REPORT ON OFGEM'S PROPOSED COST OF CAPITAL FOR ELECTRICITY DISTRIBUTION NETWORK OPERATORS

A Report for EDF Energy

Prepared by NERA

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1. INTRODUCTION

In March 2004 Ofgem published its final consultation document for the Electricity Distribution Price Control Review ("DPCR4"). As part of that consultation Ofgem published two papers, "Background information on the cost of capital" and "Beta estimates for Ofgem" (a report prepared for Ofgem by Smithers & Co).

Our overall conclusion is that Ofgem has set out a useful framework and has listed a significant amount of relevant evidence, however at crucial points in its analysis Ofgem reaches conclusions that are impossible to reconcile with the evidence Ofgem has provided. In this report we reassess Ofgem's evidence on each parameter to obtain parameter estimates and a range for the overall WACC that we believe are more reflective of that evidence. We also highlight differences in Ofgem's parameter estimates and parameter estimates calculated in a recent NERA report on the cost of capital, "UK Electricity Distribution Cost of Capital, A Report for EDF Energy" (NERA, March 2004).

The remainder of our report is structured as follows:

- Section 2: Overview
- Section 3: Risk-free rate
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- Appendix B: Analysis of Competition Commission evidence on the equity risk premium

2. OVERVIEW

Ofgem's proposed WACC for the current review (DPCR4) and the final determination in the 1999 review ("DPCR3") are set out in Table 2.1 alongside our own estimate of the WACC (as per NERA (2004b)).

Table 2.1
Ofgem's WACC for Electricity Distribution in DPCR3, DPCR4

Component	DPCR3 1999	DPCR4 2004		NERA 2004
		Low	High	
Risk-free rate (%)	2.5	2.25	3.00	2.9
Debt-premium (%)	1.4	1.0	1.5	0.85*
Embedded debt adjustment (%)	0.4		0.3**	
Cost of Debt (%)	4.3	3.25	4.8	3.75
Equity risk premium (%)	3.5	2.5	4.5	5.0
Gearing (%)	50.0	50.0	60.0	60.0
Equity beta	1.0	0.6	1.0	1.28
Equity issuance costs (%)				0.3
Cost of equity (post-tax) (%)	6.0	3.75	7.50	9.58
Cost of equity (pre-tax) (%)	8.6	5.36	10.71	13.68
Post-tax WACC (%)	4.5	3.0	5.0	5.4
Pre-tax WACC range (%)	6.5	4.3	7.2	7.7
"Vanilla" WACC (%)	5.2	3.5	5.9	6.1
Proposed "Vanilla" WACC (%)		5.1	5.9	
Equivalent range post-tax (%)		4.2	5.0	
Equivalent range pre-tax (%)		6.0	7.2	

Source: Ofgem (2004), p. 28, NERA (2004b), p. 68.

****NERA estimated the cost of debt directly based on coupon rates and yields on corporate bonds. The debt premium shown is therefore an implicit premium calculated on the basis of our estimate of the cost of debt and our estimate of the risk-free rate.***

*****Ofgem does not explicitly show an embedded debt allowance, but rather reports a debt-premium of 1.0%-1.8%. However, as discussed in Section 6.1, we believe the upper end of this range includes an allowance for embedded debt, and we have split out this allowance in our representation of Ofgem's figures in this table. Note that our own estimate of the cost of capital, as shown in the right-hand column, does not include an allowance for embedded debt, since we believe that any such allowance should ideally be made on a company-specific basis rather than as a adjustment to the industry-wide cost of capital.***

We note several points in relation to Ofgem's range for the overall WACC:

- Ofgem's calculations show a range of 3.5%-5.9% for the "Vanilla WACC", but Ofgem proposes a range of 5.1%-5.9% ***with no reasoning to explain the upward adjustment to the lower bound***. The proposed range is equivalent to 6.0%-7.2% for the pre-tax real

WACC.[1] It may be that Ofgem was keen to avoid signalling that this headline value would ever fall below 6.0%, in order to maintain investors' confidence, but the lack of reasoning prevents any clear message from coming through.

- The adoption of a very wide range for each parameter gives the impression that Ofgem is holding back some flexibility as a negotiating tool. At present, the lower bound parameter estimates in Table 2.1 are redundant, but any challenges to Ofgem's calculations run the risk that Ofgem brings the lower bound parameter estimates back into play. Such a procedure would not be conducive to the transparency of the regulatory process and it would be helpful for Ofgem to dispel any such notion. For most parameters, the wide range is unnecessary or unjustified and the lower bound should be raised, so reconciling parameter estimates with a (narrower) range is feasible.

- Ofgem will not wish to be seen to be inhibiting required investment and may have in mind an overall WACC that is "sufficiently high" to avoid that perception.

- The upper and lower bounds for several of Ofgem's parameter estimates are not consistent with the evidence presented by Ofgem. We have made revisions throughout this report to bring Ofgem's parameter estimates in line with the evidence it presents; this shifts the range for the "vanilla" WACC from 3.5%-5.9% (ignoring Ofgem's unexplained upward adjustment to the lower bound) to 5.0%-6.9%.

Notwithstanding our adjustments to Ofgem's parameter estimates, the key differences between Ofgem's original parameter estimates as shown in Table 2.1 and NERA's estimates are as follows:

- Our estimate of the cost of debt excludes allowance for embedded debt, whilst we assume that Ofgem's cost of debt includes such an allowance;

- Our estimate of 5.0% for the equity risk premium (ERP) is above the upper end of Ofgem's range of 2.5%-4.5%;

- Our estimated equity beta (1.28) is above the upper end of Ofgem's range (0.6-1.0);

- Our estimate of the cost of equity includes an allowance of 0.3% for the cost of issuing new equity, whilst Ofgem makes no allowance for such costs.

These and other differences in methodology and data sources place our estimate slightly above the upper bound of Ofgem's stated range. However, we find that a revised range based more closely on Ofgem's evidence would span our estimate, as explained below.

[1] The "equivalent" labels are Ofgem's. There is no way of verifying in what way the lower bounds of the post-tax and pre-tax WACCs are "equivalent" to the lower bound for the vanilla WACC since the calculations for the lower bound of the vanilla WACC are not reported.

3. RISK-FREE RATE

3.1. Ofgem's Evidence

Ofgem assesses a range for the risk-free rate of 2.25%-3.00%. Ofgem presents the following evidence in its assessment of this range:

- In the last electricity price distribution review, Ofgem assessed a range for the risk-free rate of 2.25%-2.75%;
- In its most recent decisions the Competition Commission ("CC") determined a range of 2.5%-2.75% at a time when ILG yields ranged from 2.2% (20-year) to 2.3% (10-year and 5-year). This range was lower than the range of 2.75%-3.25%assessed by the CC in the water cases in 2000;
- Current yields on ILGs are at 1.99% (20-year), 1.92% (10 year) and 1.65% (5-year);
- Smithers & Co advocate a risk-free rate of 2.5%;[2]
- Evidence recently reported by NERA suggests a range of 2.6%-3.1% based on historic time-series;[3]
- Future ILG yields may increase due to a number of factors that may increase future demand, including a fall from the high recent levels of equity market volatility, maturing pension funds, expected reforms to the Minimum Funding Requirement (MFR) and changes in accounting standards (such as FRS17). An increase in the supply of gilts would likewise increase the yield on gilts.[4]

3.2. Interpreting Ofgem's Evidence

Ofgem does not identify specifically how it arrived at a lower bound of 2.25%. Having presented the evidence above, Ofgem concludes that there is "considerable uncertainty" around the risk-free rate, and decides, somewhat arbitrarily, to widen the CC range

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[2] The Smithers & Co study was published in February 2003.

[3] The range quoted here by Ofgem was from NERA (2003), an early version of NERA's report for Water UK, which was updated in February 2004 (NERA, 2004a). Our updated figures for the range quoted by Ofgem, as per NERA (2004a) and NERA (2004b) - of which Ofgem has received a copy - would be 2.5%-2.9%. The lower bound reflects current yields on French and US ILGs, and the upper bound reflects the average two-year historical yield. In each of these reports NERA argued that the use of time-series evidence on yields is appropriate to ensure internal consistency and to reduce the impact of distortions arising from abnormal market conditions (see, for example, NERA (2004b), p.21). Our current central estimate of the risk-free rate is therefore 2.9%, i.e. the two-year historical yield.

[4] There is evidence that the supply of gilts will increase. See for example, Reuters News, 20 October 2003, "***Gilt supply to soar as UK deficit worsens***".

[5] Ofgem (2004) paragraphs 4.10-4.11.

symmetrically from 2.5%-2.75% to 2.25%-3.0%.[6] We have been able to identify three possible ways of reconciling Ofgem's lower bound with the evidence it has presented:

- Firstly, one can arrive at Ofgem's lower bound by taking the rate of 2.5% suggested by Smithers & Co, and/or the lower bound of the range used by the Competition Commission in its most recent decision, which is also 2.5%, in combination with Ofgem's argument that there are uncertainties and sensitivities around the expected risk-free rate. This is the approach that Ofgem appears in fact to have taken.

- Secondly, we note that there is an implicit upward adjustment to current actual ILG yields implied in Ofgem's range. The upward adjustment for the lower bound might be justified on the basis that it is broadly consistent with the implicit upward adjustment in the CC's recent decisions. Table 3.1 shows that Ofgem's lower bound for the risk-free rate implies an upward adjustment of 0.26%-0.60% to long-term yields (>5-years). This is broadly consistent with the implicit upward adjustment applied by the CC of between 0.20%-0.55% in its decision on Vodafone, O2, Orange and T-Mobile in February 2003.

Table 3.1
Ofgem and CC Upward Adjustments to Current Yields

	Ofgem		Competition Commission		
	Current ILG yields (Ofgem, 2004)	Implicit adjustment for lower bound of 2.25%	ILG yields at time of CC decision (Feb 2003)	Implicit adjustment for lower bound of 2.50%	Implicit adjustment for upper bound 2.75%
5-Year	1.65%	0.60%	2.30%	0.20%	0.45%
10-Year	1.92%	0.33%	2.30%	0.20%	0.45%
20-Year	1.99%	0.26%	2.20%	0.30%	0.55%

Source: ILG yields are taken from Ofgem (2004), paragraph 4.2. Implicit adjustments are NERA's figures.

- Thirdly, the lower bound for Ofgem's range might be reconciled to the lower bound of 2.25% for the range used by Ofgem in the 1999 electricity distribution price review.

The upper bound for Ofgem's estimate of the risk-free rate can be broadly reconciled to the evidence cited by NERA, which suggests a range for the risk-free rate of 2.6%-3.1%.

6 Ofgem (2004) paragraphs 4.10-4.11.

7 Ofgem (2004) paragraphs 4.10-4.11.

3.3. Comparison with NERA's Evidence on the Risk-Free Rate

Our estimate of the risk-free rate, as shown in Table 2.1, is 2.9%, which is within Ofgem's range of 2.25%-3.0%, but above the mid-point of 2.625%. However, we believe there are a number of problems with Ofgem's analysis, which we outline as follows:

- The downward adjustment for "uncertainties" to the figures presented by Smithers & Co is not warranted. In assessing their estimate Smithers & Co have already taken account of the fact that current and recent yields have been depressed and do not necessarily provide the best estimate of the forward-looking risk-free rate. Therefore no further downwards adjustment is required according to their methodology.

- Notwithstanding this last point, we outlined in NERA (2004b) a number of criticisms of the Smithers & Co approach, which we reproduce here as Appendix A. Given the problems with the Smithers & Co methodology, we do not believe any weight should be given to their estimate.[8]

- As noted in section 3.2, Ofgem also appears to be giving some weight to past assessments by the CC and/or by Ofgem itself in its previous electricity distribution price control review, either by making use of the estimate directly or by reference to the upward adjustment implied by the estimate. However on empirical matters Ofgem has no reason to be bound by previous decisions that are significantly out of date, particularly its decision in 1999. Furthermore, we believe that the CC's decision on the risk-free rate in the Vodafone, O2, Orange & T-Mobile case was subject to many of the same non-transparent adjustments and uncertainties that characterise Ofgem's analysis. For instance:

  - The CC based its decision largely on its previous decisions and the observation that yields had continued to fall. However the CC was unable in any of those decisions to provide a specific methodology for calculating an upward adjustment to account for the fact that recent historical yields had been depressed and were therefore not reflective of forward-looking yields. In the Surrey & East Sutton Water decision the CC acknowledged its adjustment was ***"inevitably judgmental";***[9]

  - The CC acknowledged that international evidence suggested a higher risk-free rate than the range it settled on, but appeared to place little weight on such evidence on the basis that such evidence was subject to potential biases due to relative illiquidity of overseas markets.[10] However, as discussed

[8] NERA's analysis of the approach by Smithers & Co was discussed in NERA (2004b), p. 19-20. Our discussion is reproduced here as Appendix A.

[9] Competition Commission (2000b), p. 117.

[10] Competition Commission (2002a), p. 174, paragraph 4.48.

below, we believe the data shows these markets to be liquid, so that this evidence is relevant.

In summary we conclude that, of the evidence presented by Ofgem, only Smithers & Co (2.5%) and NERA (2.6%-3.1%) provide estimates that are reconcilable with specific, observable evidence. Notwithstanding our severe misgivings about the Smithers & Co evidence, we therefore believe a fair range for the risk-free rate consistent with the evidence presented by Ofgem would be 2.5%-3.0%.

In our recent report on the cost of capital for the electricity distribution industry we estimate a risk-free rate of 2.9%.[11] (This figure updates our range of 2.6%-3.1% mentioned by Ofgem, which is from an earlier report.) Our estimate is based on the average yield on US and French ILGs over the last two years, and represents an implicit adjustment of 1.0% over current long-term UK ILG yields (>5 years) given our estimate for these yields of 1.9%.[12] However unlike Ofgem's implicit adjustments to evidence on current UK yields, our adjustment is objectively verifiable by reference to empirical data.

Our report also deals with the concern voiced by the Competition Commission that overseas markets for index-linked debt may be less mature than those in the UK, and consequently less liquid.[13] We analysed bid-ask spreads, a common indicator for liquidity, on French, US and UK ILGs, and found that the spreads in these countries lie within a narrow range and are very low by normal debt standards, indicating that liquidity is not an issue in terms of the comparability of French and US ILGs for the UK. We have also assessed other potential problems related to index linking, indexation and differential treatment of tax in these countries and have concluded that they do not have a significant impact on yield comparisons.[14]

3.4. Summary

We find that a fair and objective range for the risk-free rate based on the evidence presented by Ofgem is 2.5%-3.0%. This compares with our own estimate of the risk-free rate of 2.9%.

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11 NERA (2004b), p. 22.

12 NERA (2004b), p. 15.

13 NERA (2004b), p.18-19.

14 NERA (2003), pp. 61-66.

15 NERA's analysis of the approach by Smithers & Co was discussed in NERA (2004b), p. 19-20. Our discussion is reproduced here as Appendix A.

16 Competition Commission (2000b), p. 117.

17 Competition Commission (2002a), p. 174, paragraph 4.48.

4. EQUITY RISK PREMIUM

Ofgem's estimate of the ERP, 2.5%-4.5%, is below our estimate of 5%.[25] However the evidence presented by Ofgem suggests a higher lower bound for the ERP than Ofgem's proposed figure of 2.5%, as shown in Table 4.1.

Table 4.1
ERP Evidence Reported by Ofgem

Source	ERP Estimate	Basis
Arithmetic Means		
Dimson et al (2003)	5.1%	Arithmetic historical UK ERP
Dimson et al (2003)	5.0%	Recommended global prospective ERP on arithmetic basis
Welch (2001)	3.4%	Survey data on 1-year prospective ERP
Average**	4.5%	
Geometric Means		
Dimson et al (2003)	3.8%	Geometric historical UK ERP
Dimson et al (2003)	3.0%	Recommended global prospective ERP on geometric basis
Welch (2001)	3.4%	Survey data on 1-year prospective ERP
Average**	3.4%	

Source: Ofgem. Ofgem also quotes earlier historical results reported by Dimson et al (2001), however we show here only the most recent results.

In addition, there are a number of problems with Ofgem's interpretation of its sources:

- Dimson, Marsh & Staunton (DMS) advocate the use of arithmetic means for the prospective ERP, not geometric means. Based on the UK historical evidence this points to an ERP of at least 5%.

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18 NERA (2004b), p. 22.

19 NERA (2004b), p. 15.

20 NERA (2004b), p.18-19.

21 NERA (2003), pp. 61-66.

22 NERA's analysis of the approach by Smithers & Co was discussed in NERA (2004b), p. 19-20. Our discussion is reproduced here as Appendix A.

23 NERA (2004b), p. 22.

24 A concern voiced by the Competition Commission is that overseas markets for index-linked debt may be less mature than those in the UK, and consequently less liquid. This concern was discussed in NERA (2004b), p.18-19. Our analysis showed that French, US and UK bid-ask spreads, a common indicator for liquidity, lie within a narrow range and are very low by normal debt standards, indicating that liquidity is not an issue in terms of the comparability of French and US ILGs for the UK. We also addressed potential issues related to index-linking and indexation and differential treatment of tax in NERA (2003), pp. 61-66, where we assessed that these potential problems would not have a significant impact on yield comparisons.

25 NERA (2004b), p. 48.

- As noted by Ofgem, DMS argue that the prospective ERP is not as high as the historical ERP. This indicates that the UK ERP could potentially be slightly lower than 5%, although DMS only produce illustrative calculations of the downward adjustment to the historical ERP.[26] We note also that the view that the prospective ERP is lower than the historical ERP is not without controversy.[27]

- DMS conclude that there is a strong case for adopting a global rather than country-specific approach when determining the prospective ERP. Taking into account any downward adjustments in calculating prospective ERPs from historical ERPs, DMS conclude that the global arithmetic prospective ERP is 5%.[28]

- The 3.4% figure reported by Ofgem for Welch (2001) represents the one-year forecast premium. However the Welch survey also suggested an estimate for the 30-year (arithmetic) premium of 5.5%.[29] The prospective five-year premium, the most appropriate for a five-year price review, is presumably somewhere in between 3.4% and 5.5%. We would therefore not place any weight on the Welch figure.

- Ofgem discuss several pros and cons for the use of arithmetic returns and geometric returns in estimating the ERP, without appearing to come down in favour of one methodology over the other. In practice, we believe that only the arithmetic average will provide credible estimates for the forward-looking ERP.

The Ofgem range is the same as that used by the Competition Commission (CC) decision on ERP in its recent decisions on BAA (2002) and Vodafone, O2, Orange & T-Mobile (2003). However in empirical matters, as opposed to matters of principle or procedure, we would expect Ofgem to assess the evidence before it on its own merits, rather than being bound by previous estimates made by other agencies, possibly in quite different conditions. In any case, there are a number of problems with the CC's decision on the ERP, which we outline in Appendix B.

Given the impact of the ERP on the final WACC, we believe this is a key area where Ofgem's decision is inconsistent with the available evidence. Ofgem note that, "arguably, the higher end of [Ofgem's] range [of 2.5%-4.5%] is at present more relevant than the lower end".[30] In fact we find that Ofgem's own evidence implies a range of 3.0% (geometric basis) to 5.0% (arithmetic basis), and we believe theoretical arguments favour the higher value.

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[26] See for example, Dimson, Marsh & Staunton (2002), p. 192. DMS noted that their calculations of the downward adjustment were "simplistic" and "should not be taken seriously". Nevertheless the Competition Commission quoted these DMS downwardly adjusted figures in its most recent cases. This is discussed further in Appendix B.

[27] See NERA (2004b), p. 47 for a discussion of this issue.

[28] DMS (2003), p. 13. The prospective ERP on a geometric basis is 3%.

[29] Welch (2001).

[30] Ofgem (March, 2004), paragraph 4.19.

5. BETA

5.1. Raw Beta Estimates

Ofgem's equity beta range of 0.6-1.0 and gearing range of 50%-60% implies an asset beta range of 0.3-0.4. This is well below our estimate for the asset beta of 0.51.[31] However we found that some of the analysis used to arrive at Ofgem's estimated range is not supportable.

We note firstly that Ofgem's estimates (via Smithers & Co (2004)) of the raw daily equity betas concur approximately with our own estimates, and exceed our estimates for weekly and monthly raw equity betas:

Table 5.1
Comparison of Raw Equity Betas Estimated by Smithers & Co and NERA[32]

Company	Daily		Weekly		Monthly	
	S&C	NERA	S&C	NERA	S&C	NERA
Scottish Power (SPW)	0.698	0.674	0.686	0.620	0.731	0.399
Scottish & Southern (SSE)	0.488	0.434	0.635	0.343	0.460	0.275
United Utilities (UU)	0.591	0.559	0.547	0.357	0.541	0.352
Viridian (VRD)		0.170		0.209		0.224
National Grid Transco (NGT)		0.631		0.554		0.484
Average (excl. VRD, NGT)	0.592	0.555	0.623	0.440	0.577	0.342
Average (incl. VRD, NGT)		0.493		0.416		0.347

Source, Ofgem (paragraph 4.22) and NERA (2004b, pp. 69-71). Note that Ofgem reported figures only for SPW, SSE, and UU, whereas we also used VRD and NGT as comparators. Although we do not report their results here, Smithers & Co (2004) did also calculate equity betas for VRD & NGT; as with the other comparators the results were similar to ours for daily and weekly betas, but substantially different for monthly betas.

Ofgem appears to place greater weight on the daily beta results, noting that "there is a clear ranking of the precision of beta estimates with higher frequency data increasing precision".[33] We would support this conclusion. However there are a number of problems with the rest of Ofgem's analysis, as we discuss in the remainder of this section.

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[31] NERA (2004b), pp. 39-40.

[32] The "raw" term refers to the fact that these beta estimates are unadjusted using an adjustment process such as the 'Blume adjustment' to account for the tendency of betas to regress towards the mean market value of one (see NERA (2004b), p.25).

[33] Ofgem (2004), paragraph 4.23.

5.2. Recent Trends in Betas

Ofgem notes that betas have declined in recent years. We summarise Ofgem's analysis of this phenomenon:

- Ofgem (via Smithers & Co (2004)) suggests two possible reasons for declining betas: the TMT (Technology, Media & Telecommunications) bubble over recent years (this is equivalent in effect to NERA's "excess volatility" explanation), or "markets learning", a phenomenon which would cause betas to fall over time as investors become used to a new or recently privatised industry.

- The implication of the "markets learning" hypothesis is that beta estimates that take into account higher historical betas overstate the forward-looking beta. It would therefore be appropriate to use the most current estimable beta for the forward-looking beta or to use a downward adjustment to a longer-term historical beta.[34] Ofgem might be using this argument to justify the use of the average daily equity beta estimate of 0.60 (~0.592 in Table 5.1) as the lower bound for its range.

- However while the 'markets learning' hypothesis provides a theoretically plausible explanation, the evidence shows that market volatility is the overriding factor. Figure 5.1 shows that the decrease in beta occurred as market volatility became "decoupled" from the covariance between electricity stocks and the market.[35] This contrasts with the "markets learning" hypothesis, under which falling covariance would be the dominant feature. However the covariance shows no downward trend. Similar graphical analysis for each comparator individually in NERA (2004b) showed this to be true for all comparators.[36]

- Ofgem argued that under the "TMT bubble" hypothesis beta estimates would be unstable. Ofgem argues that if this is the case then future betas cannot be easily forecasted, and forecasts of the equity beta must revert to the default "unconditional" assumption that beta is equal to 1. This perhaps, provides the rationale for the upper bound for Ofgem's range, the alternative "markets learning" argument providing the lower bound.

- Ofgem also discusses evidence from studies by Hern & Zalewska and Annema & Goedhart, which suggest that excess market volatility has depressed the beta for electricity stocks by around 0.29 and 0.50 respectively. Using this evidence, one can arrive at the upper bound of Ofgem's range (1.0) by adding the average upward adjustment implied by these two studies, 0.40, to the estimated average daily equity beta of around 0.6. (This is NERA's interpretation of Ofgem's evidence; Ofgem is not explicit about its interpretation.)

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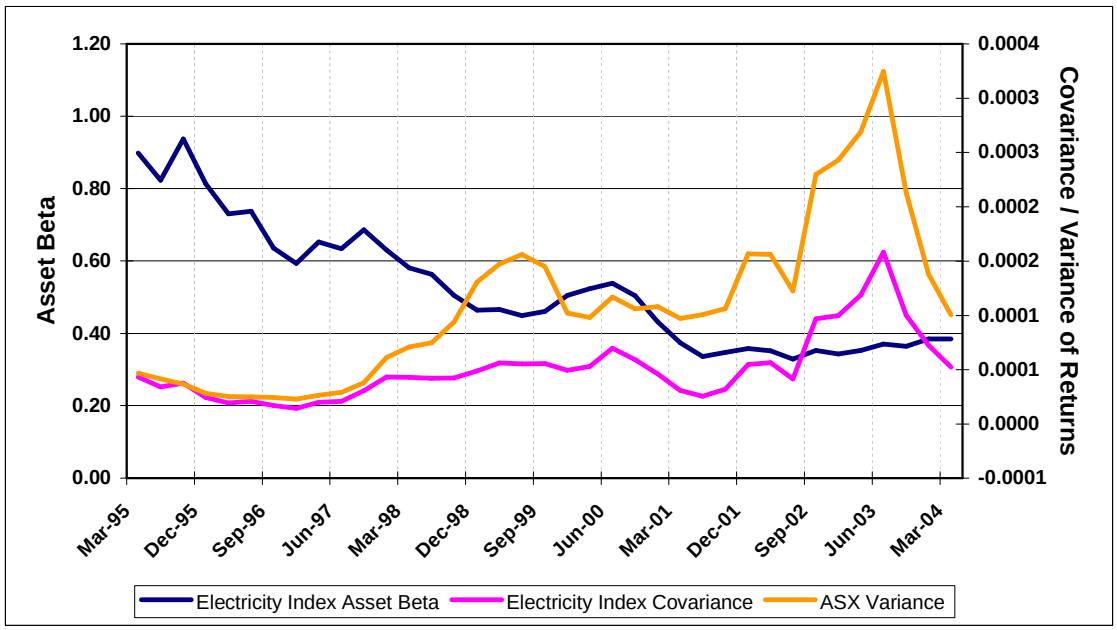
[34] Smithers & Co (2004), p. 5.

[35] See NERA (2004b), pp. 29-34 for a more extensive discussion of these issues.

Figure 5.1
1-Year Daily Asset Betas (Quarterly Rolling) for Index of Five Comparators



Source: NERA analysis of Bloomberg data. The "electricity index" is an equally weighted index of NERA's five comparator companies, as shown in Table 5.1.

The latter adjustment could represent an attempt to adjust beta for excess volatility using a statistical approach. This is an appropriate type of adjustment because it correctly identifies market volatility as a key cause of declining betas (rather than "markets learning"), and because it employs an objectively verifiable empirical approach in assessing the size of the adjustment. This is more or less what our "dummy variable" approach achieves, albeit by a more rigorous methodology.[37] However Ofgem should use the approach to provide a central estimate for beta, not an upper bound, since, as discussed, the evidence points to the excess volatility hypothesis as being the dominant explanation for declines in estimates of beta.[38]

Like Ofgem, we also believe that betas were depressed by the impact of various regulatory measures around the period late 1998-late 1999, including: DPCR3, the proposal to separate supply from distribution and the opening up of retail competition, the break-up of National Power and Powergen, which would have created expectations of stronger wholesale

[36] See NERA (2004b), pp. 72-73.

[37] In NERA (2004b), we used dummy variables in the beta regression equations to account for excess volatility over the period March 2000-Feb 2004.

[38] For instance, in our regressions using dummy variables to account for "excess volatility", the dummy variables were correctly signed and statistically significant for four out of the five comparator companies at the 95% probability level, and correctly signed for the fifth comparator with a p-value (two-sided) of 19%. (See NERA (2004b), Table 5.3, p. 36).

competition, the attempt to impose the Market Licence Abuse Condition, and the forthcoming (at that time) introduction of NETA. We used dummy variables in our beta estimates to account for the potential effect on betas over this period.[39]

5.3. Adjustments for Gearing

An additional problem remains right through Ofgem's analysis, which is that Ofgem does not de-lever the equity betas for the comparator companies' actual gearing and re-lever for the assumed regulatory gearing. Ofgem justifies this on the grounds that "gearing at licensee level is in the case of the listed companies higher than gearing at the parent company level"; de-levering and re-levering is therefore "unlikely to be appropriate unless the parent company beta has been decomposed". However Ofgem is unwilling to attempt to decompose the betas as this is "complex" and may not "yield robust estimates".[40]

We find Ofgem's logic here to be faulty. The equity beta at the parent company level reflects the parent companies' level of gearing. Simply ignoring the effect of gearing is therefore highly misleading. Gearing at the parent company level for all of Ofgem's comparators is lower than the 50%-60% gearing range proposed by Ofgem, so Ofgem's approach will understate the implicit asset beta for the three comparators.

We acknowledge Ofgem's point that the equity beta at the parent company level may not reflect the equity beta at the licensee level given different levels of gearing. However Ofgem's solution – simply ignoring the gearing of the parent company – produces estimates that reflect neither the equity beta for the parent company nor the equity beta for the licensee. It seems more sensible to consider the relative betas of the parent company and the licensee in terms where the effect of differential gearing has been removed, i.e. by considering asset betas.

To summarise this issue: Ofgem is assuming a 50%-60% gearing for the licensee, so the assumed equity beta must be consistent with this assumption. Equity betas taken from

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[39] We tested the dummy variable for all comparators, and left the dummy variable in our beta equations for the three comparators (Scottish Power, Viridian, and United Utilities) where the dummy was correctly signed.

[40] Ofgem (2004), paragraph 4.30. Note that we did attempt to unbundle the parent company betas (see NERA (2004b), pp. 37-40. As it turned out, the unbundling process gave results that reflected similar asset betas for the distribution subsidiary and the parent company, although our results were very sensitive to assumptions about betas for the non-distribution parts of the business.

[41] This range is calculated by de-levering and re-levering ***raw*** equity betas. Applying the Blume adjustment to raw equity betas before de-levering and re-levering leads to an estimated average equity beta range of 0.99-1.24. Note also that these results are no different if Ofgem's equity beta data is used instead of ours, given that Ofgem's daily beta estimates are very similar to ours, as shown in Table 5.1.

[42] The same range for the equity beta, had the Blume adjustment been applied before de-levering and re-levering (as in the previous footnote), would be 1.39-1.64.

companies with lower gearing are inconsistent and understate the cost of equity applicable to Ofgem's assumptions.[43]

We now examine in detail the effect of Ofgem's failure to account for the impact of gearing on the equity beta, by de-levering Ofgem's equity beta estimates based on the gearing of the comparator companies over the beta estimation period, and then re-levering the resulting asset beta estimates to Ofgem's target gearing. Our results are shown in Table 5.3.

Table 5.3
Adjustments to Ofgem's Equity Beta Estimates

Comparator	Equity beta	Average gearing (D/E) over estimation period	Implied asset beta	Equity beta consistent with 50%-60% target gearing	Upward adjustment for excess volatility (+0.40%)
Scottish Power	0.698	35%	0.590	1.03-1.29	
Scottish & Southern	0.488	24%	0.532	0.79-0.99	
United Utilities	0.591	56%	0.467	0.76-0.95	
Average	0.592	38%	0.530	0.86-1.08	1.26-1.48
Average excluding SPW	0.540	40%	0.499	0.77-0.97	1.17-1.37

Source: All source data is implied by evidence in Ofgem (2004), except average gearing levels, which we have calculated using Bloomberg data by averaging gearing levels over the last 12 years, consistent with Ofgem's beta estimation period. The relationship used to de-gear and re-gear the equity betas is $b_e=b_a[1+(D/E)]$***, where*** b_e ***is the equity beta,*** b_a ***is the asset beta, D is the market value of net debt and E is the market value of equity.***

The equity beta range consistent with the target gearing assumed by Ofgem is 0.86-1.08. We adjust these figures upward by 0.40 to account for the TMT bubble (using the Hern & Zalewska/Annema & Goedhart adjustment implicit in Ofgem's analysis), yielding an estimated range for the equity beta of 1.26-1.48. These figures are significantly higher than the initial equity beta figures put forward by Ofgem, which average just 0.592. This is because historically the gearing levels of these companies have been significantly lower than Ofgem's target gearing, and the forward-looking equity betas will be higher, reflecting the increased risk at higher target gearing levels.

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[43] We note that Ofgem has been inconsistent in considering the effect of gearing on equity betas in the past. For DPCR3, Ofgem completely ignored the conventional financial theory behind de-levering and re-levering betas by capping the equity beta at one, despite the fact that Ofgem's own empirical evidence, as applied by standard financial theory, pointed to an equity beta of greater than one. If Ofgem repeats this error for DPCR4 and once again ignores established financial theory, it will be impossible to establish the transparent and objective regulatory regime needed to protect consumer interests by encouraging efficient investment.

[44] See Ofgem (1999a), paragraphs 6.32-6.34, Ofgem (1999b), paragraphs 5.33-5.35, and Ofgem (1999c), paragraph 5.20. Ofgem's decision to cap the equity beta at one was based on Ofgem's observation that a cross section of utilities with different levels of gearing did not show substantially different equity betas. However this is a spurious observation that could be based on any number of other factors, including that the asset betas for these utilities were very different.

A lower beta estimate is obtained if Scottish Power is excluded from the analysis. In NERA (2004b) we ultimately excluded Scottish Power from our analysis, as we were unable to account for the beta of the company's US operations, which account for approximately 61% of the business as measured by net asset value and are subject to a very different set of regulatory and market risks.[45] As shown in Table 5.3, excluding Scottish Power from the analysis of Ofgem's data leads to an adjusted equity beta estimate of 1.17-1.37. We believe this is a reasonable estimate of the equity beta, consistent with the evidence presented by Ofgem.

5.4. Summary

To recap, we have made the following observations about Ofgem's estimated range for the beta:

- Ofgem's raw estimates for the daily equity beta are consistent with NERA's estimates, although Ofgem uses a narrower comparator set than NERA.
- Ofgem has suggested two causes for the declining betas observed in recent years: a "markets learning" hypothesis, and an "excess" market volatility hypothesis. However our evidence does not support the markets learning hypothesis, showing rather that excess market volatility is the dominant factor underlying declining betas in recent years.
- Studies cited by Ofgem suggest a possible upwards adjustment of approximately 0.40 to beta estimates to account for the impact of excess market volatility on utility stocks. However the evidence supporting the excess volatility hypothesis suggests that the resulting beta estimates represent central estimates, not an upper bound as per Ofgem's analysis.
- Ofgem has made no adjustment to its equity beta estimates to account for the effect of gearing on equity betas. This is inconsistent with long-established financial theory.
- Adjusting Ofgem's beta estimates for the gearing of the comparator companies (and excluding Scottish Power from the comparator set given the high proportion of its operations based in the US) produces an estimated range for the beta of 1.17-1.37.

There are significant number of differences between our approach and that taken by Ofgem:

- We used dummy variables in the beta regressions to account for excess volatility and the negative impact of regulatory events on betas, whilst Ofgem has accounted (implicitly) for excess volatility by an upward adjustment based on other studies of the impact of excess volatility on utility stocks;

[45] See NERA (2004b), p. 28 for a breakdown by enterprise value of the business operations of our comparator set.

- We applied the Blume adjustment used to account for the tendency of the equity beta estimates to regress towards one;[46]
- We attempted to "unwind" the beta for the electricity distribution entities within the comparator set from their parent companies;
- We used a wider comparator set that included National Grid Transco and Viridian.[47]

Despite these methodological differences, our estimate of 1.28 for the equity beta in NERA (2004b) falls with the revised range derived from Ofgem's evidence.

[46] See NERA (2004b), p. 25 for a discussion of the Blume adjustment.

[47] See NERA (2004b), pp. 23-40, for a full discussion of our methodology for estimating beta.

[48] The key difference is that Ofgem's raw equity beta estimates are based on slightly longer time periods of around 12-13 years for the three comparators, while our estimates are based on 10 years of returns. This may have a minor effect in terms of the average gearing applied across the estimation period.

[49] Note that this range is calculated by de-levering and re-levering ***raw*** equity betas. Applying the Blume adjustment to raw equity betas before de-levering and re-levering leads to an estimated average equity beta range of 0.99-1.24. (See NERA (2004), p. 25 for a discussion of rationale for the Blume adjustment.)

[50] The same range for the equity beta, had the Blume adjustment been applied before de-levering and re-levering (as in the previous footnote), would be 1.39-1.64.

[51] However note that there are considerable differences in NERA and Ofgem's methodology, including: the adjustment process for excess volatility and, in NERA's case, the negative impact of regulatory events on the betas of the comparator companies; the Blume adjustment used to smooth on raw equity beta in the case of NERA's work (but not Ofgem's; the fact that NERA has made an attempt to "unwind" the beta for the electricity distribution entity from the parent company; the different comparator set (NERA's comparator set included National Grid Transco and Viridian)..

6. DEBT PREMIUM & GEARING

6.1. Debt Premium

Ofgem's range for the debt premium is 1.0%-1.8%. Together with the range for the risk-free rate of 2.25%-3.00%, this gives a total cost of debt of 3.25%-4.80%. The mid-point of this range is 4.025%, which is higher than NERA's estimate of 3.75%.

However our estimate did not include any allowance for embedded debt, an allowance that is necessary to provide a reasonable prospect of cost recovery, but which must be assessed on a company-specific basis. We believe that Ofgem's debt premium does include a general allowance for embedded debt:

- The evidence quoted by Ofgem consists of: an actual debt premium based on two years of data of 0.93% for UK debt, 1.60% for US debt, and 0.88% for Euro bonds, and a "long-term" UK average debt premium of 1.36%.[52] This evidence points to a lower debt premium than 1.8%, although Ofgem points out that the current debt premium may be temporarily depressed due to increased demand for corporate debt by pension funds.
- Peter Bucks has stated that Ofgem should take a "cautious" approach to estimating the cost of debt, instead of estimating the (company-specific) cost of embedded debt, which we interpret as setting the cost of debt high enough to provide an allowance for reasonable (average) costs of embedded debt.[53]

If we assume that Ofgem has incorporated an embedded debt premium of 0.3% in the debt premium (i.e. the premium that the CC included in its decision on Mid-Kent Water for example), then a range for the debt premium excluding the allowance for embedded debt might be 0.9%-1.5%. This range is calculated as follows:

- The lower bound of 0.9% is calculated as the average two-year debt premium of 0.93% for the UK and 0.88% for Europe (~0.90%);
- The upper bound of 1.5% is calculated as Ofgem's upper bound of 1.8% less the assumed embedded debt premium of 0.3%. This is also approximately equal to the mid-point of Ofgem's data on the debt premium for US debt of 1.60% and the long-term UK average debt premium of 1.36%.

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[52] Ofgem does not specify the meaning of "long-term" as it is applied here. (Ofgem (2004), paragraph 4.33).

[53] Mr Bucks wrote, "There appears to be a good case for taking a cautious view of the cost of debt in the forthcoming reviews. This should obviate the need for any additional embedded debt allowance." (Utilities Journal, October 2003).

Given our belief that Ofgem's range of the debt premium includes of an embedded debt premium of around 0.3%, an appropriate range for the debt premium given Ofgem's evidence would be 1.2%-1.8%. We would support the inclusion of an allowance for embedded debt, but we suggest that Ofgem should be more open about the allowance that it has made for embedded debt (or what aspect of its calculation provides an equivalent allowance), so that companies and investors can understand Ofgem's process for setting prices in future reviews.

6.2. Gearing

Ofgem has assumed a gearing of 50%-60%, which is approximately consistent with a single A rating, as we have proposed.

7. EQUITY ISSUANCE COSTS

Our estimate of the cost of equity includes an allowance of 0.3% for equity issuance costs. This is discussed in NERA (2004b), pp. 49-55. Ofgem does not make any allowance for equity issuance costs. However inclusion of such an allowance is justified for three reasons:

- First, it is important for electricity companies to maintain single A credit rating status in order to access the debt capital markets at efficient rates. Current market evidence suggests that many electricity companies are approaching maximum levels of gearing consistent with a single A credit rating status.[54] Electricity companies will therefore need to finance new investment through equity finance as well as debt finance if they are to maintain steady-state capital structures over the DPCR4 period. Thus, many DNOs will actually incur the cost of issuing new equity, if they have not already done so.

- Second, UK regulators estimates of WACC are based on a "steady state" gearing assumption (in DPCR3, Ofgem used an estimate of gearing of 50% debt). It is therefore consistent to take into account the new issue costs that would be incurred by electricity companies in ***both*** the debt and equity markets in order to maintain this steady state gearing assumption. In other words, any assumption of a steady debt-to-equity ratio would understate the cost of capital if it omitted the cost of issuing equity.

- Third, the costs and availability of new debt finance can vary significantly according to market conditions and liquidity constraints - it is therefore prudent to ensure that the allowed rates of return to all electricity companies enable them to access both equity and debt finance in order to meet new investment obligations.

Our report on the cost of capital for electricity distribution (NERA (2004)) sets out our calculation of the allowance that should be made for equity issuance costs. We note also that there is regulatory precedent for an allowance for equity issuance costs; the Competition Commission made an allowance of 0.25% (calculated as an upward adjustment to the overall pre-tax WACC) related to the construction of Terminal 5 in the 2002 BAA case.[55] Failure to includes such an allowance would be inconsistent with the assumption of steady-state gearing (and will require consideration of the long-term consequences of risking levels of gearing). In particular it would be opportunistic to assume 60% gearing at the start of each review period, whilst also assuming that gearing will exceed 60% at the end of each review period.

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[54] Water UK's investor survey (Water UK, 2003) indicated that for companies that have not restructured their asset base, average maximum acceptable level of gearing (debt to debt plus equity) is around 65%.

[55] Competition Commission (2002), paragraphs 4.70-4.72, p. 179.

8. ALTERNATIVE APPROACHES TO THE CAPM

8.1. Summary of Alternative Sources

Table 8.1 summarises the cost of equity calculations under Ofgem's alternative methodologies. The lower bound of these estimates is higher than Ofgem's lower bound under the CAPM methodology. We note that this alternative range for the cost of equity does not explain Ofgem's upward adjustment to the lower bound for the overall WACC, as shown in Table 2.1; the calculation of that upward adjustment therefore remains a mystery.

Table 8.1
Alternative Approaches to CAPM

	Cost of Equity	
Methodology	Low	High
Link Hi/Lo & Lo/Hi (RFR/ERP)	5.5	6.75
Smithers & Co (+/- 2% on geometric mean basis)	3.5	7.5
Smithers & Co (+/- 2% on arithmetic mean basis)	4.5	9.5
Dividend Growth Model (companies which fall within the price control)	6.3	7.6
Dividend Growth Model (FTSE 100)	5.75	6.0
Smithers & Co (+/- 1% on geometric mean basis)*	[4.5]	[6.5]
Smithers & Co (+/- 1% on arithmetic mean basis)*	[5.5]	[8.5]
Average	5.1	7.5
Ofgem CAPM cost of equity	3.75	7.5

Source: Ofgem, NERA. *NERA has included the cost of equity based on +/-1% to the Smithers& Co central estimates. Ofgem's +/-2% adjustment seems rather large. As it turns out the inclusion of these figures makes no difference to the average figures at the level of 1 decimal place.

While we support the use of alternative calculations, particularly the Dividend Growth Model (DGM) as a cross check on the CAPM, we have a number of specific comments on Ofgem's use of these methodologies as set out in the following sections.

8.2. Alternative Approach to Risk-Free Rate and ERP

In paragraphs 5.3-5.5, Ofgem discusses several possible explanations of the historical decline in the dividend/price ratio. Ofgem's essential point is that the ERP and risk-free rate may be inversely related, since high equity market volatility leads to greater demand for higher

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[56] See for example, NERA (2003b), paragraphs 2.9-2.11.

[57] Smithers & Co (2003), pp. 49.

[58] For instance, Ofgem uses a dividend growth of 1%-2% based on load growth, which is lower than the growth rate of 2.19% NERA used for its study into the water industry cost of capital based on forecast GDP growth (NERA (2004a), p. 77.

quality government bonds, a point made by NERA in previous submissions to Ofgem.[59] Ofgem then calculates an alternative range for the cost of equity based on the sum of the lower bound for the risk-free rate and the upper bound for the ERP, and vice versa. Based on a range for the risk-free rate of 2.25%-3.00% and a range for the ERP of 2.5%-4.5%, this provides an alternative range for the cost of equity of 5.5%-6.75% if the equity beta is equal to one, whereas the evidence suggests the equity beta is higher (see section 5). Hence this simplified approach should not be taken to define any real bounds on the cost of equity.

Our submission to Ofgem that the risk-free rate and ERP were inversely related was made in the context that estimates of these two parameters should be internally consistent. Internal consistency is achieved by assessing these parameters as the average of a long-term historical time-series. Simply combining upper and lower bounds of an (inconsistently defined) range of estimates is not a robust methodology. (Ofgem's ranges are based on a number of mixed premises and uncertainties; adding these figures together is only likely to add in further biases.) Furthermore, Ofgem's calculations rest on an arbitrary assumption that beta equals one.

8.3. "Aggregate Return on Equity Approach"

The "aggregate return on equity approach" adopted by Smithers & Co leads to estimates of the cost of equity of 5.5% (geometric mean) and 6.5%-7.5% (arithmetic mean). Ofgem adds +/- 2% to these estimates to derive a range for the cost of equity of 3.5%-7.5% (geometric) and 4.5%-9.5%(arithmetic).

The Smithers & Co approach does not provide an objective estimate, since it rests on the controversial and unjustified assumption that the equity beta is equal to one. The Smithers & Co calculation also uses a historical estimate of the ERP and a forward-looking estimate of the risk-free rate.[60] Given the possible relationship between the ERP and the risk-free rate, this approach is likely to understate the cost of equity, since high current market volatility will depress yields on government bonds used to estimate the risk-free rate.

8.4. Dividend Growth Model

Ofgem estimates the cost of equity using the dividend growth model (DGM). We note that some of the parameters used in Ofgem's analysis are different from those we have used in past studies.[61] Ofgem's final ranges for the cost of equity under this approach (6.3%-7.6% for electricity distribution companies, 5.75%-6.00% for the FTSE 100) are within the range

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[59] See for example, NERA (2003b), paragraphs 2.9-2.11.

[60] Smithers & Co (2003), pp. 49.

[61] For instance, Ofgem uses a dividend growth of 1%-2% based on load growth, which is lower than the growth rate of 2.19% NERA used for its study into the water industry cost of capital based on forecast GDP growth (NERA (2004a), p. 77.

identified by the CAPM approach. However, Ofgem′s application of the DGM is subject to a number of possible criticisms:

(1) Ofgem uses a historical measure of dividend yield, instead of a prospective one;

(2) Ofgem does not explicitly make any allowance to base the dividend yield on "ex dividend" shared prices, as required by the model, which may lead to an overstatement of share prices (P) and an underestimate of the cost of capital;

(3) Ofgem′s estimate does not build in any analysts′ forecasts of future dividend growth, a potentially rich source of evidence.

In paragraph 5.12, Ofgem assumes that the DNOs′ dividend growth would only match load growth, whereas in paragraph 5.13 Ofgem uses GDP growth (a higher figure) as an indicator of dividend growth amongst the FTSE 100 companies. In fact, there are good reasons to suspect that the DNOs′ dividend growth will exceed their load growth:

- Dividends are likely to be proportional to profits (in the long-term) and hence to the Regulatory Asset Value (RAV);
- The RAV is the product of net capital stock per unit and load (number of units);
- Capital stock per unit will rise in real terms due to accelerating capex and due to any substitution of capital for opex (e.g. installing computerised monitoring systems to replace labour), and will decline in real terms due to capital efficiency;
- Realistic parameters suggest that capital stock per unit will rise in the near future, so that profits and dividends will rise faster than load.

To illustrate the last point, consider a DNO whose total costs are split 50/50 between opex and capital costs (depreciation and return). If unit revenues (the price cap) is falling in real terms by only 0.5%-1.0% per annum, unit opex only has to fall by 1.0%-2.0% per annum to provide the required total efficiency gain. Any opex gains in excess of this rate must be offset by rising unit capital costs, and hence rising profits and dividends per unit. As a result, dividends will rise faster than load growth (i.e. than the number of units)

This relationship provides a useful consistency check on the final outcome of the review. If Ofgem projects an increase in the future net capital stock per unit for individual DNOs, it would be reasonable to assume that dividends will rise faster than load growth and so the cost of capital (by DGM) must incorporate a higher rate of dividend growth. Examining analysts′ forecasts at this stage would provide some guidance as to whether they believe this is a necessary or likely outcome.

Using GDP growth (2.25%-2.5%) as a proxy for dividend growth for the DNOs, Ofgem′s own estimate of dividend yield of 5.3%-5.6% would imply a real cost of equity of 7.55%-8.1%. Closer examination of the data might lead to a revised estimate.

8.5. Summary

It is useful to compare a formulaic approach such as CAPM with other methods of estimation, as Ofgem has done. However, close scrutiny suggests that these other methods are consistent with slightly higher ranges than Ofgem has indicated.

9. RECALCULATION OF OFGEM WACC

In this section we recalculate Ofgem's WACC based on what we believe are consistent interpretations of the evidence presented by Ofgem. Table 9.1 shows Ofgem's stated range, the range implied by our review of the evidence quoted by Ofgem, and our own estimate of the electricity distribution WACC, repeated from Table 2.1.

Table 9.1
Ofgem's WACC Under Consistent Interpretations of Ofgem's Evidence

Component	DPCR4 2004		DPCR4 2004, Under a Consistent Interpretation of Ofgem Evidence		NERA 2004
	Low	High	Low	High	
Risk-free rate (%)	2.25	3.00	2.50	3.00	2.9
Debt-premium (%)	1.0	1.8	0.9	1.5	0.85
Embedded debt adjustment (%)			0.3	0.3	
Cost of Debt (%)	3.25	4.80	3.70	4.80	3.75
Equity risk premium (%)	2.5	4.5	3.0	5.0	5.0
Gearing (%)	50.0	60.0	50.0	60.0	60.0
Equity beta	0.6	1.0	1.17	1.37	1.28
Equity issuance costs (%)			0.3	0.3	0.3
Cost of equity (post-tax) (%)	3.75	7.50	6.31	10.15	9.58
Cost of equity (pre-tax) (%)	5.36	10.71	9.01	14.50	13.68
Post-tax WACC (%)	3.0	5.0	4.5	6.1	5.4
Pre-tax WACC range (%)	4.3	7.2	6.4	8.7	7.7
"Vanilla" WACC (%)	3.5	5.9	5.0	6.9	6.1
Proposed "Vanilla" WACC (%)	5.1	5.9			
Equivalent range post-tax (%)	4.2	5.0			
Equivalent range pre-tax (%)	6.0	7.2			

Source: Ofgem (2004), p. 28, NERA (2004b), p. 68 and this report. NERA's estimate excludes an embedded debt premium, as we believe this should be calculated separately for each company as a cashflow line item.

Note that the key revisions we have made to Ofgem's figures, based on its own evidence, are to the risk-free rate, debt premium (and embedded debt adjustment), equity risk premium, beta, and equity issuance costs.

Consistent use of Ofgem's own evidence raises the range for the "Vanilla" WACC from 3.5%-5.9% to 5.0%-6.9%, without any need for arbitrarily imposing a cut-off to the lower bound. The corresponding ranges are 6.4%-8.7% for the pre-tax (real) WACC and 4.5%-6.1% for the post-tax (real) WACC.

NERA's estimate of 6.1% for the vanilla WACC falls just above the mid-point of Ofgem's range for the vanilla WACC (5.95%).

10. CONCLUSION

Ofgem has made a significant effort to adopt a consistent method for setting the allowed cost of capital, namely the CAPM and "vanilla" WACC formula. The adoption of such a consistent method is a useful aid to understanding.

Ofgem has also recorded the available evidence on the key parameters used in these formulae. Again, stating the basis for decisions like this helps transparency, strengthens incentives for efficient investment, and protects consumers' interests.

However, at crucial points in its calculations, Ofgem reaches decisions that are impossible to reconcile with the available evidence, either by adopting values ***below*** the lower bound, or by adopting downwardly biased estimates with no evidence to explain the bias, or by adopting ranges that are entirely unconnected with the evidence. This disconnection between available evidence and decisions is worrying, as it injects a degree of arbitrariness into the outcome of the price control review which undermines transparency and incentives.

In this report, we have re-assessed the available evidence on each parameter and have indicated where Ofgem could usefully tighten up its methodology, by tying decisions more closely to the evidence. We have also highlighted areas where Ofgem appears to have adopted low estimates within a possible range, without explaining why the lower estimate is appropriate.

In general, therefore, Ofgem has set out a useful framework and has listed a significant amount of relevant evidence, but would have to adjust its method of estimating the WACC to ensure that the final decision is consistent with both.

APPENDIX A. ANALYSIS OF SMITHERS & CO EVIDENCE ON THE RISK-FREE RATE[62]

Smithers and Co (2003) appears to conclude that a reasonable assumption for the real risk-free rate is 2.5%. They state:

> *"**realistically, most available long-term forecasts of real short rates are likely to be driven by assumptions about equilibrium real rates drawn from relatively short samples. Thus, for example, the common assumption in discussions of monetary policy along "Taylor Rule" lines, that the mean real interest rate should be of the order of 2.5%, is largely driven by experience since the 1980s**"* (p43).

There are two points to be noted with regard to the use of this estimate of the long-term interest rate of 2.5% as a measure of the real risk-free rate.

First, as argued by the Competition Commission, there is little formal evidence of long-term mean reversion in the real risk-free rate.[63] The use of a long term interest rate based on twenty years of historical evidence as an estimate of the forward looking risk-free rate is therefore not appropriate. The key component of the formulation of the Taylor rule - the relationship between output and inflation - is subject to many underlying economic influences.[64] It is not reasonable to expect that the nature of these influences will remain as they have since the 1980s in generating an average policy determined rate of 2.5%.

Second, a recent Federal Reserve Staff paper by Sack (2002) suggests that the Federal Reserve has moved away from the use of the Taylor rule in deriving a methodology for setting interest rates. It is instead suggested that monetary policy decisions made in the US since 1999 correspond to a simple rule determined by differences between the forward rates implied by the prevailing yields of nominal and inflation-indexed US Treasury bonds.

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62 This section is reproduced from NERA (2004b) (section 4.4, pp. 19-20).

63 See for example Competition Commission (2000a), (2000b) and (2002).

64 The Taylor rule was originally formulated as an explanation of ***observed*** Federal Reserve monetary policy since the 1980s, based on the apparent minimization by the monetary authority of a weighted average of the "output gap" and deviation of inflation from target levels. The average interest rate of 2.5% generated by this rule is therefore reliant on underlying economic factors such as productivity and wage bargaining relationships that affect the output gap, inflation, and the relationship between the two.

APPENDIX B. ANALYSIS OF COMPETITION COMMISSION EVIDENCE ON THE EQUITY RISK PREMIUM

B.1. Competition Commission Decisions

Table B.1 shows that the ERP applied by the Competition Commission has fallen over recent years. For instance, the 4% figure used in the Mid-Kent Water (MKW) and Sutton & East Surrey Water (SESW) decisions in 2000 was 0.25% below the mid-point of 4.25% in the Cellnet & Vodafone decision in 1999. The mid-point estimate fell again to 3.5% in the BAA and Vodafone, O_2, Orange & T-Mobile decisions in 2002 and 2003, although this was offset by the addition of 0.25% to the WACC in order to "smooth the downward trend".[65]

Table B.1
Recent UK Regulatory Decisions on the Equity Risk Premium

Institution	Case	ERP	Basis for Decision
MMC	Cellnet / Vodafone, Jan 1999	3.5%-5%	Considers both long-term (1919-96) and recent (1994-96) historical evidence on equity returns against recent risk-free rate evidence (1986-96).
Competition Commission	Mid-Kent Water Plc; and Sutton and East Surrey Water Plc, Sept 2000	4.0%	Considers arithmetic and geometric averages of 100-year returns against gilts and bills, and survey evidence from Price Waterhouse (1998), NERA (1999), Merrill Lynch (1998) + Director's own consultations within the city. Concludes ERP is currently lower than historical average.
Competition Commission	BAA, Nov 2002	2.5%-4.5%	New analyses of historical evidence over various periods from 10 years to 100 years against gilts and bills. Weight also given to survey evidence. An additional 25bp was added to the real pre-tax WACC "to smooth the downward trend in ERP".
Competition Commission	Vodafone, O_2, Orange and T-Mobile, Feb 2003	2.5%-4.5%	New analyses of historical evidence over various periods from 10 years to 100 years against gilts and bills. Weight also given to survey evidence. An additional 25bp was added to the real pre-tax WACC "to smooth the downward trend in ERP".

Source: Competition Commission.

The CC justified its range of 2.5%-4.5% for the ERP in the most recent cases for BAA and Vodafone, O2, Orange & T-Mobile by reference to several pieces of evidence, as shown in Table B.3.

[65] CC (2002), paragraph 4.69

Table B.3
Evidence on the ERP in BAA & Vodafone, O2, Orange & T-Mobile Cases

Source	Evidence
Trend in historical ERP over time	ERP declining
Historical arithmetic ERP from DMS	4.7%
Prospective ERP from DMS (geometric)	2.4%
Prospective ERP from DMS (arithmetic)	3.7%
Fama & French on US ERP	2.6%-4.8%
Application of DGM to UK	2.7%-3.3%
Survey evidence	2.0%-4.5%
ERPs implied by valuations of mobile companies' pension schemes	2.0%-2.8%

Source: Competition Commission (2002), pp. 174-176, Competition Commission (2003), pp. 188-191.

However, the CC's decisions do not appear to be consistent with a proper interpretation of this evidence, and the CC appears to have been selective in its selection of evidence. We set out specific areas of weakness below.

B.2. Possible Critique of Competition Commission Position on ERP

B.2.1. Dimson, Marsh & Staunton (DMS) estimates

DMS show that historical equity returns are lower than those usually quoted due to the exclusion of the 1900–1919 period and due to survivorship bias. We accept this argument.

DMS also argue that the prospective ERP is lower than the historical ERP due to a number of transitional factors that have historically underpinned rising stock prices.[66] DMS calculate a prospective geometric UK ERP of 2.4% by adjusting down their estimate of the historical geometric ERP from 4.7%.[67] In the BAA decision the CC relates the lower end of their ERP range to this 2.4% figure.[68]

We have several problems with the CC's interpretation of DMS' evidence:

- DMS are unequivocal that the arithmetic ERP should be used for the prospective ERP, not the geometric ERP.[69] As mentioned, the CC initially related the lower bound of their 2.5%-4.5% range to DMS' geometric (prospective) ERP.

[66] These factors include unanticipated dividend growth, falling transaction costs, declining inflation rates in recent decades, and declining business risk and investment risk due to diversification and stronger economic and political climates.

[67] Dimson, Marsh & Staunton (2001), p. 142, and Dimson, Marsh & Staunton (2002), p. 192.

[68] The CC wrote: "the lower figure (of 2.5%) [is] based on the recent evidence from Dimson, Marsh & Staunton", CC (2002), paragraph 4.61.

[69] This was discussed in NERA (2004b), p. 46.

- DMS acknowledged that their estimates of the downward adjustment to the historical ERP were "***simplistic***" and "***should not be taken too seriously***".[70] DMS appear to have drawn back from their earlier calculations; their latest publication makes only a small downward adjustment to come up with a UK arithmetic ERP of 5.2%.

- The CC also noted that DMS advocate a global prospective ERP, which at the time of the most recent CC decision DMS estimated at 3% (geometric mean) and 4% (arithmetic mean).[71] The arithmetic global prospective ERP is raised from 4% to 5% in the latest DMS publication.[72]

- The argument that historical ERPs should be adjusted for unanticipated dividend growth is controversial, with a number of authors disagreeing with the conclusion that investors have consistently underestimated dividend growth.[73]

B.2.2. Evidence from Fama & French

We note that the Fama & French approach, which is based on dividend growth and earnings growth, are sensitive to assumptions about dividend yields, dividend growth and earnings growth.

In addition, we note there is a large amount of additional academic evidence available, while the CC has presented just one of these sources. For example, in NERA (2003) we presented an illustrative range of some of the better-known academic estimates of the ERP. We reproduce this range in Table B.5. It is noticeable that the evidence selected by the CC is among the lowest academic evidence available. The most widely quoted source in international regulatory contexts is Ibbotson & Chen (2001).

[70] Dimson, Marsh & Staunton (2002), p.192.

[71] DMS (2002), p. 193. CC (2003), paragraph 7.216.

[72] DMS (2003), p. 13-15.

[73] See NERA (2004b), p. 47 for a discussion of these arguments.

Table B.5
Recent Academic Evidence on the Equity Risk Premium

Source	ERP estimate	Details
Brealey and Myers (1996)	8.5%	Long-run historical data
Bowman (2001)	7.5%	
Franks (2001)	5%	
Dimson, Marsh and Staunton (2001)	5%-7%	Ex post estimates based on 101 years of data.
	4%-5%*	Forward-looking estimates based on lower volatility assumption.
Fama and French (2001)	2.6%-4.3%	Estimates derived from dividend and earnings growth models over 2nd half of 20th century. Compares with estimate from average returns of 7.43%.
Ibbotson and Chen (2001)	5.9-6.2%	Historical and supply side models.
Oxera (undated)**	4.7%-8.5%	Ex post estimates of one year and five years returns averaged using various periods over the last 100 years. Using the whole period the ERP was around 5%
Smithers and Co (2003)	4%-5%	Based on a cost of equity for the market of 6.5%-7.5%m and a risk free rate estimate of 2.5%, on the basis of their preference of arithmetic averages.

As noted, DMS' latest publication recommends that on a prospective basis, their global prospective ERP of 5% (arithmetic) should be used. **Cited in Franks and Mayer (2001).

B.2.3. Application of dividend growth model to UK

The CC applies its own analysis to form a view on the cost of equity via the dividend growth model in the UK. Results presented by the CC are shown in Table B.7.

Table B.7
CC Results on Dividend Growth Model for the UK

Assumptions			Estimated ERP
Yield (%)	Growth (%)	Risk-free rate (%)	
2.69	2.25	2.30	2.7
2.69	2.50	2.30	3.0
3.50	2.00	2.30	3.3

Source: CC (2003), paragraph 7.217. Yields were based on dividend yields observed in April 2002. The growth assumptions were related to GDP forecasts.

The CC notes that Vodafone and T-Mobile believed that very little weight should be given to forward-looking estimates of the cost of ERP. We agree with their reasoning, which we paraphrase here:

- The model is very sensitive to the growth rate assumption;

- Dividend yields change with changes in market prices; for instance, dividend yields taken from later time periods were shown to produce significantly higher estimates for the ERP than those using the CC's April 2002 estimate;
- The ERP is considered to be slow moving as it reflects investors' underlying risk preferences; it is implausible to suggest that it would alter dramatically over the short or even medium term.[74]

B.2.4. Survey evidence

The CC appears to give some weight to survey evidence, which appears to NERA to point to an ERP in a range of around 2.0%-4.5%. However this evidence does not appear to be particularly robust, as the CC acknowledges.[75]

B.2.5. ERPs implicit in valuations of mobile companies' defined benefit pension schemes

These valuations suggested an ERP of around 2.5%-2.75%. However a number of companies were critical of this approach, noting that these valuations did not include fund management fees, and that the companies' actuaries who make the valuations have incentives to be deliberately cautious.

B.2.6. Comparison of CC ERP with regulators elsewhere

The ERP range of 2.5%-4.5% used by the CC is generally lower than that used by regulators elsewhere. NERA discussed this extensively in NERA (2004b).[76]

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[74] CC (2003), paragraph 7.218.

[75] See for example, CC (2002), paragraph 4.60: *"**Survey and other evidence may be subject to biases which are difficult to quantify and assess"**.* Some of the survey evidence does not appear to have particularly wide coverage; for instance the NERA evidence cited by the CC consisted of a sample of six analysts only.

[76] For instance, we showed that recent ERPs adopted by regulators in the US fall within a range of 5.89% to 8.9%, and that in recent regulatory cases in Australia the ERP has ranged between 5.0% and 7.0%. We also discussed the assessment of the ERP by the DTe, the electricity regulator in the Netherlands, which assessed a range of 4%-7%. (NERA (2004b), p. 43).

B.3. Conclusions

We believe that the CC has selectively interpreted and selected evidence on the ERP, and that there would be scope to challenge the CC on certain interpretations as described above. We also note that a new paper from DMS argues for a prospective ERP of 5% on an arithmetic basis.

For our reports on the WACC for Water UK (NERA (2003), NERA (2004a)) and EDF (NERA (2004b) we estimated the ERP to be 5%.

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