# COST OF EQUITY ESTIMATES FOR ELECTRICITY DISTRIBUTION NETWORK OPERATORS USING A DIVIDEND GROWTH MODEL

A Report for the Distribution Network Operators

Prepared by NERA

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Project Team:
Dr Richard Hern
Phillippa Lowe

n/e/r/a
**National Economic Research Associates**
Economic Consultants

15 Stratford Place
London W1C 1BE
Tel: (+44) 20 7659 8500
Fax: (+44) 20 7659 8501
Web: http://www.nera.com

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# EXECUTIVE SUMMARY

The electricity Distribution Network Operators (DNOs) jointly commissioned NERA to estimate the cost of equity for the DNOs, using the dividend growth model (DGM). This report sets out our conclusions.

Table 1 presents our central estimate of the real post-tax cost of equity for UK DNOs using the DGM at 60% gearing. Table 1 also shows a comparison of our DGM-based cost of equity estimate with our central estimate of the cost of equity for DNOs using the CAPM as presented in NERA (2004).[1]

Table 1
NERA Real Post-Tax Cost of Equity Estimates for UK DNOs

| | DGM | CAPM |
|---|---|---|
| Gearing | 60% | 60% |
| Real post-tax cost of equity (excluding issuance costs) | 10.4% | 9.3% |
| Issuance Costs | 0.3% | 0.3% |
| Real post tax cost of equity (including new issuance costs) | 10.7% | 9.6% |

***Source: NERA analysis of Bloomberg and IBES data.***

Our estimate of the DGM-based real post-tax cost of equity of 10.7% is slightly higher than our estimate of the CAPM-based real post-tax cost of equity of 9.6% for UK DNOs, at 60% gearing.

We do not strongly advocate either the DGM or the CAPM as the preferred model for estimation of the cost of equity for UK DNOs. This report presents reasons for why the CAPM may lead to an under-estimate of the cost of equity for UK DNOs, and why the DGM may lead to an over-estimate of the cost of equity for UK DNOs. We conclude that the best estimate of the real post-tax cost of equity for UK DNOs is 10.2%, based on an average of the DGM and CAPM results.

### *Comparison with Ofgem's Cost of Equity Estimates*

Our estimate of the DGM based cost of equity of 10.7% is significantly higher than Ofgem's DGM-based estimated range of 6.3% to 7.6% presented in the March 2004 document on the Distribution Price Control Review.[2] There are five reasons for this difference.

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[1] NERA (2004), "UK Electricity Distribution Cost of Capital, A Report for EDF Energy", March 2004

[2] Ofgem (2004) "Electricity Distribution Price Control Review: Background information on the cost of capital", March 2004.

First, Ofgem incorrectly uses a ***historical*** measure of the dividend yield, instead of a ***prospective*** dividend yield. Using 2003 data, this leads to a downward bias of +0.5% in Ofgem's estimate of the cost of equity.

Second, Ofgem assumes that DNOs dividend growth would only match load growth, which Ofgem states has been in the range of 1% to 2%. However, our report presents reasons why real dividend growth rates for DNOs are likely to be higher than load growth over the long term (on the basis that the capital stock RAB per unit will likely increase over time as a result of capital substitution and accelerating capex).

Ofgem also ignores analyst data on expected dividend growth rates, despite substantial empirical evidence that shows analysts' forecasts of dividend growth provide the best available evidence on investors' expectations. Our report presents estimates of five-year dividend growth rates for UK electricity companies based on consensus analysts' forecasts taken from IBES. These data show five year forecast dividend growth rates in the range of 2% to 6% over the period 1999 to 2003.

By contrast to Ofgem, we use a two-stage specification of the DGM which allows for annual expected dividend growth rates for the first five years (derived from analysts' forecasts), followed by a constant rate of dividend growth thereafter (assumed equal to GDP). Using 2003 data, we show that differences in expected dividend growth rates account for +0.8% of the difference between our DGM-based estimate of the real post tax cost of cost of equity of 10.7% and Ofgem's central estimate of 7.0%.

The third (and most significant) reason why our estimate of the DGM-based cost of equity for UK DNOs differs from Ofgem's estimate concerns failure to adjust the estimated cost of equity estimate for consistency with the gearing assumption used in calculating the WACC. By contrast, we "re-lever" our cost of equity estimates to be consistent with a notional gearing assumption of 60%. Using 2003 data, this adjustment explains +1.9% of the difference between our estimate of the real post-tax cost of equity of 10.7% and Ofgem's central estimate of 7.0%.

Fourth, our estimate of the DGM-based real post-tax cost of equity of 10.7% is based on share price and dividend data over a period of time from 1999 to 2003 for consistency with the current regulatory period, whereas Ofgem appears to only use recent data on dividend yields. We prefer to base all our estimates of WACC parameters on time series data in order to smooth the impacts of temporary events such as excessive market volatility and regulatory events on our estimates. Our use of time series data explains only +0.2% of the difference between our estimate of the real post-tax cost of cost of equity of 10.7% and Ofgem's central estimate of 7.0%.[3]

[3] Our results actually show that the (gearing adjusted) cost of equity has been reasonably constant over the period 1999-2003.

Fifth, the remaining difference between our estimate of the DGM-based real post-tax cost of equity of 10.7% and Ofgem's central estimate of 7.0% is due to our inclusion of an allowance for equity issuance costs of +0.3%.

Overall, the bulk of the difference between our estimates and Ofgem's is attributable to flaws in Ofgem's methodology, rather than to differences over the interpretation of data.

# 1. INTRODUCTION

The electricity distribution network operators (DNOs) jointly commissioned NERA to estimate the cost of equity for the DNOs, using the dividend growth model (DGM). This report sets out our conclusions. We also compare our DGM-based estimates of the cost of equity with Ofgem's estimates presented in its March 2004 document on the Distribution Price Control Review.[4]

The remainder of the report is structured as follows:

| | |
|---|---|
| Section 2: | Overview of DGM models |
| Section 3: | Review of Ofgem's DGM methodology |
| Section 4: | NERA methodology and results |
| Section 5: | Gearing adjustments |
| Section 6: | Reconciliation with Ofgem's estimate |
| Section 7: | Conclusions |
| Appendix A: | Model details |
| Appendix B: | Results |
| Appendix C: | Prospective dividend yields |
| Appendix D | De-levering DGM cost of equity estimates |

[4] Ofgem (2004) "Electricity Distribution Price Control Review, Background information on the cost of capital", March 2004, henceforth Ofgem (2004).

# 2. INTRODUCTION TO DIVIDEND GROWTH MODELS

The Dividend Growth Model (DGM) estimates the "cost of equity" by computing the discount rate that equates a stock's current market price with the present value of all future expected dividends. In a simple (one-stage) DGM model, it is assumed that there is a constant expected growth rate of dividends for all future years. Given this assumption, the stock is valued at a price $P_0$ as follows:

(2.1) $$P_0 = D_1/(r-g)$$

Where:

| | |
|---|---|
| $D_1$ | is the expected real post-tax dividend per share in period 1; |
| $r$ | is the real post-tax cost of equity; |
| $g$ | is the dividend per share growth rate (assumed constant); and |
| $P_0$ | is equal to the share price at period 0 (measured at ex-dividend date). |

Solving for ***r*** yields:

(2.2) $$r = (D_1/P_0) + g$$

Equation 2.2 states that a firm's cost of equity is equal to (1) its ***prospective dividend yield*** (expected next period dividend per share ***divided*** by stock price on the ex-dividend date of the previous dividend paid out) ***plus*** (2) the long-term expected rate of growth in its dividend.

The simple DGM is based on a number of assumptions, such as (i) constant expected dividend growth rates; (ii) constant gearing; and (iii) no external financings. More complex DGM models allow for a relaxation of these assumptions.

The "two period dividend growth model" is the standard formulation of the DGM model for use in US regulatory proceedings and is widely used elsewhere to estimate a company's cost of equity. This model allows for non-constant dividend growth for a short time horizon, usually matching the business planning period, followed by a constant rate of dividend growth for following years. Equation (2.3) shows a two-stage DGM incorporating non-constant dividend growth for the first five years, followed by a constant long-term dividend growth from year 6 onwards:

(2.3) $$P_0 = \sum_{t=1}^{5} \frac{D_t}{(1+r)^t} + \left( \frac{D_5 * (1+g)}{r-g} \right) \left( \frac{1}{1+r} \right)^5$$

Where:

| | |
|---|---|
| $D_t$ | is the expected real post-tax dividend per share at time $t$; |
| $r$ | is the real post-tax cost of equity; and |
| $g$ | is the dividend per share growth rate (assumed constant). |
| $P_0$ | is equal to the share price at period 0 (measured at ex-dividend date). |

All formulations of dividend growth models require three primary data inputs: (1) expected dividends per share, (2) share price at the ex-dividend date, and (3) estimated dividend growth rates. Of these three inputs, the most contentious issue in using the DGM model is the assumption that is made about the growth rate of future dividends per share.

As a proxy for the short-term dividend growth rate we favour the use of consensus analyst forecasts for two key reasons:

- There is evidence that analysts' forecasts provide a reasonable proxy for investors' expectations.[5] This evidence is of key importance to the application of the DGM which derives the cost of equity implied by the market's pricing of a stock for an expected stream of dividend payments.
- The use of datasets of analysts' forecasts reduces the degree of subjectivity in the choice of dividend growth rate to be used in application of the DGM.

[5] Morin's (1995) widely used text book "Regulatory Finance" summarises the relevance of analysts' forecasts for use in DGM / DCF models as follows: "***Published studies in the academic literature demonstrate that growth forecasts made by security analysts represent an appropriate source of DCF growth rates, are reasonable indicators of investor expectations and are more accurate than forecasts based on historical growth***".

# 3. OFGEM'S APPROACH AT DPCR4

In their March 2004 document on the Distribution Price Control Review, Ofgem sets out an estimate of the real post tax cost of equity of 6.3% to 7.6% for UK DNOs using a simple one-stage formulation of the DGM as follows:[6]

(3.1) $$R = (D/P) + G$$

Where:

| | |
|---|---|
| ***R*** | is the cost of equity |
| ***D*** | is the dividend |
| ***P*** | is the share price |
| ***G*** | is the expected dividend growth rate |

Using this model, Ofgem derived their estimate of the cost of equity of 6.3% to 7.6% as follows: they stated that the range of average dividend yields calculated from the sample of companies which directly fall within the current price control is 5.3% to 5.6%. They then assumed a dividend growth rate of 1% to 2% in line with load growth.

We believe that Ofgem's application of the DGM contains a number of errors and flawed assumptions that lead to a significant underestimation of the cost of equity for UK DNOs. We discuss the problems with Ofgem's approach below.

## 3.1. Ofgem's Specification of the DGM

Ofgem's specification of the DGM is imprecise since it does not state the date on which dividends and share prices are measured. We believe Ofgem's application of the DGM contains two important errors.

First, as our formula (2.1) in Section 2 shows, a DGM that is applied correctly should calculate the cost of equity using the ***prospective*** dividend yield (where the dividend used is next year's expected dividend). By contrast, Ofgem appears to have used a historical measure of the dividend yield. This is incorrect and leads to an under-estimation of the cost of equity when expected dividend growth rates are positive (since the historical dividend yield will be lower than the prospective dividend yield).

Second, a correct application of the DGM requires use of the share price on the ex-dividend date in the calculation of the dividend yield. However, Ofgem does not explicitly make any attempt to base the dividend yield on "ex-dividend" share prices. The use of a share price

[6] See Ofgem (2004), p26.

(P) on a date other than the ex-dividend date may lead to overstatement of share prices and (because of the inclusion of dividends in the price) underestimation of the cost of equity.

Hence, Ofgem's specification of the DGM is imprecise but Ofgem's explanation suggests an incorrect use of the model that underestimates the cost of equity of UK electricity companies.

## 3.2. Ofgem's Dividend Growth Assumptions

In paragraph 5.12 of the March 2004 document, Ofgem assumes that the DNOs dividend growth would only match load growth, which Ofgem states has been in the range of 1% to 2%. Ofgem does not substantiate the assumption that dividend growth should be equal to load growth. We do not agree with Ofgem's assumption for the following reasons.

First, Ofgem's estimate does not build in any analysts' forecasts of future dividend growth. Empirical studies suggest that analysts' forecasts are the most accurate predictor of future dividend growth rates. More importantly there is evidence that analysts' forecasts of dividend growth provide the best available evidence on investors' expectations.[7]

In Section 4 we present evidence on analysts' forecasts of dividend growth. For all years from 1999 to 2003, our data shows that analysts' forecasts of real dividend growth rates for UK electricity companies are, on average, higher than Ofgem's assumption of 1% to 2%.

Second, there are good reasons to believe that the DNOs' dividend growth will exceed their load growth over the long term:

- 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.

The relationship between forecasts for total costs per unit (i.e. the price cap) and opex per unit (i.e. growth in opex efficiency) provides a useful consistency check on the final outcome of the review. A rise in the price cap accompanied by a rapid decline in opex per unit must

[7] A good discussion of the forecasting accuracy of analysts' forecasts, by comparison to historical growth measures, is provided in Patterson's (1995) widely quoted book "***The Cost of Capital: Theory and Estimation***".

imply growing capital costs per unit. More directly, if Ofgem projects an increase in the future net capital stock (RAB) 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.

## 3.3. Consistency between Cost of Equity Estimates and Gearing Assumptions

Ofgem's final and most significant error in estimating the cost of equity for DNOs using the DGM concerns the failure to adjust the estimated cost of equity estimate for consistency with the gearing assumption used in calculating the WACC.

Ofgem's DGM estimates appear to be consistent with the actual gearing levels for the DNOs over the period that dividend yields are calculated. Although it is unclear over what period Ofgem calculates dividend yields, 2003 gearing levels for UK electricity companies are currently in the range of 22% to 55%, with an average gearing level of 46% across the five companies.

Gearing levels consistent with Ofgem's DGM cost of equity estimates are therefore below Ofgem's assumption of 50% to 60% gearing used in calculation of the WACC. For companies with (assumed) higher gearing ratios than those observed in the market, the (equivalent) cost of equity must be higher. Ofgem's failure to adjust the cost of equity estimate for consistency with the gearing assumption used in calculation of the WACC will, by itself, lead to an underestimation of the cost of equity for UK electricity companies. We show in Section 5 that adjustments to the cost of equity for higher gearing have a significant impact on the values of the cost of equity to be used in calculation of the WACC.

# 4. OBSERVED COST OF EQUITY FOR UK ELECTRICITY COMPANIES

## 4.1. Methodology

This chapter derives cost of equity estimates for UK electricity companies using a two-stage DGM as specified in Equation (2.3), which allows for different annual (expected) dividend growth rates for the first five years, followed by a constant rate of (expected) dividend growth thereafter.

Reliable estimates of WACC parameters require the use of data from an extended period, such as a business cycle or regulatory period (in the case of regulated companies), in order to ensure that estimates of WACC parameters are internally consistent and not affected by temporary shocks to capital markets that cause excess volatility or by structural biases such as the Minimum Funding Requirement.

Accordingly, we use a two-stage DGM to estimate the cost of equity for UK DNOs over the period1999-2003. This period is consistent with the current regulatory period.[8]

### 4.1.1. Selecting companies comparable to DNOs

A key problem in estimating a cost of equity for the DNOs using the DGM is that UK DNOs are all subsidiaries of larger energy companies, only some of which are publicly quoted. There are no "pure play" (i.e. distribution-only) companies, as all of the parent companies are involved in other activities such as electricity generation and supply and other activities unrelated to electricity.

Our criteria for selecting comparators are to include all quoted UK-based companies with DNO subsidiaries or UK transmission businesses. This excludes E.ON and PPL, which are both based outside the UK. Our criteria identify the following comparators:

- Scottish Power plc (SPW)
- Scottish & Southern Energy plc (SSE)
- United Utilities plc (UU); and
- Viridian Group plc, formerly Northern Ireland Electric (VRD)

In addition to this set we include National Grid Transco (NGT), which owns the regulated electricity transmission activities (and the gas transmission networks) in the UK.

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[8] The current regulatory period spans April 2000 to April 2005. Including data for 1999 means that we capture the (ex dividend) share price ($P_0$) that incorporates expectations of dividend growth over this regulatory period.

4.1.2. Data

Our dividend growth model requires three primary data inputs for each company: (1) share price at the ex-dividend date, (2) short-term dividend forecasts for years 1-5, and (3) estimated long term dividend growth rates.

- Share Price Data

  Share price data is collected from Bloomberg for each electricity company on the final dividend ex-dividend date for the years 1999 to 2003.

- Short Term Dividend Forecasts

  Estimates of short-term expected dividend growth rates are taken from the International Brokers Estimation System (IBES) database. This database contains forecast data from all major UK brokerage institutions. IBES data for the five quoted UK Electricity companies consists of 1-year, 2-year, 3-year, 4-year and 5-year annual real post-tax dividend per share forecasts for each year between 1999 and 2003.

  Table 4.1 shows that analysts' forecasts of average dividend growth rates between years 1 and 5 for UK electricity companies have been in the range of 2.9% (2003) to 5.6% (1999) in recent years. These forecasts are significantly higher than Ofgem's dividend growth assumption of 1% to 2% consistent with historical load growth rates.

Table 4.1
IBES Average Dividend Growth Rates

| Year of Data (Y0) | Y0-Y1 | Y1-Y2 | Y2-Y3 | Y3-Y4 | Y4-Y5 | Average Y0-Y5 |
|---|---|---|---|---|---|---|
| 1999 | 5.0% | 6.3% | 5.5% | 4.9% | NA | 5.4% |
| 2000 | 4.5% | 5.8% | 5.9% | 7.0% | 7.8% | 6.2% |
| 2001 | 4.4% | 5.9% | 6.0% | 4.9% | 3.3% | 4.9% |
| 2002 | 4.2% | 0.3% | 6.4% | 9.9% | 2.8% | 4.7% |
| 2003 | -1.4% | 1.5% | 4.2% | 4.5% | 1.4% | 2.0% |

***Source: NERA analysis of Thomson Financial/IBES data. Note that NA relates to years where data is available for 3 companies or fewer.***

- Long Term Dividend Growth Forecasts

The second part of the DGM is constructed using the assumed annual long-term dividend growth rate.[9] In section 3.2 we set out reasons for why the expected long term dividend growth rate are likely to be higher than load growth rates of 1% to 2%.

There is no universal standard by which long-term dividend growth rates are derived. In the US, it is common to make one of two assumptions. Either the five year consensus analysts' dividend growth rate is used as the assumed long term growth rate; or the long term dividend growth rate is assumed to be equal to a "sustainable growth" measure such as an expected economy wide output growth measure e.g. GDP growth.

Our reservation with using IBES analyst five year growth rates as the basis for the long term dividend growth rate is that these may over-estimate the cost of equity in the UK, when the scope for operating and capital efficiencies might be expected to decline over time as the regulatory system matures. At the current time, there are also specific factors that are incorporated into the recent IBES five year dividend forecasts for UK electricity companies (such as a 20% dividend cut for Scottish Power in 2003-2004) that would be reasonable to regard as a "one-off" factors relating to companies current financial circumstances, and international energy markets in general, rather than factors that are likely to be built into investors' long term dividend forecasts.

An argument in favour of the use of an expected economy wide output measure as the basis for a long-term dividend growth measure for UK electricity companies is that there is other evidence that the riskiness of electricity companies is likely to be similar to the market as a whole over the longer run.[10] This argument is, however, somewhat circular since it implicitly makes an assumption about the long run cost of equity of the company in order to determine the cost of equity of the company now. It is also likely to overstate the cost of equity for "high yield firms" and understate the cost of equity for low yield firms.

Overall, we do not find that there is an overwhelming argument to use either analysts' five-year dividend forecasts ***or*** GDP forecasts as the basis for the long term dividend growth forecasts. We observe, however, that over the period from 1999 to 2003, IBES analysts' 5 year dividend growth rates are higher than long term GDP forecasts for all years over the period 1999-2003 (except 2003). The average five-year dividend growth forecast over this period is 4.6% whereas the ten year real GDP

[9] For some companies, 4- and 5-year forecasts were not available for the years 1998 and 1999. In these cases a three-year two stage DGM is used.

[10] Work by Blume (1971), confirmed in many subsequent papers has shown that there is a tendency for betas to tend towards 1 over a period of time.

forecast for the UK is currently 2.2%. Given this evidence we adopt the more conservative assumption that the long term dividend growth rate is equal to the long term forecast growth rate of GDP of 2.2%.[11] This assumption derives a lower bound on the true cost of equity over this period as a whole.[12]

In Appendix B we also derive cost of equity estimates using the consensus analysts' forecasts of the five year dividend growth rate of 4.6% rather than the 10 year real GDP growth rate forecast of 2.2%. The use of a long term dividend growth forecast of 4.6% leads to an average cost of equity estimate that is 1.9% higher than the estimate shown in Table 4.2 below.

## 4.2. NERA Results

Table 4.2 presents our estimates of the DGM-based real post-tax cost of equity for the five quoted UK electricity companies (selected as comparators) using IBES consensus analysts' forecasts of dividends for the first five years and using the assumption of 2.2% long-term real dividend growth thereafter. We also show average gearing levels for all companies in each year and across this period.

Table 4.2
UK Electricity Company Real Post-Tax Cost of Equity Derived from a Two-Stage DGM
(1999-2003)

| Company | 1999 | 2000 | 2001 | 2002 | 2003 | Average 1999 - 2003 |
|---|---|---|---|---|---|---|
| NGT | 5.8% | 5.7% | 5.6% | 6.1% | 7.3% | 6.1% |
| SSE | 7.4% | 8.3% | 7.8% | 8.1% | 8.9% | 8.1% |
| SPW | 6.8% | 7.3% | 8.2% | 8.5% | 7.4% | 7.6% |
| VRD | 7.2% | 7.2% | 7.9% | 10.6% | 8.8% | 8.3% |
| UU | 8.5% | 9.2% | 8.8% | 8.6% | 9.1% | 8.8% |
| Average Real Post-tax Cost of Equity | 7.1% | 7.5% | 7.6% | 8.4% | 8.3% | 7.8% |
| ***Average Gearing (D/(D+E)*** | ***27%*** | ***33%*** | ***37%*** | ***46%*** | ***46%*** | ***39%*** |

***Source: NERA analysis of Bloomberg and IBES data***

We stress that these results are not directly relevant for the cost of equity that Ofgem should be using in estimating the WACC at DPCR04. Instead these results show the cost of equity of UK electricity companies over the period 1999-2003 consistent with the actual gearing levels of these companies over this period. The average gearing level of these companies increases from 27% to 46% across this period but is significantly below the gearing level of

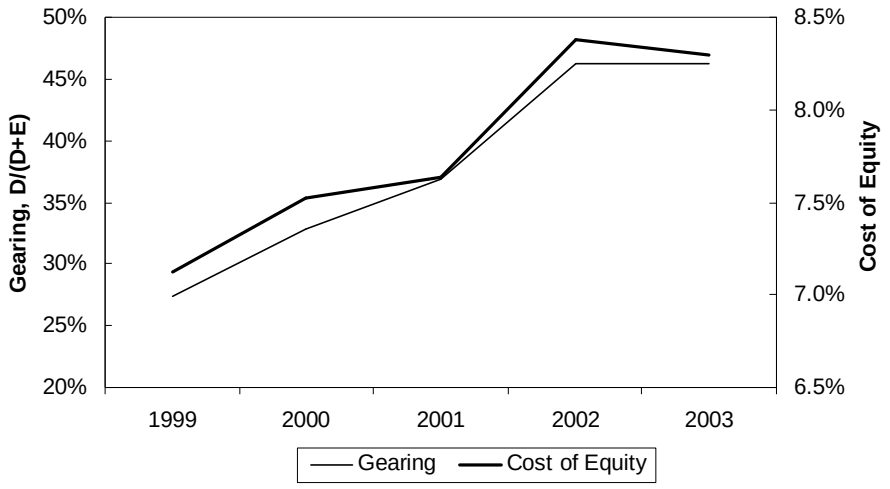
[11] The long term forecast for GDP growth was taken as the average of annual forecasts of UK GDP growth until 2013 from Consensus Economics (2003).

[12] By comparison to the use of IBES five year forecasts as the basis for the long term dividend assumption, this leads to a lower estimate of the cost of equity for all years across the period 1998-2003 except 2003 when IBES 5 year forecasts are only slightly lower.

60% that Ofgem is proposing to use for calculation of the WACC at DPCR04. In Section 5 we adjust the cost of equity estimates shown in Table 4.2 for a higher level of gearing.

Two key features of the results shown in Table 4.2 stand out. First, the average cost of equity for all companies is significantly higher in 2003 than in 1999. This increase can be partly explained by the concurrent increase in gearing for all companies over the period. Figure 4.1 shows the time series cost of equity and average gearing for the five quoted electricity companies between 1999 and 2003.[13] The figure shows that sector gearing increased significantly over the period 1999-2002 from around 27% in 1999 to around 46% in 2002. Figure 4.1 also shows that the cost of equity also increased significantly over this period. Since 2002, both gearing and the cost of equity have remained relatively constant.

Figure 4.1
UK Electricity Company Real Post-Tax Cost of Equity and Sector Average Gearing




***Source: NERA analysis of Bloomberg and IBES data***

Second, the trends in individual company cost of equity estimates are also interesting. NGT and VRD exhibit relatively flat costs of equity until 2000/2001, after which the cost of equity for both companies increased. SSE and SPW show more consistent increases in the cost of equity over the period, although SSE's cost of equity dipped slightly in 2001 and SPW's in 2003. UU shows a significant increase in 1999/2000, followed by a relatively stable cost of equity to 2003. A significant proportion of the differences in company trends can be attributed to changes in gearing over the period, although other factors may have played a role.[14]

[13] Appendix D.1. presents charts showing the relationship between the DGM-derived cost of equity and gearing for individual companies.

[14] For example, the increase in the cost of equity for UU in 1999/2000 may be related to uncertainty surrounding the UK water sector price review in 2000.

# 5. LOOKING FORWARDS TO DPCR04: ESTIMATING A "LEVERAGED" COST OF EQUITY

The cost of equity to be used in calculation of the WACC must be consistent with the gearing assumption. Standard finance theory predicts that the cost of equity increases with gearing as a result of the increase in risk to shareholders arising from an increase in debt holders' prior claims on a firm's future profits. Figure 4.1 shows that there is a clear relationship between gearing and cost of equity for the UK electricity companies over the period 1999-2003.

In Section 3.3 we argued that Ofgem made a significant error in their March 2004 methodology paper in calculating the cost of equity without "re-levering" the estimate drawn from real companies to make it consistent with Ofgem's assumed gearing of 50% to 60%. Ofgem's failure to adjust the cost of equity estimate for consistency with the gearing assumption used in calculation of the WACC will lead to an underestimation of the cost of equity for UK DNOs.

In this section we "re-lever" our post tax cost of equity estimates for UK electricity companies derived in Section 4 to be consistent with Ofgem's indicated gearing assumption of 50%-60%. Our method of doing this is explained in Appendix D.

Table 5.1 shows the implied cost of equity for the UK electricity companies 1999 to 2003 "re-leveraged" for Ofgem's indicated notional 50%-60% gearing assumption.

Table 5.1
UK Electricity Companies Average Real Post-Tax Cost of Equity (1999-2003)
"Re-leveraged" for Ofgem's Indicated Notional Gearing Assumptions

| | 1999 | 2000 | 2001 | 2002 | 2003 | Average 1999 - 2003 |
|---|---|---|---|---|---|---|
| Cost of equity (50% gearing assumption) | 9.0% | 9.1% | 8.9% | 8.8% | 8.7% | 8.9% |
| Cost of equity (60% gearing assumption) | 10.6% | 10.7% | 10.4% | 10.3% | 10.2% | 10.4% |

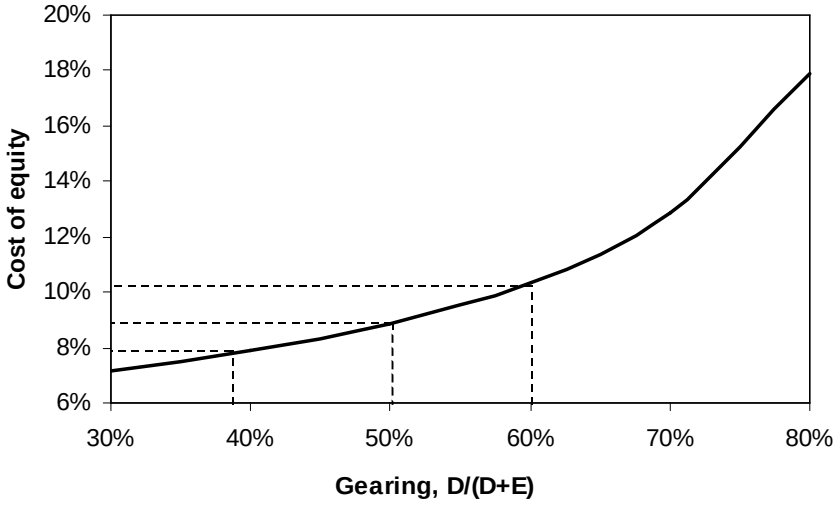
***Source: NERA analysis of Bloomberg and IBES data.***

The table illustrates that when the cost of equity estimates derived in Section 4.2 are "re-levered" for a higher level of gearing, the estimates are remarkably stable across the period. The average cost of equity at an assumed forward-looking gearing of 50% increases is 8.9%, an increase of 1.1% from 7.8% at 39% gearing. The average cost of equity estimate at assumed forward-looking gearing of 60% is 10.4%, an increase of 2.6% from 7.8% at 39% gearing.

As an illustration of the relationship between the cost of equity and gearing over a wider range of gearing assumption, the following graph shows the implied relationship between

gearing and the cost of equity of UK electricity companies over a range of gearing from 30% to 80%.[15]

Figure 5.1
UK Electricity Company Real Post-Tax Cost of Equity and Gearing (1999-2003)




[15] Our key assumptions in deriving the relationship shown in Figure 5.1 are based on an equity risk premium of 5% and a risk free rate of 2.9%, consistent with the WACC parameters presented in NERA (2004). Appendix C presents the formal derivation of this relationship.

# 6. RECONCILIATION WITH OFGEM'S ESTIMATE

As discussed in Section 3, Ofgem presents an estimate of the real post tax cost of equity of 6.3% to 7.6% for UK DNOs using a simple one-stage formulation of the DGM.

By comparison, our results presented in Section 4 show that the average real observed post-tax cost of equity for UK electricity companies is 8.3% in 2003 and 7.8% over the period 1999-2003. After "re-levering", our results in Section 5 show that the average real-post tax cost of equity for UK electricity companies is 10.2% in 2003 and 10.4% over the period 1999-2003 at 60% gearing.

Although we have used a more complex formulation of the DGM (that allows for different annual expected dividend growth rates) than Ofgem's model (that assumes a constant annual dividend growth rate) we can explain the reasons for the differences between our results and Ofgem's results by converting our annual estimates of dividend growth rates for each company into an equivalent annuity growth rate. By doing this, we can then compare our estimates of the prospective dividend yield and the expected dividend growth rate with Ofgem's estimates in order to explain the differences between the results.

Table 6.1 sets out this comparison[16]

Table 6.1
Comparison between Ofgem and NERA DGM Estimates at Actual Gearing

| | 2003 Dividend Yield | Growth Rate | Cost of Equity Consistent with Actual Gearing |
|---|---|---|---|
| NERA | $D_1/P_0$ | Implied g | $r = (D_1/P_0) + g$ |
| | 6.0% | 2.3% | 8.3% |
| Ofgem | $D_0/P_0$ | Assumed g | $r = (D_0/P_0) + g$ |
| (mid-point of range) | 5.5% | 1.5% | 7.0% |

This table shows that Ofgem's incorrect use of a historical measure of the dividend yield, instead of a prospective dividend yield, leads to a downward bias of 0.5% in Ofgem's estimate of the cost of equity. Differences in expected dividend growth rates account for the remaining +0.8% of the difference between our 2003 DGM-based estimate of the real post tax cost of equity of 8.3% and Ofgem's central estimate of 7.0%.

Using 2003 data, which is comparable to the data that Ofgem is likely to have considered (although Ofgem does not explicitly state the time period used), the adjustment for gearing increases the cost of equity from 8.3% to 10.2%, an increase of 1.9%. Ofgem's error in not

[16] Appendix C presents company-specific prospective dividend yields

adjusting the cost of equity for a higher assumed level of gearing of 60% therefore leads to a downward bias of 1.9% in the estimated cost of equity to be used in setting prices at DPCR04 (on the basis that they use a gearing assumption of 60%).

# 7. CONCLUSIONS

## 7.1. DGM Results

In deriving our conclusions on the cost of equity for UK DNOs using the DGM we adopt the following principles:

- In the absence of quoted data for UK DNOs, our sample set consists of all quoted UK-based companies with DNO subsidiaries or UK transmission businesses.
- In order to smooth the impacts of temporary events such as excessive market volatility on our estimates, we use the average cost of equity over the period 1999-2003 for all comparators;
- We re-lever this cost of equity estimate to be consistent with our preferred gearing assumption of 60% used in calculation of the WACC and set out in NERA (2004).
- After re-levering, the estimated cost of equity is remarkably stable over the whole period 1999-2003.
- We include an allowance for new equity issuance costs. This allowance is derived in NERA (2004) as 0.3% post-tax real.

Using these principles, our estimate of the DGM-based real post tax cost of equity is 10.7%, as set out in Table 7.1 below. This Table also presents Ofgem's DGM-based estimates for of the cost of equity for comparison.

Table 7.1
Conclusions: Real Post-Tax Cost of Equity Estimates for DNO's

| | Ofgem Low | Ofgem High | NERA 2004(1) |
|---|---|---|---|
| Gearing | ? | ? | 60% |
| Real post-tax cost of equity (excluding issuance costs) | 6.3% | 7.6% | 10.4% |
| Issuance Costs | ? | ? | 0.3% |
| Real post-tax cost of equity (including issuance costs) | | | 10.7% |

***Source: NERA analysis of Bloomberg and IBES data. .***

NERA's estimate of the DGM based cost of equity of 10.7%, is consistent with a 60% notional gearing assumption and is significantly higher than the range of 6.3%-7.6% estimated by Ofgem. This is due to the following reasons:

- First, Ofgem incorrectly uses a ***historical*** measure of the dividend yield, instead of a ***prospective*** dividend yield. Using 2003 data, this leads to a downward bias of 0.5% in Ofgem′s estimate of the cost of equity, as shown in 6.

- Second, we use a two-stage specification of the DGM which allows for annual expected dividend growth rates for the first five years (derived from analysts′ forecasts), followed by a constant rate of dividend growth thereafter (assumed equal to long term GDP growth rate). By contrast, Ofgem assumes a constant real dividend growth rate of 1%-2% for all future years based on historical rates of load growth. Using 2003 data, we show in Section 6 that differences in expected dividend growth rates account for +0.8% of the difference between our DGM-based estimate of the real post tax cost of cost of equity of 10.7% and Ofgem′s central estimate of 7.0%.

- Third, we "re-lever" our cost of equity estimates to be consistent with a notional gearing assumption of 60%. Ofgem′s estimates appear to be consistent with companies′ actual gearing levels. Using 2003 data, as explained in Section 5 this adjustment explains +1.9% of the difference between our estimate of the real post-tax cost of cost of equity of 10.7% and Ofgem′s central estimate of 7.0%.

- Fourth, our estimate of the DGM-based real post-tax cost of equity of 10.7% is based on share price and dividend data over a period of time, from 1999-2003, whereas Ofgem appear to only use recent data on dividend yields. Our use of time series data explains +0.2% of the difference between our estimate of the real post-tax cost of cost of equity of 10.7% and Ofgem′s central estimate of 7.0%.[17]

- Fifth, the remaining difference between our estimate of the DGM-based real post-tax cost of equity of 10.7% and Ofgem′s central estimate of 7.0% is due to our inclusion of an allowance for equity issuance costs of +0.3%.

## 7.2. Comparison between DGM and CAPM Results

We do not strongly advocate either the DGM or the CAPM as the preferred model for estimation of the cost of equity for UK DNOs, although we believe that there is merit in adopting a particular formula and a set of publicly available data sources.

The CAPM is widely established as the primary model for estimating the cost of equity for UK regulated companies, but there are good reasons why the CAPM may underestimate the cost of equity for UK DNOs as a result of its failure to take account of asymmetric risk factors. The CAPM is based on an assumption of normality of the distribution of stock returns and cannot take account of the impact of any skewness in the distributions of

[17] Our results actually show that the (gearing adjusted) cost of equity has been reasonably constant over the period 1998-2003.

company returns. At the time of a price review, there are good reasons to believe that investors will expect the distributions of companies' returns to be negatively skewed as a result of the impact of regulatory actions that are more likely to reduce returns than increase them. The CAPM does not pick up this particular feature of investor expectations and would therefore underestimate the cost of equity (unless the formula involves some offsetting adjustment in another parameter).

In contrast to the CAPM, the DGM is not based on an assumption of normally distributed returns, and it will take account of the impact of skewed risk factors such as regulatory risks to the extent that these are reflected in companies' share prices.

A concern that we have with both the DGM and CAPM analysis is that there are no pure-play (ie. distribution-only) companies, and that estimates of the cost of equity using both models need to be based on market evidence of electricity companies that also undertake other activities. However, in NERA (2004)[18] we 'unbundled' the quoted betas for UK electricity companies into beta estimates for the component business segments by applying an assumption that the overall parent beta is equal to a weighted average of the component segments. This evidence suggested that the betas for the DNO businesses were only very slightly lower than the average betas for parent company as a whole.

We are not able to decompose the DGM-based estimates of the cost of equity for UK electricity companies into DGM-based estimates of the cost of equity of their component businesses. However, our decomposition analysis of observed beta for UK electricity companies supports our assumption that the cost of equity estimates for the parent companies are a good approximation to the cost of equity for the DNO businesses.

Overall, we do not strongly advocate either the DGM or the CAPM as the preferred model for estimation of the cost of equity for UK DNOs. On the one hand, the presence of downside asymmetric risk would lead the CAPM to under-estimate the cost of equity for UK DNOs. On the other hand, the DGM may over-estimate the cost of equity for UK DNOs if the riskiness of electricity companies' non-core businesses is higher than the riskiness of the DNO businesses, although our beta decomposition analysis does not suggest that this is the case.

Overall, we conclude that the best estimate of the real post-tax cost of equity for UK DNOs is 10.2%, based on an average of the DGM and CAPM results.

[18] See Section 5.7. NERA (2004), "UK Electricity Distribution Cost of Capital, A Report for EDF Energy", March 2004

# APPENDIX A. MODEL DETAILS

## A.1. DGM Methodology

As discussed briefly in Section 4.1, we employ a two-stage DGM methodology to estimate the cost of equity for the UK DNOs. A simplified version of this model is presented below.

(A.1) $$P_0 = \sum_{t=1}^{5} \frac{D_t}{(1+r)^t} + \left( \frac{D_5 * (1+g)}{r-g} \right) \left( \frac{1}{1+r} \right)^5$$

Where:

| | |
|---|---|
| $D_t$ | is the expected real post-tax dividend per share at time $t$; |
| $r$ | is the real post-tax cost of equity; and |
| $g$ | is the dividend per share growth rate (assumed constant). |
| $P_0$ | is equal to the share price at period 0 (measured at ex-dividend date). |

Given the standard division of UK electricity companies dividend payments into interim and final dividends, we have adjusted Equation (A.1) to account for bi-annual payments as shown in Equation (A.2) below.[19]

[19] It should be noted that SPW moved to a quarterly dividend distribution from 2001 onwards, whilst all other companies have consistently adopted a bi-annual distribution. For simplicity and consistency we adopt a bi-annual structure for all companies including SPW. However, we take account of the key element of SPW's change in dividend distribution by incorporating the resulting change in the ratio of SPW's interim dividends to final dividends.

(A.2)

| | |
|---|---|
| $P_0 =$ | ex-dividend date share price |
| $\left\{I_1/[(1+r)^{T/365}]\right\}+\left\{F_1/[(1+r)^1]\right\}$ | present value of total Y1 dividend forecast |
| $+\left\{I_2/[(1+r)^{(T/365)+1}]\right\}+\left\{F_2/[(1+r)^2]\right\}$ | present value of total Y2 dividend forecast |
| $+\left\{I_3/[(1+r)^{(T/365)+2}]\right\}+\left\{F_3/[(1+r)^3]\right\}$ | present value of total Y3 dividend forecast |
| $+\left\{I_4/[(1+r)^{(T/365)+3}]\right\}+\left\{F_4/[(1+r)^4]\right\}$ | present value of total Y4 dividend forecast |
| $+\left\{I_5/[(1+r)^{(T/365)+4}]\right\}+\left\{F_5/[(1+r)^5]\right\}$ | present value of total Y5 dividend forecast |
| $+\left\{[(I_5+F_5)*(1+g)]/[(1+r)^5*(r-g)]\right\}$ | Present value of total dividends from Y6 to infinity. |

Where:

| | |
|---|---|
| $I_i$: | is the real post-tax interim dividend forecast in year i; |
| $F_i$: | is the real post-tax final dividend forecast in year i; |
| $T$: | is the average number of days between final ex-dividend date and following interim ex-dividend date; |

For the short-term forecasts for years 1-5 we divide analyst's forecasts of total dividends into interim and final dividend forecasts using historical interim : final dividend ratios for each company.[20]

The observed ex-dividend date share price (left hand side of Equation (A.2)) is equated to the theoretical price calculated as the stream of forecast future dividend payments (right hand side of Equation (A.2)) The unknown parameter, the market-implied cost of equity or discount rate, ***r***, can then be solved for.

[20] This historical fraction of total dividends made up by interim dividends has remained stable over past years for each company (excluding SPW as discussed in Footnote 19).

# APPENDIX B. RESULTS

## B.1 Company-Specific DGM Based Cost of Equity

Table B.1
UK Electricity Company-Specific Cost of Equity

| | 1999 | 2000 | 2001 | 2002 | 2003 | Average 1999-2003 |
|---|---|---|---|---|---|---|
| 0% Long Run Dividend Growth Rate | | | | | | |
| NGT | 3.9% | 3.7% | 3.6% | 4.2% | 5.5% | 4.2% |
| SSE | 5.5% | 6.6% | 6.0% | 6.4% | 7.2% | 6.3% |
| SPW | 4.9% | 5.5% | 6.5% | 6.7% | 5.6% | 5.9% |
| VRD | 5.3% | 5.4% | 6.1% | 9.0% | 7.1% | 6.6% |
| UU | 6.8% | 7.5% | 7.1% | 6.9% | 7.4% | 7.1% |
| Average | 5.3% | 5.7% | 5.9% | 6.7% | 6.6% | 6.0% |
| 1% Long Run Dividend Growth Rate | | | | | | |
| NGT | 4.7% | 4.6% | 4.5% | 5.1% | 6.3% | 5.0% |
| SSE | 6.3% | 7.3% | 6.8% | 7.2% | 8.0% | 7.1% |
| SPW | 5.8% | 6.3% | 7.2% | 7.5% | 6.5% | 6.7% |
| VRD | 6.1% | 6.2% | 6.9% | 9.7% | 7.9% | 7.4% |
| UU | 7.5% | 8.3% | 7.8% | 7.7% | 8.2% | 7.9% |
| Average | 6.1% | 6.6% | 6.7% | 7.4% | 7.4% | 6.8% |
| 2% Long Run Dividend Growth Rate | | | | | | |
| NGT | 5.6% | 5.5% | 5.4% | 5.9% | 7.1% | 5.9% |
| SSE | 7.2% | 8.1% | 7.7% | 7.9% | 8.8% | 7.9% |
| SPW | 6.7% | 7.1% | 8.0% | 8.3% | 7.3% | 7.5% |
| VRD | 7.0% | 7.0% | 7.7% | 10.5% | 8.6% | 8.2% |
| UU | 8.3% | 9.0% | 8.6% | 8.5% | 9.0% | 8.7% |
| Average | 7.0% | 7.4% | 7.5% | 8.2% | 8.1% | 7.6% |
| 2.2% Long Run Dividend Growth Rate Equal to LT GDP Forecasts | | | | | | |
| NGT | 5.8% | 5.7% | 5.6% | 6.1% | 7.3% | 6.1% |
| SSE | 7.4% | 8.3% | 7.8% | 8.1% | 8.9% | 8.1% |
| SPW | 6.8% | 7.3% | 8.2% | 8.5% | 7.4% | 7.6% |
| VRD | 7.2% | 7.2% | 7.9% | 10.6% | 8.8% | 8.3% |
| UU | 8.5% | 9.2% | 8.8% | 8.6% | 9.1% | 8.8% |
| Average | 7.1% | 7.5% | 7.6% | 8.4% | 8.3% | 7.8% |
| 4.6% Long Run Dividend Growth Rate Equal to LT GDP Forecasts | | | | | | |
| NGT | 8.0% | 7.5% | 7.6% | 8.2% | 9.2% | 8.1% |
| SSE | 9.4% | 10.3% | 9.7% | 9.9% | 10.8% | 10.0% |
| SPW | 9.1% | 9.2% | 10.2% | 10.1% | 9.7% | 9.7% |
| VRD | 9.3% | 9.0% | 10.0% | 11.6% | 10.7% | 10.1% |
| UU | 9.1% | 10.5% | 10.9% | 10.9% | 11.5% | 10.6% |
| Average | 9.0% | 9.3% | 9.7% | 10.1% | 10.4% | 9.7% |

***Source: NERA analysis***

Table B.2 presents DGM based estimates of the cost of equity for five real dividend growth assumptions – 0% p.a, 1% p.a, 2% p.a and 2.2% p.a (equivalent to the current long-run real UK GDP growth forecasts), and 4.6% p.a (equivalent to the average consensus analysts' five year dividend growth forecast for UK electricity companies over the period 1999-2003).

Table B.2
UK Electricity Company Average Real Post-Tax Cost of Equity Implied by Two-Stage DGM (1999-2003)

| Long Run Growth Rate | 1999 | 2000 | 2001 | 2002 | 2003 | Average 1999 - 2003 |
|---|---|---|---|---|---|---|
| 0% p.a. | 5.3% | 5.7% | 5.9% | 6.7% | 6.6% | 6.0% |
| 1% p.a | 6.1% | 6.6% | 6.7% | 7.4% | 7.4% | 6.8% |
| 2% p.a. | 7.0% | 7.4% | 7.5% | 8.2% | 8.1% | 7.6% |
| 2.2% p.a. | 7.1% | 7.5% | 7.6% | 8.4% | 8.3% | 7.8% |
| 4.6% p.a | 9.0% | 9.3% | 9.7% | 10.1% | 10.4% | 9.7% |

***Source: Consensus Economics (2003), NERA analysis of Bloomberg and IBES data.***

# APPENDIX C. PROSPECTIVE DIVIDEND YIELDS

Table C.1
UK Electricity Company Prospective Dividend Yields (1999-2003)(1)

| Company | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---|---|---|---|---|
| NGT | 3.2% | 2.8% | 2.8% | 3.4% | 4.4% |
| SSE | 4.7% | 5.4% | 4.9% | 5.1% | 6.0% |
| SPW | 4.2% | 4.6% | 5.6% | 7.0% | 6.2% |
| VRD | 4.2% | 4.1% | 5.1% | 6.6% | 6.1% |
| UU | 5.0% | 6.2% | 6.5% | 6.5% | 7.3% |
| Average | 4.3% | 4.6% | 5.0% | 5.7% | 6.0% |

***Source: Bloomberg. (1) Prospective dividend yields calculated as $D_1/P_0$***

# APPENDIX D. DE-LEVERING DGM COST OF EQUITY ESTIMATES

## D.1 Company-Specific Gearing vs. Cost of Equity

Figure D.1
NGT Gearing vs. Cost of Equity

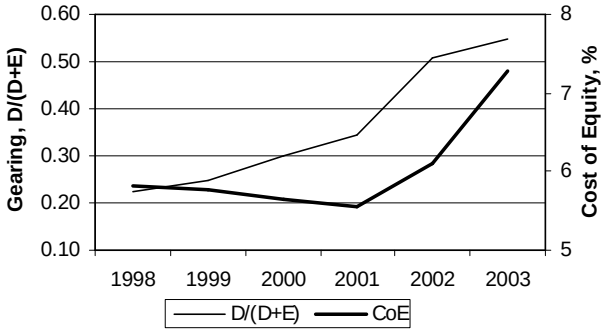



Figure D.2
UU Gearing vs. Cost of Equity

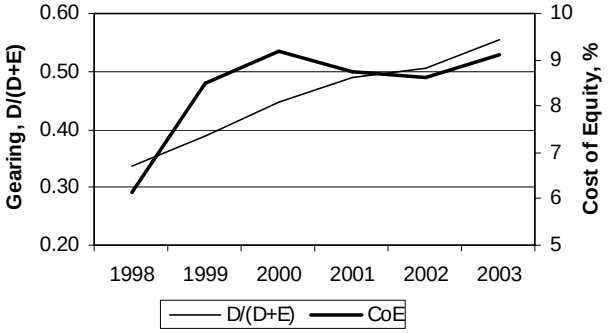


Figure D.3
VRD Gearing vs. Cost of Equity

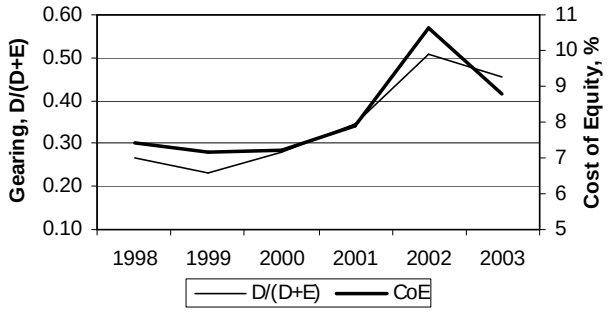



Figure D.4
SSE Gearing vs. Cost of Equity

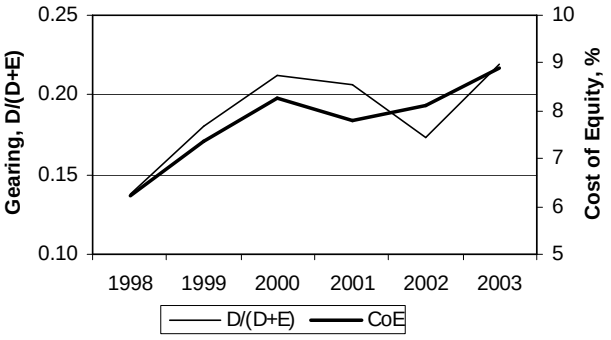
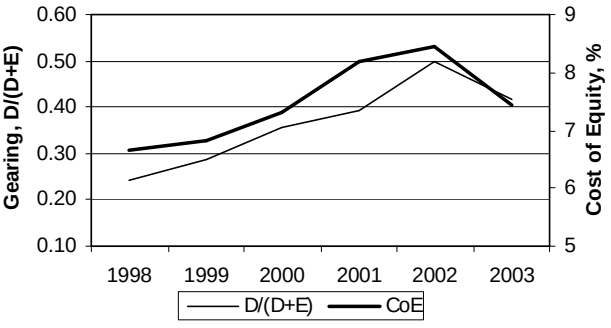



Figure D.5
SPW Gearing vs. Cost of Equity



## D.2 Methodology

Under the CAPM, the standard method of accounting for the relationship between the cost of equity and gearing is that specified by Miller (1977):

(D.1) $$b_{equity} = b_{asset} * (1 + (D/E))$$

Where $b_{equity}$ is a measure of the observed systematic risk of a company's equity, incorporating the impact on equity risk arising from observed gearing. $b_{asset}$ is a measure of the underlying equity risk, adjusted for the observed level of gearing consistent with the $b_{equity}$ estimate. Under the CAPM, the cost of equity is calculated by applying a forward-looking measure of gearing to the asset beta to generate a forward-looking equity beta. The cost of equity is then calculated as:

(D.2) $$CoE = (b_{equity} * (ERP)) + RFR \qquad (4)$$

Where the ERP is the equity risk premium and RFR is the real risk-free rate.

Cost of equity estimates derived using the DGM can be "de-levered" to find the theoretical asset beta consistent with the assumed equity risk premium and risk-free rate. This asset beta is then "re-levered" for forward-looking gearing to derive the forward-looking cost of equity.

Taking our central DGM based cost of equity estimate over 1999-2003 of 7.8% and the corresponding average gearing of 39% over the period, the following relationship between gearing and the cost of equity for the DNOs is derived:[21]

(D.3) $$\boldsymbol{CoE_{notional\ gearing} = 2.99*(1+(D/E)_{notional}) + 2.9\%}$$

[21] Assuming an implicit equity risk premium of 5% and risk free rate of 2.9%, consistent with NERA (2004).