what the optimal gearing level may be. This suggests that empirical regularities may be the most appropriate basis for making any assumption, and, as shown in the previous OXERA paper for the Electricity Association, considering a range of utilities, both national and international, and over a sustained period of time, the evidence indicates that 50% gearing levels tend to be most frequently observed.

- The updated analysis of beta continues to demonstrate that betas in the utility sector have trended downward, and are currently at low levels—typically 0.3–0.5, compared with levels around 1, which have been assumed by regulators on the basis of relatively high gearing levels observed. While a systematic decomposition of betas is beyond the scope of this cost of capital update, a number of hypotheses may be put forward to explain the relatively low betas observed. One possibility is that the market has been through several periods of high volatility in recent years, although this has affected certain sectors to a much greater extent than others, such as technology, media and telecoms stocks. Utility stocks have been relatively unaffected by these recent trends, resulting in a substantial fall in measured betas. However, this paper argues that it would be risky to assume that

[1] OXERA (2002) 'The Capital Structure of Water Companies', report for Ofwat, October.

utility stocks will not correlate more closely to the market in the future, and that the use of very low betas may even give the counter-intuitive outcome that measured debt premia are greater that the measured premium on equity returns. Furthermore, there does not appear to be any real evidence that investors perceive the regulatory regime to be less risky than previously: if anything, the difficulties encountered by a number of regulated businesses since the last DPCR, including Network Rail, NATS, and Hyder, might suggest that investors may be more wary of utility businesses in future.

- The paper does suggest, however, that it may be appropriate to alter the range for the debt premium, which it had previously been argued should be at least 200 basis points. The new analysis suggests that a range of between 1.25 and 2% would be more appropriate. Both these figures rely on the use of historical averages. The low end of the range represents the average debt premium of DNO debt over the past five years, for which information is available. The high end of the range represents the average premium for BBB-rated debt over the past five years, reflecting the fact that almost one-third of DNOs have a credit rating of BBB+ (negative outlook) or worse. It is recognised that credit spreads on utility bonds are currently at a level below this range—typically around 50 to 100 basis points, reflecting the need for a prudent approach to reflect the risk of a change in market environment.

- In light of the ongoing discussions within the industry as to whether a pre- or post-tax cost of capital is the more appropriate, both are calculated below. The pre-tax cost of capital assumes that tax will be levied at 30% and that a tax wedge of 1.429 is therefore appropriate, while the post-tax cost of capital is, in fact, a pre-tax debt, post-tax equity WACC.

- The end result of these adjustments is that a range is identified for the WACC of 5.5–7.9% (pre-tax) or 4.4–6.3% (post-tax). The midpoints of these ranges are 6.7 and 5.3% respectively. However, for three distinct reasons, it is proposed that it would be inappropriate for Ofgem to use this midpoint in making its determination for the appropriate WACC for DNOs.

  – First, alternative measures of the cost of equity, such as the dividend growth model (DGM) (a model Ofgem has committed itself to use as a check on the results of the CAPM) suggest that cost of equity figure toward the higher end of the range may be appropriate. The range for the cost of equity derived from this methodology is between 6.96% and 7.75%, assuming current and recent distribution company dividend yields, and ongoing growth in the distribution dividends compared with the 5.75–7.25% established from the CAPM. The paper discusses two explanations of what might be driving this distinction, based on theoretical literature, and shows that both are of some relevance in the distribution sector.

  – Second, a wide variety of stakeholders have acknowledged that DPCR4 will present a significant investment challenge to the DNOs, both to facilitate distributed generation and in terms of asset renewal and replacement. In these contexts, there is a wealth of regulatory precedent to suggest the use of a cost of capital figure higher than the midpoint of the range identified, in part to recognise the serious negative consequences that would arise from the adoption of a cost of capital below that which is required by investors. The paper shows that, even

within the last year, the CAA adopted this approach in relation to the investment programme faced by BAA, and presents evidence that international regulators adopt this approach.

- Finally, there are a number of issues that may affect a firm's cost and revenue volatility, and/or their financing costs that have not been explicitly considered in this paper. These include the uncertainties surrounding the investment for facilitating distributed generation (as opposed to simply its magnitude), and the extension of the Information and Incentives Project (IIP). Similarly, the paper does not make an explicit adjustment to deal with the problem of embedded debt, recommending instead a company-by-company approach.

- Given the above considerations, it is proposed that the WACC for the DNOs be set at a level of at least 7% on a pre-tax basis, or 5.5% on a post-tax basis.

Contents

1. Introduction

Between February and May 2003, OXERA produced a paper for the Electricity Association[2] providing an initial assessment on the weighted average cost of capital (WACC). This concluded that, on a pre-tax basis, the appropriate range for the cost of capital was 6.2–7.6%[3] and that, bearing in mind the uncertainties in the parameter estimates, the need for substantial future levels of investment and the potential increase in risk resulting from the IIP and distributed generation, the minimum level was likely to be at least 7%[4].

When the original paper was provided, it was agreed that it would be appropriate to update this analysis closer to the time when Ofgem would make its determination. This is the purpose of this paper. Its structure is relatively straightforward, derived from the structure of the previous paper. Taking each of the components of the WACC, and including a section on the alternative to the standard use of the capital asset pricing model (CAPM) for estimating the cost of equity, it first summarises the arguments used in the May 2003 paper, then turns to look at market, academic and regulatory evidence that has since emerged and which may inform understanding of DNO's cost of capital. The paper is therefore structured as follows:

- section 2 updates the analysis relating to the cost of equity, as estimated using the CAPM;
- section 3 considers the evidence regarding other models that seek to explain the cost of equity, and examines possible reasons for the discrepancies observed;
- section 4 assesses the recent evidence on the cost of debt parameters.

As the paper is an update, an understanding of the theoretical underpinnings of the models, and components within them, is assumed. These issues are discussed in detail in the collection of work that contributed to the May 2003 paper.

[2] OXERA (2003), 'The Cost of Capital for Distribution Network Operators', May 2nd.
[3] On a pre-tax debt, post-tax equity WACC basis, this is equivalent to between 5% and 6%
[4] 5.5% on a pre-tax debt, post tax equity basis.

2. The Cost of Equity using CAPM

The standard model for assessing the cost of equity is the CAPM. This states that the cost of equity, is given as:

$$E[R_e] = R_f + \beta * (E[R_m] - R_f) \quad \text{(Equation 2.1)}$$

where:

$$\beta = \frac{Cov(R_e, R_m)}{Var(R_m)} \quad \text{(Equation 2.2)}$$

$E[R_e]$ is the cost of equity, β is the correlation between the firm and the market, and $(E[R_m] - R_f)$ is the equity risk premium (ERP). There are therefore three parameters that need to be estimated to assess the cost of equity under the CAPM: the risk-free rate; the ERP; and the (equity) beta. These are considered in turn.

2.1 The risk-free rate

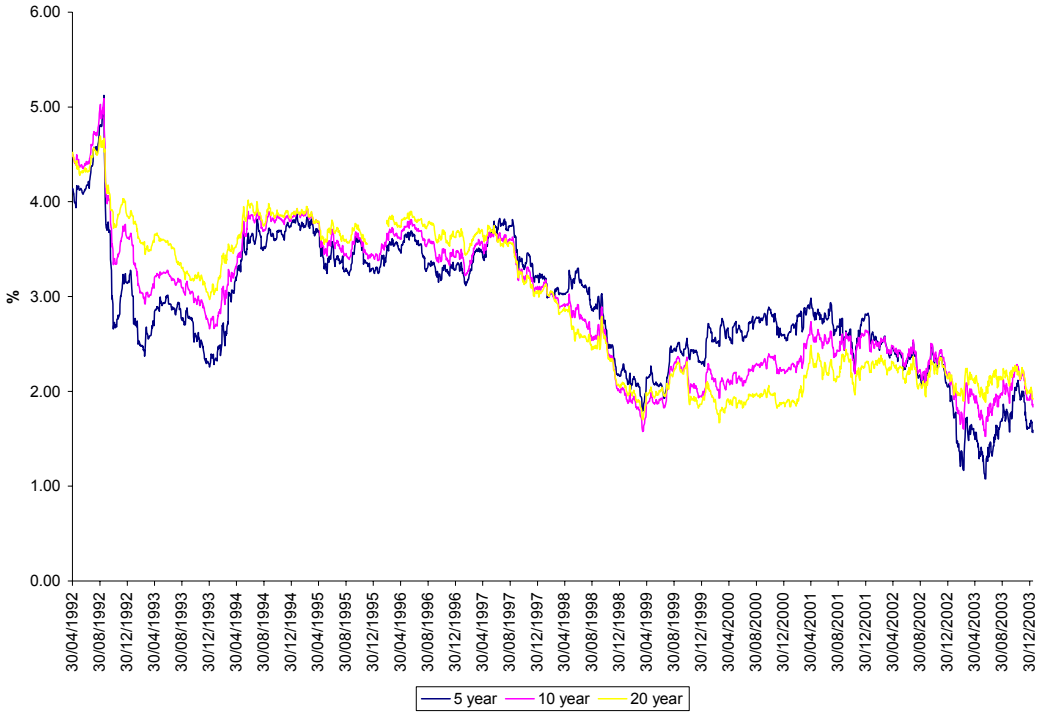
2.1.1 Summary of previous paper

The May 2003 paper estimated that the appropriate range for the risk-free rate should be between 2.25 and 2.75%. This conclusion was reached on the basis that current evidence on various maturities of index-linked gilts (five, ten and 20 years) was towards the lower end of this range, while historical averages, to which it was suggested there might be a return, suggested a higher level. The most recent regulatory determinations at this time were in the range of 2.5–3%. However, it was suggested that this parameter, in particular, might be subject to future upward revision, especially in light of the expected increase in government debt issuance.

2.1.2 Market evidence

Figures 2.1 and 2.2 show real five-, ten- and 20-year zero coupon yields over two time periods, from October 2002 (when the previous analysis concluded) to the latest date for which information is available, and back to May 1992, so that these recent movements may be placed into historical context.

Figure 2.1: Real five-, ten- and 20-year zero coupon yields since May 1992



Source: Bank of England.

Figure 2.2: Real five-, ten- and 20-year zero coupon yields since October 2002

Source: Bank of England.

Together, Figures 2.1 and 2.2 show that, despite some fluctuation, gilt yields have not changed substantially since October 2002. This is particularly the case for debt of ten- and 20-year maturities, which have yields at around 2%, as they were in October 2002. Although there has been a slight decline in yields for debt of five-year maturity, arguably this is of less importance for DNOs whose debt portfolios tend to consist mainly of debt with longer maturities.[5] Moreover, as can be seen from Figure 2.1, these spot rates are well below the longer-term averages that are given in Table 2.1.

Table 2.1: Average yields for zero coupon bonds (%)

Period for averaging	5-year maturity	10-year maturity	20-year maturity
5 years	2.31	2.19	2.08
10 years	2.82	2.79	2.76

Source: Bank of England and OXERA calculations.

As emphasised in the previous paper, it would be inappropriate for Ofgem to set the risk-free rate parameter according to current spot rates, if there was a reasonable belief that the average yield on zero coupon yields over the five years of the next review period is likely to be noticeably higher than the present spot rates. One source of market-based evidence that can inform this decision, as recommended in the Smithers and Co report,[6] is evidence from forecasting organisations. Interestingly, the latest National Institute Economic Review stated that:

> By historical standards current short-term interest rates are unusually low; it makes much more sense to expect a rise than a fall for the simple reason that one of the best ways of forecasting the medium term is on the basis of experience in the recent past. This rise in expected future interest rates has been part of an international phenomena [sic].[7]

Although this reference is concerned explicitly with short-term interest rates, there is little reason to believe that the same will not be the case for debt further out along the yield curve.

2.1.3 Academic evidence

Conceptually, the argument that information other than just the existing spot rate should be used to inform forward-looking estimates of the risk-free rate rests on the assumption that there is some systematic pattern to the behaviour of this economic variable. In particular, if it can be shown that interest rates are 'mean-reverting'—ie, that there is some equilibrium level towards which the variable tends, despite random variation—then historical estimates would provide a useful indication of both the mean level to which the variable reverted, and the speed of this reversion. The alternative scenario would be that the variable follows a 'random walk', in which case there would be no way in which the past could be used to predict the future, and the best estimate of future values would be the present spot value.

[5] A non-weighted average of a sample of DNO debt, used later in the paper, suggested that portfolios had an average debt maturity of 20.6 years.
[6] Smithers & Co (2003), 'A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK', February 13th.
[7] Weale, M. (2003), 'Commentary: The UK Economy' *National Institute Economic Review*, No. 186, October.

In light of this theory, it is interesting to note that a paper published in 2002 suggests that UK real interest rates are indeed mean-reverting.[8] Coakley and Fuertes examine data for the UK between 1950 and 1999, and conclude that there is statistically significant evidence that real interest rates are mean-reverting, although the speed of this reversion is quicker when rates are above, as opposed to below, their long-term value. As the authors note, this is consistent with a series of other studies on the behaviour of UK real interest rates, including Harvey et al, Tzavalis, and Andreou et al.[9] Although these results were observed in relation to short-term interest rates, given the close links between interest rates for short-term debt and debt further along the yield curve, there would seem little reason to doubt that similar behaviour could be uncovered for such longer-term debt.

2.1.4 Regulatory precedents

Since the previous OXERA paper, there have been three regulatory determinations, all of which provide support for evidence other than just the present spot rates to be taken into account when reaching a decision regarding the risk-free rate. However, where an explicit determination has been reached, it has tended to be lower than the determinations between 1998 and 2000—where rates as high as 3.8% were discussed—while still within the range identified in the previous OXERA paper. Most explicit was the Competition Commission decision in the inquiry into mobile-phone call-termination charges. In this case, the Commission stated:

> Bearing all these factors in mind, and reflecting the continuing downward trend in the underlying rates, we have used a range for the real risk-free rate of 2.5 to 2.75 per cent. While this is below the range of 2.75 to 3.25 per cent used by the CC in the water inquiries, it is above the current spot rates, which have recovered slightly to around 2.2 per cent from their level in 2000 of around 2 per cent.[10]

Within this range, the Competition Commission ultimately used a figure of 2.6%. Furthermore, although it stated that spot rates stood at 2.2% at the time it reached its decision, OXERA analysis suggests that they were very similar to present spot rates, with a simple average of the 5-, ten- and twenty-year zero coupon yields being almost exactly 2%. This would suggest that the Commission provided a premium of 60 basis points, rather than 40, implied by the quote above.

The other regulatory determinations have been less explicit. In its review of BAA's airports,[11] the CAA, which followed the recommendations of the Competition Commission, did not explicitly discuss the risk-free rate. However, it did endorse the Commission's conclusions on the cost of equity. This implied acceptance of a risk-free rate in the range 2.5–2.75%—again, above the spot rates at the time of the determination. Finally, in its review of Network Rail's access charges, the ORR did not disaggregate Network Rail's overall cost of debt into a risk-free rate and debt premium figure, but did nonetheless state that its overall figure was informed by the fact that:

[8] Coakley, J. and Fuertes, A.-M. (2002), 'Asymmetric Dynamics in UK Real Interest Rates', *Applied Financial Economics*, **12**, 379–87.

[9] Harvey, D., Leybourne, S. and Newbold, P. (1998), 'How Great are the Great Ratios?', Economic Research Paper 98/6, Loughborough University. Tzavalis, E. (1999), 'A Common Shift in Real Interest Rates Across Countries', *Applied Financial Economics*, **9**, 365–9. Andreou, E., Osbourne, D. and Sensier, M. (2000), 'A Comparison of the Statistical Properties of Financial Variables in the USA, UK and Germany over the Business Cycle', *The Manchester School*, **68**, Special Issue Topics in Macroeconomics, 396–418.

[10] Competition Commission (2003), 'Vodafone, O2, Orange and T-Mobile: Reports on References under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks', February 18th.

[11] CAA (2003), 'Economic Regulation of BAA London Airports (Heathrow, Gatwick, Stansted) 2003–2008 CAA Decision'.

> Recent movements in the UK bond markets suggest that future interest rates are likely to be more in line with the five year average than the relatively low rates of the last two years.[12]

These recent determinations are in keeping with a strong regulatory precedent to make an assumption on the risk-free rate that incorporates a premium on the spot rates at the time—see Table 2.2.

Table 2.2: Regulatory determinations on the risk-free rate and implied premia

Regulator	Case (date)	Assumption (%)	Maturity			Margin[1]	Embedded debt adjustment?
			5-yr	10-yr	20-yr		
Ofwat	Water companies (Nov. 1999)	2.5–3	2.44	2.21	2.13	0.49	yes
Ofgem	Electricity distribution companies (Dec. 1999)	2.25–2.75	2.41	2.10	2.00	0.33	yes
Competition Commission	WOC cases (Aug. 2000)	3 (2.75–3.25)	2.66	2.17	1.91	0.75	yes
Ofgem	NGC transmission (Sept. 2000)	2.5–2.75	2.70	2.22	1.94	0.34	no
ORR	Railtrack (Oct. 2000)	3 (2.75–3.25)	2.77	2.29	1.97	0.66	no
Oftel	BT Retail (Feb. 2001)	2.6[2]	2.64	2.24	1.88	0.35	no
Oftel	Mobile—effective competition review[3] (Sept. 2001)	2.7[4]	2.71	2.50	2.23	0.22	no
Ofgem	Transco transportation and metering (Sept. 2001)	2.75	2.71	2.50	2.23	0.27	no
Ofgem	Independent gas transporters[5] (Feb. 2002)	2.75	2.64	2.53	2.27	0.27	no
Ofreg	Northern Ireland Electricity transmission and distribution (Mar. 2002)	2.75	2.58	2.52	2.29	0.29	no
CAA	Airports[3] (Mar. 2002)	3	2.58	2.52	2.29	0.54	no
Competition Commission	Airports (Nov. 2002)	2.50–2.75	2.27	2.31	2.18	0.37	no
Competition Commission	Mobile network operators (Feb. 2003)	2.50–2.75	1.84	2.06	2.11	0.62	no

Notes: [1] Margin provided on current rates has been estimated as the difference between the midpoint of the regulators' determination and the simple average across the yields on the different maturities of the zero-coupon gilts. [2] Oftel's cost of capital is in *nominal* terms, assuming an inflation rate of 2.4%; this assumption has been used for the purposes of the table to give an equivalent in real terms. [3] Reference to the Competition Commission. [4] Oftel's cost of capital is in *nominal* terms, assuming an inflation rate of 2.2%; this assumption has been used for the purposes of the table to give an equivalent in real terms. [5] Consultation document.

Sources: Various Ofgem, Ofreg, Ofwat, ORR, CAA, Oftel and Competition Commission reports.

[12] ORR (2003), 'Access Charges Review 2003: Final Conclusions', December.

2.1.5 Conclusion on the risk-free rate

Perhaps contrary to expectations, the spot yields for zero coupon bonds have not increased since the previous OXERA paper; that said, yields have not declined any further—particularly for that debt which is more relevant for DNOs. Furthermore, during this period of relatively stability in such yields, the Competition Commission and the CAA have determined/endorsed a range for the risk-free rate of 2.5–2.75%, representing a significant premium on the spot rates at the time. This is a practice that, as shown above, has considerable regulatory precedent. Finally, academic evidence released in the past year also supports the consideration of historical averages when setting the forward-looking risk-free rate.

On this basis, it would appear that a range of 2.25–2.75% for the risk-free rate, as estimated in the previous paper, would continue to be appropriate.

2.2 Equity risk premium

2.2.1 Summary

The ERP is a generic parameter that measures the *expected* additional return demanded by investors for holding equities rather than risk-free assets. In general, they can be calculated using one of two approaches:

- *historical averages*—by considering the actual additional return on equities received by investors in the past, on the basis that this should, on average, also reflect the additional return required by investors;
- *(semi-) ex ante models*—the use of market valuation models to give forward-looking estimates of expected equity returns.

Of these two approaches, Ofgem has tended to favour the second—the forward-looking estimates.

The previous OXERA paper concluded that a range of 3.5–4.5% for the ERP was appropriate, compared with the 2–5% range identified by Ofgem in DPCR3, where a midpoint of 3.5% was used. This was based partly on analysis that suggested that market volatility had increased since the previous review, while the higher end of the range was consistent with data from historical averages.

2.2.2 Market evidence

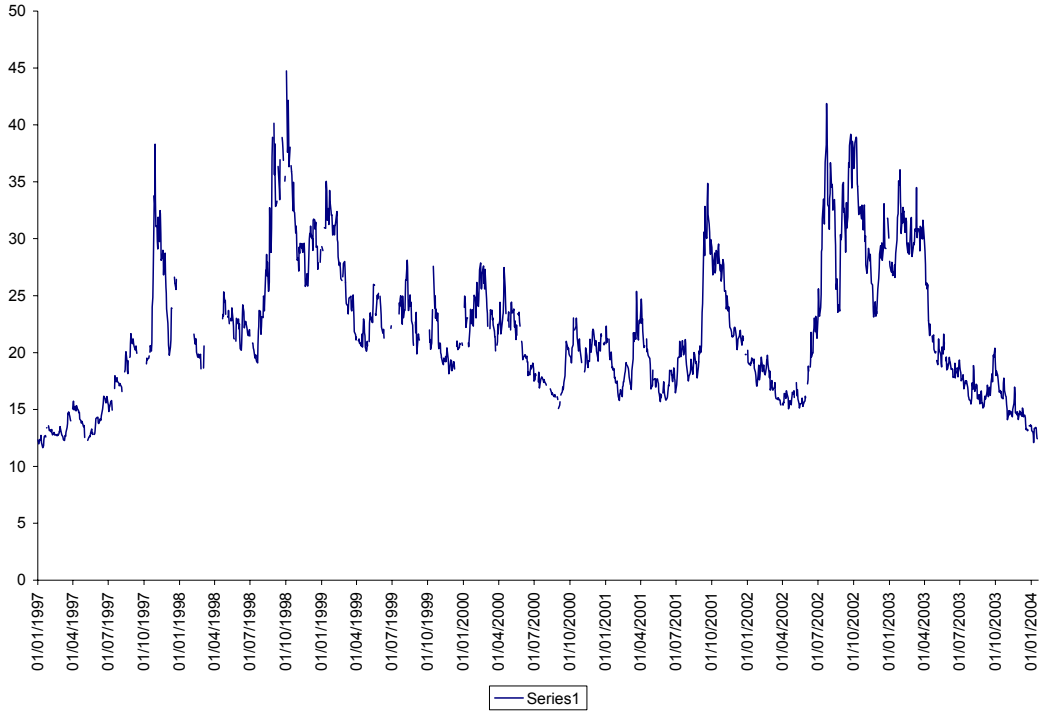
As stated above, there is considerable market evidence to support the view that the equity market, as a whole, has become more volatile since DPCR3, and that this should be reflected in a higher parameter estimate for the ERP than the 3.5% allowed for by Ofgem at DPCR3. For instance, over the course of the previous review, the FTSE 100 reached a high of 6,950.6, fell as low as 3,277.5 (a fall of more than 50% from its peak) and currently stands at 4,496.4.[13] Given this, it would not be surprising if equity investors perceived the stock market as more risky than five years ago.

A useful measure that aids understanding of the extent to which this risk has increased is data on implied volatility derived from options on the FTSE 100 index. As explained in the previous paper, this is a forward-looking measure of the expected variance in a financial instrument over the life of

[13] Opening value, January 19th.

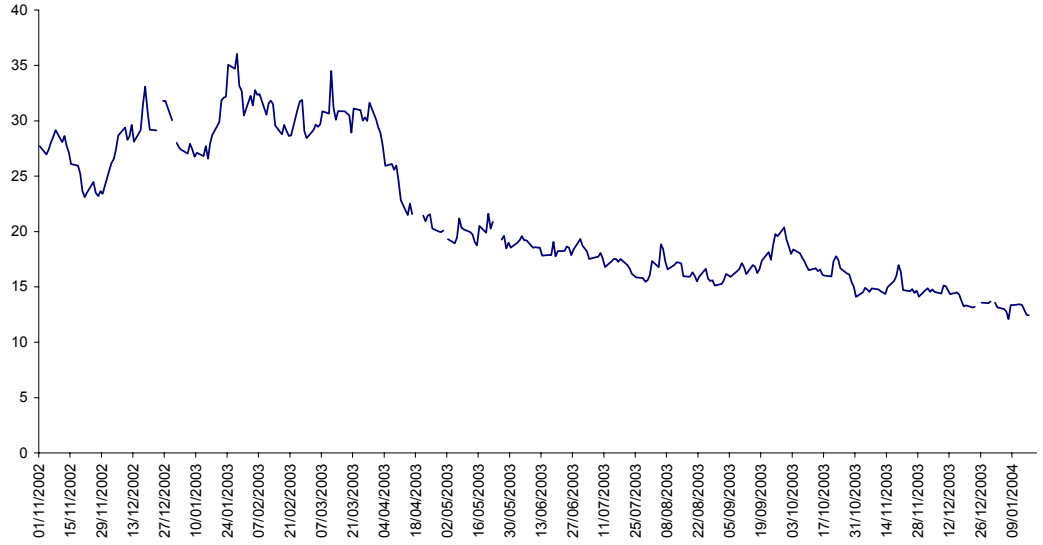
an option written on it. As with the yields on government bonds, Figure 2.3 updates the previous analysis by considering recent evidence in the context of a historical experience—in this case, from January 1997. Figure 2.4 then highlights how this variable has changed since the completion of the previous paper, which included data up to November 2002.

Figure 2.3: Implied volatility from January 1997



Source: Bank of England.

Figure 2.4: Implied volatility since November 2002



Source: Bank of England.

These graphs show that for part of the period since the previous analysis concluded, there was a continuation of a historically very high degree of volatility. However, since around March 2003, there has been a marked decline in the degree of volatility, to levels close to that observed in early 1997. Nonetheless, the existence of two significant—and, in the second instance, particularly prolonged—peaks of volatility within this price-control period are an important point that needs to be borne in mind when assessing the appropriate ERP.

An additional market measure developed in the previous paper used a dividend growth model (DGM) approach to develop an ERP estimate, following the precedent established by the Competition Commission in its 2002 report on airports.[14] It was noteworthy that using the most recent data available at the time the report was written suggested an ERP estimate above 4%. Table 2.3 updates the table in the previous report, based on data for the dividend yield during 2003, and the latest estimates, from three separate indices: the FTSE All-share, FTSE 100 and the FTSE 30.

Table 2.3: DGM-based estimates of the ERP

Model parameter	2003	Latest
Dividend yield		
FTSE All-share	3.44	3.06
FTSE 100	3.50	3.18
FTSE 30	4.11	3.63
Growth rate assumed	2.25–2.5	2.25–2.5
Risk-free rate	1.88	1.88
ERP estimate		
FTSE All-share	3.80–4.05	3.43–3.68
FTSE 100	3.86–4.11	3.55–3.80
FTSE 30	4.48–4.73	4–4.25
ERP average	**4.05–4.30**	**3.66–3.91**

Notes: the growth rate of dividends is assumed to be linked to GDP; the risk-free rate is based on the real zero coupon yield on bonds with a maturity of 10 years as of January 16th 2004.
Source: Datastream and OXERA calculations.

This table shows that, consistent with the earlier papers, this methodology suggests that the ERP in 2003 was above 4%. Although the latest estimates suggest some fall from this level, it is noteworthy that the higher end of these estimates remains close to 4%.

2.2.3 Academic evidence

Two significant academic papers considering the ERP were published in 2003. The most important results within these papers are discussed below.

[14] Competition Commission (2002), 'BAA plc: A report on the economic regulation of the London airport companies (Heathrow Airport Ltd, Gatwick Airport Ltd., and Stansted Airport Ltd', November.

- Dimson, Marsh and Staunton have updated their earlier work on the ERP,[15] which suggested that a plausible forward-looking ERP for the UK ranged from 2.4% (geometric averaging) to 3.7% (arithmetic averaging), and, using a global approach, a range of between 3% (geometric average) and 4% (arithmetic average) was reasonable. Interestingly, their latest work suggests that higher forward-looking premia may be appropriate.[16] Their new estimates for the UK suggest a geometric average of 3.9% and an arithmetic average of 5.9%. However, the Smithers & Co study for the Joint Regulators argued that the decision on the ERP should be informed by international, as well as UK, evidence.[17] In this regard, Dimson, Marsh and Staunton conclude their paper by stating that:

  > This suggests that a plausible forward looking risk premium for the world's major markets would be on the order of 3% on a geometric mean basis, while the corresponding arithmetic mean risk premium would be around 5%

  These results may well be important, as it appears that the earlier work by these authors was one of the key drivers of the lower end of the estimates made by the Competition Commission and Ofgem in recent years.

  A great deal of work has been carried out on examining the extent to which historical measures of the ERP reflect investors current and future expectations; these measures typically provide an estimate of approximately 4–5% if geometric averaging is performed, or 6–7% adopting arithmetic averaging[18]. The main factors that have been identified are as follows:

  – *Diversification and transactions costs*—work by Siegel (1998) has examined the effect that improved diversification, wider share ownership, and lower transaction costs of share trading have had on net returns. As prospects for diversification have improved, and transactions costs fallen with the advent of mutual and index funds, the required gross return on stocks relative to bonds may be less than that which has been historically measured.

  – *Unexpected cash flows*—there is some evidence from academic work that equities have exceeded expectations over a long measurement period, reflecting unprecedented growth in productivity and efficiency. Furthermore, inflation shocks post-World War II would have reduced gilt returns below expectations.

- Using a novel, simulation-based approach, Donaldson, Kamstra and Kramer have undertaken analysis to see what values of the *ex ante* ERP are most likely to be consistent with certain observed financial variables in the US economy.[19] They conclude that, although

[15] Dimson, E., Marsh, P. and Staunton, M. (2002), *Triumph of the Optimists: 101 Years of Global Investment Returns*, New Jersey, Princeton University Press.
[16] Dimson, E., Marsh, P. and Staunton, M. (2003), 'Global Evidence on the Equity Risk Premium', Institute of Finance and Accounting, Working Paper 385.
[17] Smithers & Co (2003), 'A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK', February 13th.
[18] These ranges, reported in Dimson, Marsh and Staunton (2003), are consistent with work by other academics, notably Diamond (1999), 'What Stock Market Returns to Expect for the Future', An issue in brief, Center for Retirement Research at Boston College.
[19] Donaldson, G., Kamstra, M. and Kramer, L. (2003), 'Stare Down the Barrel and Center the Crosshairs: Targeting the Ex Ante Equity Premium', Federal Reserve Bank of Atlanta, Working Paper 2003–4, January.

> *ex post* ERP in the US economy tends to be around 6%, the *ex ante* ERP is likely to be very close to 4%. Moreover, they report that these results are 'surprisingly robust to changes in the parameter values underlying the study.'

In summary, recent academic evidence would tend to support the case for making some adjustments to the historical values of the ERP in order to reflect changes in the market environment over long periods of time, in addition to various measurement issues. Taking these factors into account, a range centred around 4% would appear reasonable.

2.2.4 Regulatory precedents

As with the risk-free rate, the only regulatory determination to consider explicitly the ERP since the previous OXERA paper was written was the Competition Commission in its inquiry into call termination charges on mobile-phone networks.[20] In this, the Commission concluded that the ERP was between 2.5 and 4.5%, with a midpoint of 3.5%. This was based primarily on the fact that market conditions suggested that there had been 'a continuing downward trend in historical data and recent academic opinion.'

However, interestingly, the Commission added that:

> This range [of the ERP] is below that used in the two previous regulatory reports of the MMC/CC, reflecting further analysis of historical data and modification of the expectations of investors in present market conditions. The exact extent to which the appropriate level for the equity risk premium has been moving downwards in recent years is uncertain and, if market conditions altered, an increase might occur. In view of this uncertainty we would wish to be cautious over implementing in full the decline represented by our range of 2.5 to 4.5 per cent. We consider that a degree of smoothing of the downward trend in the equity risk premium would be appropriate, an approach that would also help to prevent volatility in the short term. We consider that the most appropriate way of recognising this factor is not by modifying our judgement of the range for the equity risk premium, but by an increase of 0.25 per cent in the overall level of the WACC.

Given this statement, it would be useful to understand what increase in the ERP would generate this increase in the WACC made by the Commission. However, this is hindered by a lack of transparency as to how the Commission calculated its real cost of capital figure. Nevertheless, a similar adjustment was made in the earlier Commission inquiry into BAA's designated airports,[21] where it is much easier to calculate that the adjustment implied an increase of 0.25 in the ERP, in turn implying a midpoint value for the ERP of 3.75%. Furthermore, since the previous OXERA paper, the CAA endorsed this approach when it came to make its decision on the cost of capital in light of the Commission's recommendations.[22]

2.2.5 Conclusion on the ERP

The evidence presented above suggests that, as with the risk-free rate, a range of 3–5% would be appropriate. The lower end of this range covers recent regulatory precedence from the Competition Commission, before the implied adjustment discussed above, and is close to the five-year average estimate derived from the DGM. Interestingly, given the change in view of Dimson et al, there

[20] Competition Commission (2003), 'Vodafone, O2, Orange and T-Mobile: Reports on References under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks', February 18th.

[21] Competition Commission (2002), 'BAA plc: A report on the economic regulation of the London airport companies (Heathrow Airport Ltd, Gatwick Airport Ltd., and Stansted Airport Ltd', November.

[22] CAA (2003), 'Economic Regulation of BAA London Airports (Heathrow, Gatwick, Stansted) 2003–2008 CAA Decision'.

would appear to be little evidence to support the lower end of ranges identified by regulators in the recent past. The higher end of the range is driven in part by the results of the ERP-based methodology, and in part by the arithmetic average figure used in the Dimson et al paper.

2.3 Equity beta

2.3.1 Summary

The final component of the cost of equity calculation in the standard CAPM framework is the equity beta. This is the measure of the sensitivity of the movement in one stock as a result of a movement in the market as a whole. According to the CAPM, this undiversifiable risk is the only company-specific factor that needs to be taken into account when assessing a company's cost of equity. In the previous OXERA paper, it was argued that an equity beta of 1 should be used, on the basis that, although beta estimates for regulated companies demonstrated a significant fall since 1999, often by as much as 50%, this was likely to be the result of the volatility of the markets, and the statistical properties of beta estimates, and that there was no credible reason for believing that the business fundamentals of DNOs had altered.

2.3.2 Market evidence

Table 2.3 updates the London Business School (LBS) beta estimates for listed water and electricity companies in the UK from October 2002, the last period covered in the previous paper, to January 2004.

Table 2.4: LBS beta estimates

Company	AWG	Kelda Group	National Grid Transco	Pennon Group	Scottish & Southern Energy	Scottish Power	Severn Trent	United Utilities
2002								
October	0.41	0.36	0.58	0.27	0.29	0.46	0.32	0.29
2003								
January	0.41	0.33	0.54	0.22	0.17	0.37	0.29	0.24
April	0.37	0.32	0.57	0.22	0.20	0.42	0.28	0.25
July	0.36	0.32	0.56	0.21	0.18	0.40	0.27	0.26
October	0.39	0.31	0.59	0.20	0.13	0.41	0.27	0.27
2004								
January	0.37	0.32	0.57	0.22	0.20	0.42	0.28	0.25

Source: LBS Risk Measurement Service.

This table illustrates that, for every company in the sample, the beta estimate has continued to fall since the previous paper was completed, although the estimates are marginally higher than in the middle of 2003.

However, the Smithers and Co report suggested that, in many cases, there might be benefits from estimating betas from daily data, due to the lower standard errors that will result from using

additional data.[23] This compares with the monthly data, over five years, used by LBS. Estimating betas on daily returns provides the following results.

Table 2.5: Latest beta estimates using daily data

AWG	Kelda Group	National Grid Transco	Pennon Group	Scottish & Southern Energy	Scottish Power	Severn Trent	United Utilities
0.19	0.16	0.57	0.09	0.38	0.54	0.30	0.46

Source: Datastream and OXERA calculations.

It can be seen that this approach still yields the same very low measured beta coefficients, with some of the daily betas higher than those suggested using monthly data, and others slightly lower. Interestingly, for all those companies that own DNOs, the estimates using daily data are higher than those reported by LBS. Nonetheless, the predominant theme from consideration of the daily data remains the surprisingly low beta estimates, suggesting that the problem is with the use of beta at all, given the present market conditions, rather than a particular estimation technique.

Changes in beta over time would be expected to reflect a number of factors, including:

- financial gearing: increases in financial gearing would tend to increase the equity risk of a business;
- regulatory framework: changes to the regulatory framework, which may include the way in which allowed revenues are determined or the share of commercial risks between investors and customers, may be expected to affect beta over time
- commercial risk: changes in the underlying business environment, such as the introduction of competition, changes in market structure, or changes in cost variability may be expected to have an impact on beta.
- operational gearing: a change in the balance of fixed to variable costs would affect beta by changing the sensitivity of profits to volumes of output sold.

Given that gearing levels for most utilities have increased over time, that the regulatory framework and commercial environment have remained fairly constant, it is somewhat difficult to explain why measured betas are so low. Previous analysis undertaken by OXERA has suggested that the main driver of the change is a fall in the correlation coefficient between utility stocks and the market, as opposed to reduced volatility in either the market or the stock itself. However, further evidence would need to be gathered in order to support this hypothesis. This may broadly reflect the market trends over the past three to five years, which have been largely driven by the technology, media and telecoms phases of boom, bust and subsequent partial recovery. Should the market begin to be driven by other, primarily macroeconomic, factors in future, utility stocks may be expected to experience higher correlations with the market (and hence betas) relative to current levels.

[23] Smithers & Co (2003), 'A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK', February 13th. Daily data may not be appropriate in circumstances where returns are not independently and identically distributed (ie, there may be positive serial correlation or heteroscedasticity) or when stocks are infrequently traded.

A great deal of the recent academic literature has been concerned with the sufficiency of beta as a determinant of cross-sectional variation of expected stock returns, rather than with methods relating to beta estimation techniques. As such, discussion of these papers is deferred to section 3 below, in which alternatives to the CAPM are considered.

2.3.3 Regulatory precedents

Again, with the 100% debt structure of Network Rail, relevant regulatory precedence since the last paper was written is restricted to the Competition Commission's inquiry into termination charges on mobile networks, and the CAA's conclusions for BAA, in light of the Commission's earlier recommendations.

The Competition Commission decision on the mobile operators was to allow for an equity beta of between 1 and 1.6, with the lower figure resulting from estimates of monthly estimates, and the experience of BT, and the higher figure from daily beta estimates.[24] The decision made by the CAA was to endorse the Competition Commission's decision that an equity beta in the range 0.8–1 was appropriate.[25] The main significance of this decision comes from the fact that the Commission, when making its decision, recognised that it was appropriate to use a higher figure than the latest report from LBS, which reported a figure of 0.71. This was due, first, to the recent events that had affected the aviation sector, but also because of the substantial capital investment programme that BAA would have to undertake during the period (in addition to Terminal 5, for which additional provisions were made).

2.3.4 Summary on the equity beta

In light of the evidence presented above, there seems little reason for altering the earlier conclusion that an equity beta of at least 1 would be appropriate. As stated above, there is little that has changed in the regulatory environment that could justifiably lead to a determination that reflected recent empirical estimates.

Further justification for using a beta value of at least 1 is provided by the arguments included in the Smithers and Co report for the Joint Regulators' Group.[26] In this paper, it is argued that it may be appropriate to assess the cost of equity using an aggregate approach. This approach, which involves considering the overall returns received by investors in equity markets, will yield the same result as the CAPM with a beta value of 1, provided the CAPM is the appropriate model for assessing the cost of equity. As Ofgem has also stated that it will consider this option, this provides further evidence to support the use of a beta value of 1.

2.4 Overall cost of equity

Using the parameter estimates discussed above yields a range for the post-tax cost of equity of between 5.25 and 7.75%. This range has been developed using the standard CAPM approach, together with consideration of the Smithers & Co report, which suggests the use of the aggregate

[24] Competition Commission (2003), 'Vodafone, O2, Orange and T-Mobile: Reports on References under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks', February 18th.
[25] CAA (2003), 'Economic Regulation of BAA London Airports (Heathrow, Gatwick, Stansted) 2003–2008 CAA Decision'.
[26] Smithers & Co (2003), 'A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK', February 13th.

cost of equity. The next section of the paper considers whether these estimates are consistent with other approaches to calculating the cost of equity.

3. Alternatives to the CAPM

The previous OXERA paper examined a number of alternatives to the CAPM for assessing the cost of equity, including the arbitrage pricing theory (APT), Fama and French's three-factor model, and the DGM. It concluded that, of these, the DGM was perhaps the most useful in providing a check on the results from the CAPM, and its individual components. Given this result, this section comprises two parts:

- the first re-estimates the cost of equity resulting from the DGM, taking into account the latest market evidence; and
- the second investigates the factors that may be driving the discrepancies observed between the CAPM and DGM.

3.1 DGM update

In its simplest form, the DGM provides an estimate of the cost of equity through the summation of the dividend yield and the future expected dividend growth rate. As such it takes into account the two variables that are of most direct interest to (prospective) investors. Table 3.1 provides estimates for the cost of equity using the DGM, based on a sample of companies across the regulated sectors.[27] Two sets of figures are presented. In all cases, the dividend yields used in the calculation are taken from either the most recent available value for dividend yields or a five-year average of dividend yields. Future dividend growth rates are then calculated in one of two ways: using the historical dividend growth rate over the past five years; or using the Competition Commission's approach and assuming a dividend growth rate equivalent to the expected increase in GDP—2.25%.

Table 3.1: DGM estimates of the cost of equity

	Dividend growth rate using a five-year average (1.6%)	Dividend growth rate as GDP (2.25%)
Dividend yield as five-year average	6.96	7.58
Dividend yield as current value	7.13	7.75

Source: Datastream and OXERA calculations.

Further evidence based on the DGM may be derived from the recent rights issue by United Utilities. On July 26th United Utilities announced a rights issue that is intended to raise £1 billion from its shareholders in two tranches—one which took place in September 2003, ahead of Ofwat and Ofgem's price-control determinations, and one in June 2005, when the regulators' reviews have been completed. According to the company, the rights issue is designed to fund growth in the regulated asset bases of the two regulated utilities—growth that is being driven by substantial capital investment requirements, mainly in relation to the water sector. Table 3.2 demonstrates the impact of the two rights issues on United Utilities' dividend bill based on projections from the company.

[27] A sample across the utilities sector is used due to the scarcity of evidence on companies owning DNOs. The specific companies examined were Anglian Water Group, BT, East Surrey Holdings, Kelda Group, Pennon Group, Scottish Power, Scottish and Southern Energy, Severn Trent, United Utilities and Vodafone.

Table 3.2: Future dividend payments by United Utilities

	Before the issues	After the issues
Number of ordinary shares (m)	556.8[1]	866.1[2]
Dividend per share (£)	0.476[3]	0.4034[4]
Total dividend (£m)	266.46	349.38

Notes: [1] As of close of business on July 25th 2003. [2] The maximum number of shares after both rights issues, assuming all rights are exercised. [3] As of March 2003. [4] United Utilities' projection of the dividend per share following the rights issue.
Source: OXERA calculations using information provided in United Utilities (2003), 'United Utilities Proposes Rights Issues to Raise up to Approximately £1.0 Billion', press release, July.

As a result of the two issues, the dividend bill is expected to rise by nearly £83m, which represents a yield of 8.1% on the new capital raised of £1.02 billion. This is consistent with the stated policy of the company of maintaining the dividend yield post-issue at pre-announcement levels, and, assuming that investors do not anticipate a reduction in dividends, would suggest a cost of equity of 8% consistent with the top end of the range provided from other evidence.

It is significant that the cost of equity estimates using the DGM are at the higher end of the range identified for the cost of equity using the CAPM approach. This would appear important evidence that Ofgem should take into account when setting the cost of equity for DNOs. It is recognised that the approach depends significantly on the estimate of future growth expectations, and that, with relatively high dividend yields relative to the market, there is some uncertainty as to how much growth investors expect in future dividends. Nevertheless, the DGM evidence would appear to be consistent with values toward the upper end of the CAPM estimates.

3.2 Explaining the differences

The DGM provides higher (average) estimates of the cost of equity than the CAPM, even when a beta value of 1 is used. However, as discussed in the previous OXERA paper, the CAPM remains the principal method used by UK regulators for determining the cost of equity. This was confirmed by the Competition Commission inquiry into calls to mobiles, in which it was stated that:

> the CAPM was used by four of the five main parties to our inquiry and . . . is widely used across the private sector, finance institutions and utility regulators. We therefore adopted the CAPM to estimate the cost of capital.[28]

Nonetheless, there is considerable regulatory precedence for using the DGM as a check on the results of the CAPM—an approach that Ofgem has stated it will also follow at this review.

Given this, it is pertinent to ask what factors may be driving the difference between the two estimates. Building on previous analysis for the ENA, it would appear that there may be two important factors:

[28] Competition Commission (2003), 'Vodafone, O2, Orange and T-Mobile: Reports on References under section 13 of the Telecommunications Act 1984 on the charges made by Vodafone, O2, Orange and T-Mobile for terminating calls from fixed and mobile networks', February 18th.

- skewness of returns;
- the existence of a value premium.

These are examined in turn below.

3.2.1 Skewness of returns

A previous paper for the ENA showed how the results of the Kraus-Litzenberger model meant that the cost of equity should be adjusted to take account of the fact that returns may not be symmetrically distributed.[29] Specifically, it was shown that, taking account of the possibility of skewness, the cost of equity should be calculated as:

$$E[R_e] = R_f + \beta * (E[R_m] - R_f) + \mathrm{b}(\gamma_i - \beta) \qquad \text{Equation 3.1}$$

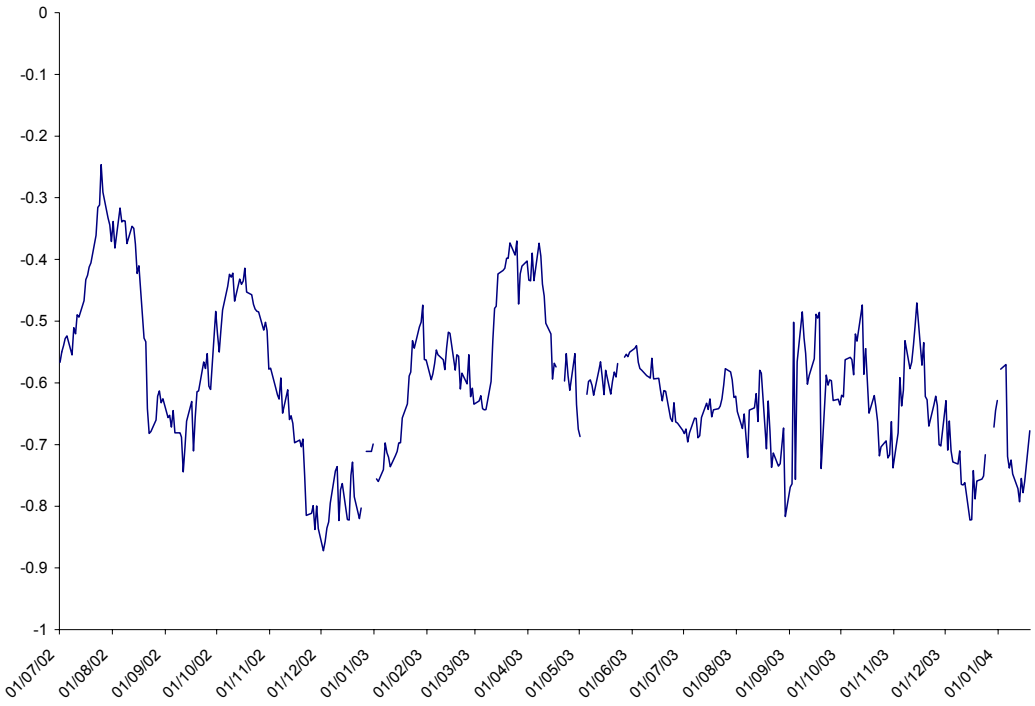
where b is a measure of the preference for positively skewed returns, which, when the market returns are negatively skewed, has a positive value; and γ_i is the ratio of the co-skewness of the stock returns of the company *i* with the market returns to the skewness of the market returns (ie, a measure of the sensitivity of the skewness of a company's returns to the skewness in the market as a whole).

In other words, investors require an additional premium to hold stocks whose systematic skewness is greater than its beta value.

To see what this theory implies for DNOs' cost of equity, it is important first to look at the implied skewness figures for the market as a whole, in order to check the sign on the b coefficient. Figure presents the Bank of England's implied skewness chart (using three month European options on the Index Futures) for the UK market.

[29] Kraus, A. and Litzenberger, R. (1976), 'Skewness Preference and the Valuation of Risk Assets', *The Journal of Finance*, **XXXI**:4, September.

Figure 3.1: Implied skewness



Source: Bank of England.

Figure 3.1 shows that skewness in the market as a whole remains negative, and may have even become slightly more negative since July 2002, when the previous analysis concluded.

In light of this, it is appropriate to consider the size of the appropriate adjustment. Table 3.2 presents the negative skewness of the market, and average market beta (as opposed to regulatory) and gamma figures for the previous five years, based on daily and monthly data, for the eight companies analysed in Tables 2.3 and 2.4.

Table 3.2: Kraus and Litzenberger model estimates

Period for measuring returns	Market skewness	Beta	Gamma
Daily	–0.14	0.33	0.64
Monthly	–0.76	0.33	0.48

Source: Datastream, LBS and OXERA calculations.

The gamma estimates in the table are substantial, and well above the equity beta figures estimated using market data, especially when daily data are used. On the other hand, the gamma estimates are below 1. This suggests that skewness may be an important factor in justifying a beta figure higher than that implied by recent market evidence—indeed, using a b value of 1.5, as discussed in OXERA's previous work, implies a cost of equity increase, using daily data, of 0.46%. However, it is not obvious that it can be used to justify a cost of equity figure above that determined using the CAPM with a beta value of 1.

3.2.2 Value premium

Although the CAPM assumes that the only factor affecting the average returns is systematic risk, there is now a significant body of academic literature showing the existence of return regularities associated with value-growth factors. Rosenberg, Reid & Lanstein, Fama & French, and Lakonishok, Shleifer & Vishny all show that stocks with low market-to-book ratios earn higher average returns than stocks with high market-to-book ratios.[30] The findings of Lakonishok, Shleifer and Vishny, documented in Table 3.3, are representative of general findings in this field.

The table suggests that the average annual returns of the value companies (group 1) are by as much as 10.5% higher than the average annual returns of the growth companies (group 10). In another words, if investors followed a strategy whereby at the beginning of every year they were to invest in the decile of companies with the lowest market to book value and kept this investment for five years following the formation, they would earn an average return of 19.8%. In comparison they would only earn an average return of 9.3% by investing in the decile of companies with the highest market to book ratios. Moreover, the authors show that the differences in the returns of value and growth companies cannot be explained by the differences in systematic risk, i.e. the average systematic risk component—beta—is the same for value and growth companies.

Table 3.3: Returns from value and growth strategies

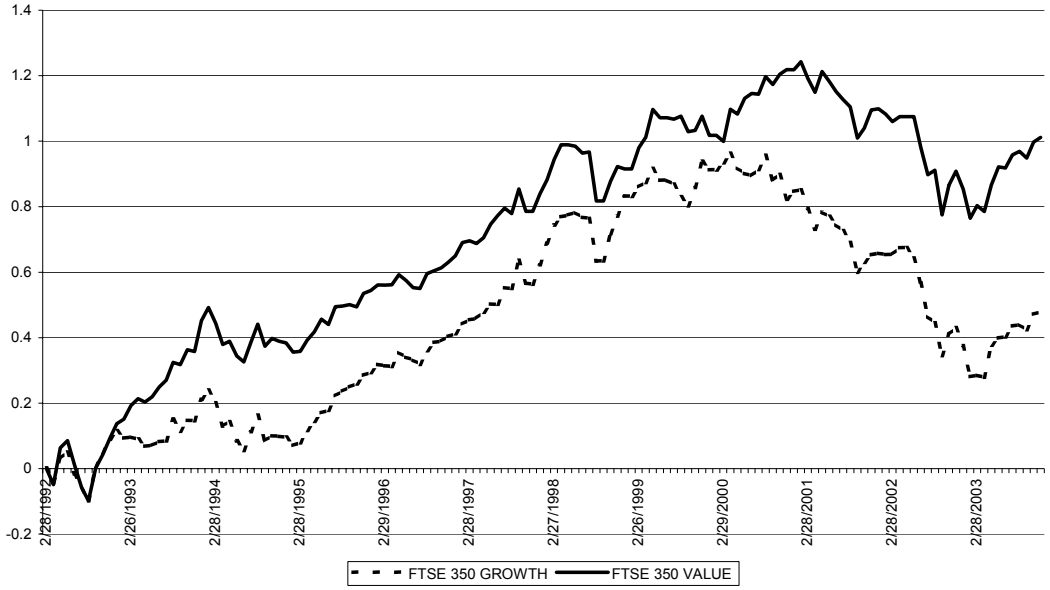
	Value									Growth	
Group	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**G1–G10**
Annual return	0.198	0.196	0.189	0.184	0.166	0.158	0.154	0.146	0.125	0.093	0.105

Note: At the end of each year in the estimation period, ten portfolios were formed in ascending order, based on the ratio of the market value of equity to book value of equity (MB). The growth portfolio refers to the quarter containing stocks ranking highest on MB. The value portfolio refers to the quarter containing stocks ranking lowest on MB. The returns presented in the table are equally weighted averages over all formation periods.
Source: Lakonishok, Shleifer and Vishny (1994).

Similar differences in the average returns of the high MB firms can be demonstrated by looking at the historical returns of the FTSE Value and FTSE Growth indices. Figure 3.2 shows that, over the past ten years, the FTSE Value index significantly outperformed FTSE Growth index, confirming the above evidence on the differences in average returns of value and growth companies.

[30] Rosenberg, B., Reid, K. and Lanstein, R. (1984), 'Persuasive Evidence of Market Inefficiency', *Journal of Portfolio Management*, **11**, 9–17. Fama, E. and French, K. (1992), 'The Cross Section of Expected Stock Returns', *Journal of Finance*, **47**, 427–65. Lakonishok, J., Shleifer, A. and Vishny, R. (1994), 'Contrarian Investment, Extrapolation, and Risk', *Journal of Finance*, **49**, 1541–78.

Figure 3.2: Returns of FTSE Value index and FTSE Growth index



Source: Datastream

There are several interpretations of the source of the excess returns associated with value-growth factors. Perhaps the most accepted explanation comes from the original arguments of Fama and French (1992).[31] They argue that market-to-book ratio is a state variable that describes changes in the investment opportunity set. They suggest that value stocks are fundamentally riskier, and their higher average returns are simply a compensation for a higher risk of investment. As a result, when assessing the expected return of a company, in addition to its systematic risk, account should also be taken of whether the company has 'value' or 'growth' characteristics. More formally, this can be defined as a two-factor model, where one factor represents the standard CAPM (ie, β*ERP), and the other represents the value-growth factor:

$$E[r_i] = r_f + \beta_i \times P1 + \gamma_i \times P2 \qquad \text{Equation 3.2}$$

where $E[r_i]$ is the expected return on security i, r_f is the risk-free rate, β is the systematic risk component, γ is the value-growth component, and $P1$ and $P2$ are factor premiums for the systematic-risk and value-growth components respectively.

Equation 3.1 suggests that use of the standard CAPM would lead to a situation in which the expected cost of equity of value companies is underestimated, while that of growth companies is

[31] Some of the alternative explanations include Berk, Naik and Green, who argue that market-to-book-return anomalies can be explained by predictable variations in firms' systematic risk. They show that predictable changes in firm's assets and growth options impart predictability to changes in firms' systematic risk and expected returns. Berk, J., Green, R. and Naik, V. (1999), 'Optimal Investment, Growth Options, and Security Returns', *Journal of Finance*, **54**, 1553–607. Alternatively, Lakonishok, Shleifer and Vishny postulate that, because of the systematic expectation errors of naive investors, low market-to-book-ratio stocks tend to be underpriced, and high ones tend to be overpriced. With price correction, stocks with a low market-to-book ratio earn superior returns.

overestimated.[32] Given this, it is necessary to consider the market-to-book ratios of regulated companies and compare these with economy-wide averages. The distribution, measured by deciles, of market-to-book ratios in the economy as a whole, both for 2003 and the average over 1991–2003, is shown in Table 3.4.

Table 3.4: Average market-to-book ratio of growth-value deciles in the UK economy

Group	1	2	3	4	5	6	7	8	9	10
1991–2003 average	0.51	0.87	1.14	1.45	1.84	2.31	2.91	3.90	6.03	12.58
January 2003	0.61	0.88	1.25	1.68	2.11	2.36	2.47	3.45	4.95	9.71

This can be compared with evidence from the regulated companies that were used to generate the DGM results in section 3.1. These show that the average market-to-book ratio in 2003 was 1.32,[33] placing these companies well below the economy average market-to-book ratio. Similarly, comparing the averages over the whole period yields the figure of 1.57, thereby still placing the sample below the economy-wide average.

Investors may therefore be requiring a value premium to invest in utility stocks, providing some of the explanation for the discrepancy between the DGM and CAPM estimates.

3.2.3 Implications for the cost of equity

In summary, this section has presented evidence that the range for the cost of equity calculated using the CAPM might underestimate the actual cost of equity. Estimates from the DGM approach suggested a cost of equity figure towards the high end of that derived using the CAPM. In searching for explanations of this discrepancy, it was shown that utility stocks appear to suffer from a negative skewness of returns, for which investors are likely to demand a premium in terms of their expected return, but that this was unlikely to be the source of the discrepancy. However, it was suggested that value-premium arguments may contribute to an explanation of these differences.

In light of this, it is argued that, at the very least, it would be prudent for Ofgem to make a conservative (ie, towards the top end of the identified range) determination on these issues. This could either be by using the higher end of the cost of capital range, or, with lesser effect, the cost of equity range.

This is especially the case given the substantial need for investment in the industry, and the requirement to ensure that this can be financed. Regulatory experience over the past year has further established this as a sensible policy when significant investment programmes need to be financed, with the CAA deciding that it would choose a cost of equity figure higher than the midpoint in reaching its decision on BAA's designated airports. In this regard, it is also interesting to note a submission by the Australian Competition and Consumer Commission (ACCC), in the context of a recent far-reaching review into access regulation in Australia:

[32] To show this, it can be assumed that the coefficient γ is increasing in the market-to-book-value ratio (ie, it will be 'large' for growth companies, and 'small' for value companies). In which case, based on the empirical evidence provided in Table 3.4, it follows that factor premium $P2$ is negative.

[33] Excluding National Grid Transco, the results of which make this company a significant outlier in 2003.

> Where there is doubt as to the most appropriate value of such [cost of capital] variables, the ACCC has tended to make conservative assessments benefiting service providers to ensure that service providers have access to sufficient resources to continue to operate facilities and undertake new investment. This view is supported by the relative performance of regulated companies against equity markets and the findings of Moody's Investors Service on the regulatory regime in Australia compared to the UK.[34]

[34] As reported in Productivity Commission (2003), 'Review of the Gas Access Regime', Draft Report, Canberra.

4. Cost of Debt

This section returns to the structure used in section 2 for considering the cost of equity under the CAPM. For the forward-looking cost of debt, recent market evidence is presented, followed by academic evidence; finally, recent regulatory precedents and statements are provided. A further section then considers whether there should be an additional allowance for the cost of embedded debt. Finally, gearing and taxation are discussed.

4.1 Forward-looking cost of debt

4.1.1 Summary

The previous OXERA paper suggested that the forward-looking cost of debt should be at least 2%, compared with the 170–185 basis points allowed by Ofgem at the previous review. The main reason for this was the deterioration in the credit ratings of DNOs since the previous review, with most DNOs having ratings between A– and BBB–, and the fact that, averaged across the whole of 2002, the premium on BBB-rated debt was 2.13%. It was also stated that further adjustments would need to be made if Ofgem decided to alter its gearing assumption.

4.1.2 Market evidence

Market evidence for DNOs' cost of debt can be taken from three sources: experience across the economy on the spreads of debt with different ratings; the experience of other regulated sectors; and the redemption yields of debt issued by DNOs. Each is examined in turn below.

Considering, first, the spreads on debt of different credit ratings, Table 4.1 highlights the Standard and Poor's credit ratings for each of the DNOs.

Table 4.1: DNO credit ratings

DNO	Credit rating	Outlook
EDF Energy (SPN) plc	A	Stable
EDF Energy (LPN) plc	A	Stable
EDF Energy (EPN) plc	A	Stable
Western Power Distribution (South Wales) plc	BBB+	Negative
Western Power Distribution (South West) plc	BBB+	Negative
Northern Electric Distribution Ltd	BBB+	Negative
Yorkshire Electricity Distribution Ltd	BBB+	Negative
Southern Electric Power Distribution	AA–	Stable
Scottish Hydro Electric Power Distribution	AA–	Stable
Aquila Networks	BBB–	Creditwatch Positive
East Midlands Electricity Distribution plc	A–	Stable
United Utilities Electricity	A–	Positive
SP Manweb plc	A–	Negative
SP Distribution	A–	Negative

Source: Standard and Poor's website, as at January 28th.

Given that, of the 14 DNOs, 12 have a credit rating of single A (stable outlook) or worse, and that, of these, five have a rating of BBB+ (negative outlook) or worse, the most important spreads to

consider are those relating to A- and BBB-rated debt. The current rates, two- and five-year averages for these ratings, are given in Table 4.2.

Table 4.2: Debt premia for different credit ratings

Time period	A	BBB
Latest	0.52	1.28
Two-year average	0.87	1.93
Five-year average	1.34	1.95

Source: Datastream and OXERA calculations.

The table highlights two prominent features:

- the historical average spreads are greater than present spreads;
- the relatively low spreads over the past year have contributed to a fall in these average historical spreads since the time of the previous paper.

Considering the experience of other regulated sectors also reveals that present spreads are considerably lower than those observed over the previous five years. For example, an examination of a selection of water companies (specifically, an average of Kelda Group, Wessex Water and Severn Trent) suggests that the latest debt premium is 0.86, compared with a five-year average between 1999 and 2003 of 1.49.

Finally, Table 4.3 illustrates the debt premia for a selection of debt issued at the DNO level. Once again, the debt premia calculated on the most recent data are well below the five-year average.

Table 4.3: DNO debt premia

Name in which debt issued (coupon, maturity)	Credit rating of the instrument	Treasury comparison	Current debt premium	5-year average
Eastern Electricity (8¾, 2012)	A	9%, 2012	0.28	1.24
London Electricity (8 5/8%, 2005)	A	8½%, 2005	0.52	0.85
Midland Electricity (7 3/8%, 2007)	BBB–	7¼%, 2007	0.68	1.16
Northern Electric (8 7/8%, 2020)	BBB+	8%, 2021	1.09	1.39
Northern Electric (8 5/8%, 2005)	BBB+	8½%, 2005	0.68	1.03
Norweb (8 7/8%, 2028)	A–	6%, 2028	0.81	1.34
Swalec 9 1/4%, 2020	BBB+	8%, 2021	1.03	1.47
Southern Electricity, 5½%, 2032	AA–	4¼%, 2032	0.73	0.90
South Wales Electricity (9¼%, 2020)	BBB+	8¾%, 2017	1.15	1.50
Western Power Distribution (5 7/8%, 2027)	BBB+	6%, 2028	1.08	1.20
Yorkshire Electricity (9¼%, 2020)	BBB+	8¾%, 2017	1.11	1.32
Average			0.83	1.18
Range	A to BBB–		(0.3–1.2)	(0.8–1.5)

Source: Datastream and OXERA calculations.

It is interesting to consider what may be driving this significant tightening in spreads. In this regard, the latest Bank of England Financial Stability Review notes that:

> Contacts report that the supply of credit has outstripped demand and that this, alongside credit market dynamics … may have contributed to a compression in credit spreads beyond that resulting from improvements in credit risk.
>
> There were, for example, strong flows into US high-yield bond mutual funds in the first half of the year ... US and UK life insurance companies have continued to have strong demand for credit instruments—in some cases, following asset reallocations from equities or reflecting attempts to increase portfolio diversification. [35]

Further evidence is provided by Barclays Capital's annual credit market research report:

> On most measures, the credit fundamentals are certainly beginning to stabilise. The upgrade-downgrade ratio, while still negative across credit markets is certainly less negative than it has been for the majority of the past two to three years. The most notable thing is that the pace of downgrades has slowed markedly over H2 03.
>
> On a more forward-looking basis, the lower number of CreditWatch listings is encouraging for a further stabilisation in credit quality over the next few months. [36]

The important point is that, although part of the decline in premia appears to have been caused by a fall in credit risk, this has been exacerbated by market imbalances. As these imbalances are unlikely to persist throughout the next review period, it would be more appropriate for Ofgem to make its assessment of the appropriate debt premium on the basis of the five-year averages.

4.1.3 Academic evidence

As with the risk-free rate, further evidence to support the use of historical averages in estimating the appropriate debt premium can be ascertained by considering whether spreads follow a mean-reversion process. Also comparable with the evidence on the risk-free rate is that recent academic evidence supports this conjecture, at least for corporate bond indexes. Bhanot shows that there was significant mean reversion in the Moody's Baa index for US corporates in the period 1986–96 and suggests that this is caused by survival—any companies that experience a significant change in credit quality are removed from the index.[37] This process causes the spread of these indices to be bounded and promotes mean reversion. As Ofgem will inform its decision on the appropriate debt premium on the basis of similar indices in the UK, this should be taken into account, and is further evidence that greater weight should be given to the five-year averages for such indexes, rather than their current values.

4.1.4 Regulatory precedent

Finally, regulatory precedent also suggests that more weight should be attached to the historical averages than present values. The Competition Commission, in its inquiry into mobile-phone operators, used a wide range for the debt premium, between 1% and 4%. The low end of the range was informed by the lower end of the Oftel range, which, in particular, stated that there should be a downward adjustment to observed spreads to take account of default risk, as the regulatory determination should reflect the expected cost of debt. The upper end of the range was informed by the recent increase in premia that the mobile operators had faced. Interestingly, however, this upward adjustment did not reflect the most recent spreads, but instead an average over the seven

[35] Bank of England (2003),'Financial Stability Review', December, p. 18. Available at www.bankofengland.co.uk
[36] Barclays Capital's Credit Research Team (2003), 'The € and £ Credit Markets 2004', p. 12.
[37] Bhanot, K. (2003) What Causes Mean Reversion in Corporate Bond Index Spreads?—The Impact of Survival', The University of Wisconsin at Madison, January.

months to July 2002. Although this averaging process was over a shorter period than it is proposed should be considered by Ofgem, it nonetheless provides support, in principle, for such an approach.

Similarly, as reported in section 2.1, in late 2003 the ORR also used the historical five-year average in reaching its decision on the cost of debt for Network Rail, on the basis that this was more likely to reflect borrowing costs in the future.

Finally, Ofgem's Senior Adviser, Peter Bucks, has noted the strength of these arguments, stating recently:

> Given the falls not only in the real interest rate but, more significantly, in bond spreads in recent times, to levels that are very low by historical standards, there appears to be a good case for taking a cautious view of the cost of debt at the forthcoming reviews.[38]

4.1.5 Conclusion on the cost of debt

Given the evidence presented above, it would appear that an appropriate range for the debt premium should be between 1.3 and 2. Both ends of this range have been informed by spreads over the past five years, which have been shown, for a number of reasons, to be more appropriate than considering present spreads. The low end of this range takes into account the historical average of spreads on DNO debt for which information is available over the last five years, plus a slight premium to take into account issuing costs, bearing in mind Competition Commission precedents on this issue. By contrast, the high end of the range takes into account the five-year average spread on BBB-rated debt, bearing in mind that almost one-third of DNOs have a credit rating of BBB+ with a negative outlook, or worse.

4.2 Embedded debt

As was suggested in the previous OXERA paper, it is considered that the most appropriate manner for dealing with embedded debt is through a company-specific adjustment, and, as such, any estimates of the cost of capital presented here are exclusive of an embedded debt adjustment.

However, it is interesting to consider a few of the statements that Ofgem, or its advisers, have made in relation to embedded debt, and their apparent reluctance to allow a similar adjustment to that made in 1999. For example, in the second consultation paper, Ofgem stated that, in its view:

> an efficiently financed company is one that takes a balanced approach to the management of its borrowings, which diversifies its risks cost effectively (especially its refinancing, interest rate, inflation and duration risks) and which aims at achieving a broadly stable real interest cost over time. Such a company will be most likely to maintain flexibility to adapt to future developments.[39]

However, it needs to be considered exactly what sort of financing strategy would be able to meet such a requirement. Although further analysis would be required, it is not clear that any of the most likely financing strategy options—ie, choosing an equal mix of maturities, matching debt maturities to the regulatory cycle, matching debt maturity to asset lives, or choosing a balance of fixed- and floating-rate debt—would be able to achieve a stable real interest cost, depending on the out-turn movement in interest rates. In this regard, it would be helpful for Ofgem to provide greater clarity

[38] Bucks, P. (2003), 'Financial Leverage and the Regulator', *The Utilities Journal*, October, pp. 38–9.
[39] Ofgem (2003), 'Electricity Distribution Price Control Review: Second Consultation', December.

as to what constitutes an efficiently financed company, for it is only with the establishment of such a benchmark that it will be possible to judge the performance of individual DNOs.

A second issue related to embedded debt are the recent assertions that, if average values are used for setting the risk-free rate and debt premium, companies will have little justification to argue for a further embedded debt premium. While this has some validity for debt that has been issued since 1999, it fails to take account of any debt that may have been issued before then. As consideration of Figure 2.1 shows, although there has been no comparable downward shift in the risk-free rate to that which took place before 1999, there has not been a significant upward adjustment since then. At the same time, there has also not been any significant compensatory increase in average spreads on corporate debt between the two periods: the average spread on A-rated debt since April 1999 has been 1.24% points, compared with 1.27% points in the previous control period (in that period for which data is available). In light of this, for those companies with a significant amount of relatively old debt in their portfolio, simply relying on using the most recent five-year averages to deal with the embedded debt problem will provide relatively little comfort.

In summary, a decision as to whether an adjustment should be made for embedded debt would be most appropriately done on a company-by-company basis, and recent statements by Ofgem and its advisors do not necessarily provide a justification for not undertaking such an adjustment.

4.3 Gearing

A previous note by OXERA for ENA discussed the issue of the appropriate gearing assumption that Ofgem should make.[40] It particular, it stressed the risk that choosing a gearing assumption above 50% may lead to an inappropriately low overall WACC, and that this, in turn, may threaten the financeability of investment as well as generating further incentives for companies to gear up, with all the (potentially systemic) risks that this may entail. This latter incentive feature of such a policy appears particularly perverse, given Ofgem's intention to change the calculation of the cost of capital from a pre- to a post-tax basis, partly on the grounds that this will reduce incentives to gear up.

This was also one of the main conclusions in the OXERA report for Ofwat on the capital structure of water companies. As well as the possible incentives to gear up generated by any switch, a number of the other results from this paper are important in considering this issue:

- as also acknowledged by the CAA, there is no consistent academic evidence, or normative model, that predicts unequivocally what an optimal capital structure might be;
- given this, it may be useful to consider empirical regularities regarding capital structures, which suggest that, considering a wide range of national and international evidence, gearing of 50% may be close to the norm;
- if investors are indeed currently demanding a lower cost of debt, this might be because of the (rational) belief that regulators will bail out companies that suffer financial difficulties, generating a wedge between the social and private cost of debt. If this were the case, it would be inappropriate for regulators to reflect this distinction by using a higher gearing assumption in their cost of capital calculations.

[40] OXERA (2004), 'Cost of Capital Issues', January 12th.

In light of these results, it is considered that a 50% gearing assumption remains appropriate.

4.4 Taxation

In light of the ongoing discussions within the industry as to whether a pre- or post-tax cost of capital is the more appropriate, both are calculated below. The pre-tax cost of capital assumes that tax will be levied at 30% and that a tax wedge of 1.429 is therefore appropriate, while the post-tax cost of capital is, in fact, a pre-tax debt, post-tax equity WACC.

5. Conclusion

Table 5.1 summarises the estimates of the components of the WACC, using the CAPM to estimate the cost of equity. As can be seen, the estimates imply a range for the pre-tax cost of capital of between 5.5% and 7.9%, or on a post-tax basis of between 4.4% and 6.3%.

Table 5.1: WACC estimates using CAPM

Parameter	Low estimate	High estimate
Risk-free rate (%)	2.25	2.75
Equity risk premium (%)	3.0	5.0
Equity beta	1	1
Post-tax cost of equity (%)	5.25	7.75
Debt premium (%)	1.25	2.0
Pre-tax cost of debt (%)	3.5	4.75
Gearing (%)	50	50
Pre-tax debt, post-tax equity (%)**WACC**	4.38	6.25
Taxation adjustment	1.429	1.429
Pre-tax debt, pre-tax equity WACC (%)	5.50	7.91

The mid-point of the range is just over 6.7% on a pre-tax basis, or 5.3% on a post-tax basis. However, as discussed in section 3, it is argued that, for three distinct reasons, choosing the midpoint estimate of this range would not be appropriate. These reasons are discussed below.

As was shown, the DGM suggested a cost of equity estimate in the region 6.96–7.75%, considerably higher than the 5.75–7.25% estimated through the CAPM approach. Possible reasons for this discrepancy were investigated. Following the model of Kraus and Litzenberger, it was shown that the returns of regulated companies were disproportionately negatively skewed, for which investors will demand an additional premium on their expected return. It was shown, however, that this factor was more appropriate in justifying the use of an equity beta value closer to 1, as opposed to any additional premium. However, it was shown that there might be a good reason to include a value premium within the cost of equity estimate for DNOs.

Second, there is a wealth of regulatory precedent demonstrating that choosing a value towards the high end of the range identified through such a process is appropriate when a significant investment programme needs to be undertaken. Even within the last year, the CAA chose a value higher than the midpoint of the cost of equity estimated through the CAPM when reaching the point estimate of BAA's cost of capital. Evidence, also from 2003, was presented that international regulators follow such a policy. This builds on practice over a longer period of time—for instance, by the Rail Regulator in his 2000 review of Railtrack's track access charges.[41] Given the extensive investment programme that needs to be undertaken during the next control period—a fact that has been acknowledged by a wide variety of stakeholders—it would be prudent for Ofgem to recognise this, by making a relatively conservative determination on the cost of capital.

[41] In this case, the ORR used a point estimate of 8% (pre-tax), having identified a range of 6.9–8.2%.

Third, there are other factors that have not been specifically addressed in this paper which are also likely to increase the cost of capital of DNOs in the next review period. Distributed generation, as well as increasing the magnitude of the investment challenge facing DNOs, is likely to raise their cost and revenue uncertainty, as could the extension to output regulation. Similarly, no overall adjustment to take account of the problem of embedded debt has been proposed.

Given this extensive collection of factors, it is proposed that the conclusion reached in the previous paper—that, on a pre-tax basis, the cost of capital for DNOs is at least 7%—remains valid.