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DGM Cost of Equity Estimates for UK Transmission Companies

A Report for EdF Energy

NERA
Economic Consulting

MMC Marsh & McLennan Companies

Project Team

Richard Hern

Phillippa Lowe

NERA Economic Consulting
15 Stratford Place
London W1C 1BE
United Kingdom
Tel: +44 20 7659 8500
Fax: +44 20 7659 8501
www.nera.com

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Executive Summary

EdF has commissioned NERA to estimate the cost of equity for the UK transmission companies using the Dividend Growth Model (DGM) as part of our review of Ofgem's initial proposals for the Transmission Price Control Review (TPCR).[1] This report sets out our conclusions.

Table 1 presents our central estimate of the real post-tax cost of equity for UK transmission companies using the DGM, assuming 60% gearing. Table 1 also shows a comparison of our DGM-based cost of equity estimate with Ofgem's initial proposals on the cost of capital for the transmission companies.

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

	NERA DGM	Ofgem Initial Proposals
Gearing	60%	60%
Real post-tax cost of equity (excl issuance costs)	**8.2%**	**7.0%**
Issuance Costs	0.3%	-
Real post tax cost of equity (incl new issuance costs)	**8.5%**	**7.0%**

Source: NERA analysis of Bloomberg and IBES data.

Our estimate of the DGM cost of equity of 8.2% (excluding issuance costs) is significantly higher than Ofgem's proposed cost of equity of 7.0% for the UK transmission companies. This finding contradicts Ofgem's statement that its DGM analysis gives a cost of equity consistent with its proposed cost of equity. However, Ofgem does not set out details or results of the analysis that it carried out and it cannot be checked.

Ofgem previously presented DGM analysis on the cost of equity for UK distribution companies as part of the DPCR process.[2] Ofgem's analysis contained key three flaws which resulted in a downwardly biased estimate of the cost of equity.[3]

First, Ofgem incorrectly used a *historical* measure of the dividend yield, instead of a *prospective* dividend yield. This led to a downward bias in the estimated cost of equity. Second, Ofgem assumed that real dividend growth for the DNOs would only match load growth – NERA (2004b) showed that this approach would underestimate long term dividend growth for the DNOs. Third, Ofgem failed to adjust estimates for consistency with the notional gearing assumption used in calculating the WACC, underestimating the cost of equity.

We cannot assess the methodology Ofgem used at TPCR 2006 as Ofgem presents no details of it. Ofgem's estimates may be based on the same flawed methodology used at DPCR 2004 – our analysis merely suggests that Ofgem's 2006 estimates are significantly too low.

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1 Ofgem (2006) "Transmission Price Control Review: Initial Proposals."

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

3 These are detailed further in NERA (2004b).

1. Introduction

EdF has commissioned NERA to estimate the cost of equity for the UK transmission companies using the dividend growth model (DGM). This report sets out our conclusions and updates analysis presented in NERA (2004) for the years 2004-06 inclusive. We also compare our DGM-based estimates of the cost of equity with Ofgem's estimates presented in its initial proposals for the Transmission Price Control Review (TPCR).[4]

Where relevant we refer to the following Ofgem and Ofwat publications:

- Ofgem (2004a) "Electricity Distribution Price Control Review: Background information on the cost of capital", March 2004.
- Ofgem (2004b) "Electricity Distribution Price Control Review. Final Proposals", November 2004.
- Ofwat (2004) "Future water and sewerage charges 2005-10: Final determinations", December 2004.

We also refer to the following NERA reports:

- NERA (2004b) "Cost of Equity Estimates for Electricity Distribution Network Operators using a Dividend Growth Model: A Report for the Distribution Network Operators", May 2004.
- NERA (2006a) "Applying the CAPM – The Case for Long Term Time Series Data. Issue Paper 1 for EDF Energy Plc", April 2006.

The remainder of the report is structured as follows:

- Section 2 presents an introduction to DGM models;
- Section 3 discusses Ofgem's application of the DGM;
- Section 4 presents cost of equity estimates for UK transmission companies;
- Section 5 presents our conclusions;
- Appendix A sets out model details;
- Appendix B presents prospective dividend yields; and
- Appendix C sets outs the methodology for de-levering of DGM cost of equity estimates.

[4] Ofgem (2006) "Transmission Price Control Review: Initial Proposals", June 2006, henceforth Ofgem (2006).

2. Dividend Growth Models

The Dividend Growth Model (DGM) estimates the cost of equity by calculating 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 the expected growth rate of dividends is constant. Given this assumption, a stock is valued at price P_0 as follows:

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

Where:

D_1 is the expected (at the ex-dividend date) 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 the 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 expected dividend growth rate.

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 financing. 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 used to estimate the cost of equity in US regulatory proceedings and is widely used by market practitioners for valuation purposes. 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 real post-tax dividend per share for time t expected at the ex-dividend date;
r is the real post-tax cost of equity; and
g is the long term dividend per share growth rate (assumed constant).
P_0 is equal to the share price at period 0 (measured at the ex-dividend date).

All formulations of Dividend Growth Models require three primary data inputs: (1) expectations of future dividends per share made at the ex-dividend date, (2) the 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.

As a proxy for the expected long-term dividend growth rate we favour the use of long-term real GDP growth forecasts for reasons set out in Section 4.3.

[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 Application of the DGM

3.1. Ofgem (2006): TPCR 2006

Ofgem (2006) states that its DGM analysis gives a cost of equity consistent with its proposed cost of equity for the transmission companies. However, Ofgem does not set out details or results of this analysis. Ofgem's DGM analysis at DPCR 2004 contained a number of errors and flaws which resulted in an underestimate of the cost of equity for the DNOs. Since Ofgem (2006) does not set out the details of its DGM analysis we cannot comment on whether the flaws in Ofgem's methodology used at DPCR 2004 are present in its current analysis. However, our analysis suggests that Ofgem's 2006 estimates are significantly too low. Ofgem's methodology used for TPCR 2006 may therefore contain those errors made at DPCR. We summarise these errors in the following Section.

3.2. Ofgem (2004): DPCR 2004

In the March 2004 document on the Distribution Price Control Review (DPCR), 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 its estimate of the cost of equity of 6.3% to 7.6% as follows. First, Ofgem stated, 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%. Second, Ofgem assumed a dividend growth rate of 1% to 2%, in line with load growth.

As set out in NERA (2004), Ofgem's application of the DGM at DPCR 2004 contained a number of errors and flawed assumptions that led to a significant underestimation of the cost of equity for UK DNOs. We summarise the problems with Ofgem's approach below.[7]

Ofgem's specification of the DGM was imprecise since it did not state the date on which dividends and share prices are measured. We believe Ofgem's application of the DGM contained several important errors which underestimated the cost of equity for the DNOs:

§ Ofgem appeared to have used a historical dividend yield rather than the prospective dividend yield as specified in formula (2.1) in Section 2. This would underestimate the cost of equity when expected dividend growth rates are positive.

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6 See Ofgem (2004), p26.

7 See NERA (2004) for a full review of Ofgem's approach at DPCR 2004.

- Ofgem did not base the dividend yield used on "ex-dividend" share prices. The use of a share price (P) on a date other than the ex-dividend date may lead to overstatement of share prices and underestimation of the cost of equity.[8]

- Ofgem assumed that the DNOs' dividend growth would only match load growth. Ofgem did not pay regard to analysts' estimates of the dividend growth rate for the DNOs. As stated previously, empirical studies suggest that analysts' forecasts are the most accurate predictor of future dividend growth rates. NERA (2004) set out reasons as to why DNOs' dividend growth would exceed load growth.

- 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 appeared to be consistent with the actual gearing levels for the DNOs over the period that dividend yields were calculated. DNO gearing levels at this time were significantly lower than Ofgem's notional gearing assumption. The DGM cost of equity consistent with the notional gearing assumption is therefore higher than Ofgem's estimates. NERA (2004b) showed that adjustments to the cost of equity for higher gearing had a significant impact on the values of the cost of equity to be used in calculation of the WACC for the DNOs.

[8] This is because the price at a date other than the ex-dividend date will include expected dividends discounted over a shorter period than assumed in the DGM model which assumes discounting back to the ex-dividend date. This will overstate the price and underestimate the discount rate.

4. Cost of Equity Estimates for UK Transmission Companies using DGM

4.1. Methodology

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

As set out in NERA (2006a), reliable and robust estimates of WACC parameters require the use of historical data from an extended period, such as a business cycle or regulatory period (in the case of regulated companies). This will ensure that estimates of WACC parameters are internally consistent and not affected by shocks to capital markets that cause excess volatility or temporary asset price distortions. We use a two-stage DGM to estimate the cost of equity for the owners of the UK transmission businesses over the period 2001 to 2006.

4.2. Inferring a Cost of Equity for UK Transmission Companies from Data for Owners of Transmission Businesses

We estimate a cost of equity using the DGM for the three owners of the transmission businesses in the UK:

- National Grid (owner of NGET and NGG NTS);
- Scottish and Southern Energy (owner of SHETL); and
- Scottish Power (owner of SPTL).

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

Of the three quoted companies National Grid (NG) has the greatest transmission share of activities (49% of operating profit as of 2006, 57% in 2005).[9] The remainder is comprised mainly of distribution. Scottish and Southern Energy (SSE)'s primary activities are generation, supply and other businesses (63% of operating profits in 2006). Scottish Power (SP)'s primary activity is distribution (54.2% of operating profits in 2006 are attributed to "Energy Networks" which we understand to be mainly distribution activities.) Other activities include generation, retail and wholesale. In the case of SSE and SP, other activities are likely to be riskier than transmission since they are in the main unregulated and conducted

[9] Based on operating profit after goodwill and exceptional items and excluding US stranded cost recoveries which represent the recovery (through a special (regulatory approved) rate charged to electricity customers) of some historical investments in generating plants, costs incurred under certain commodity purchase contracts that were stranded following divestiture of generation assets (as part of industry restructuring) and recovery of certain above-market costs of commodity purchase contracts in place at the time of restructuring and deregulation. Since these revenues reflect previous costs of discontinued operations and are set to decline to zero we exclude them.

within competitive markets. NG's other activities (mainly regulated distribution) are likely to have more closely comparable risk with transmission, as both involve operation of network infrastructure assets under similar regulatory regimes to those applied to transmission activities.

Hence, whilst NG is not a "pureplay" transmission operator, the bulk of its activities are sufficiently close to transmission to consider NG as the primary source of evidence on the DGM cost of equity for transmission activities.

4.3. 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,[10] and (3) estimated long term dividend growth rates.

Share Price Data

Daily share price data is collected from Bloomberg for NG, SSE and SP on the final dividend ex-dividend dates for the years 2004 to 2006.

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.

Table 4.1 shows that analysts' forecasts of average real dividend growth rates between years 1 and 4 for NG, SSE and SP have been in the range of 3.5% to 6.5%.

Table 4.1
IBES Average Dividend Growth Rates

Year of Data (Y0)	Year 1 to Year 2 growth	Year 2 to Year 3 growth	Year 3 to Year 4 growth	Average Growth Rate
2001	6.3%	6.4%	6.9%	**6.5%**
2002	-1.7%	6.0%	9.3%	**4.5%**
2003	0.5%	5.2%	4.8%	**3.5%**
2004	3.2%	3.7%	4.2%	**3.7%**
2005	3.6%	3.3%	5.8%	**4.2%**
2006	4.9%	3.4%	6.6%	**4.9%**

Source: For years 2001-2003, IBES data sourced in 2004 for NERA (2004). Updated IBES data (for 2004-06) is provided as nominal forecasts. Forecasts deflated using UK RPIX forecasts made in month closest to ex-date for each company and year. Source for inflation forecasts: Consensus Forecasts (HM Treasury) for the UK economy. (1) Note that FY5 forecasts no longer (at update of NERA (2004)) available consistently and that only FY1-3 forecasts available for SP.

[10] IBES dividend per share forecasts are only available for NG and SSE for financial years 1-4 and for financial years 1-3 for SP over our updated measurement period of 2004 to 2006.

Long Term Dividend Growth Forecasts

The second part of the DGM in Equation (2.3) is constructed using the assumed annual long-term dividend growth rate. There is no universal standard by which long-term dividend growth rates are derived. When estimating the appropriate long-term dividend growth rate for the economy as a whole, a widely cited approach is to use projected GDP growth.[11] There is less agreement on the appropriate approach for estimating the long-run growth rate for individual companies or industries. In the US, it is common to make one of two assumptions. Either the five year consensus analysts' dividend growth rate is assumed to indicate the 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.

We observe that IBES average forecast dividend growth rates of around 4% to 5% (average of 4.6% in Table 4.1 above) typically exceed long run GDP forecasts (which range slightly above 2% for the period under consideration). 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. This assumption derives a lower bound on the true cost of equity over this period as a whole.[12]

4.4. NERA Results

Table 4.2 presents our estimates of the DGM-based real post-tax cost of equity for NG, SSE and SP using IBES consensus analysts' forecasts of dividends for the first five/four years and using the assumption of long-term real dividend growth equal to real long-term GDP forecasts thereafter.

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[11] The convergence of GDP growth and earnings growth in the long run for the economy is widely cited. For example, the Bank of England states in the January 2006 Quarterly Bulletin (p62): "In the long run we would expect company earnings and dividends at an aggregate level to grow at the same rate as whole-economy income." Many practitioners and academics use GDP forecasts or *long run* observed GDP growth (as a proxy for forward looking long run growth) when estimating the cost of equity. Cornell's book on the equity risk premium (1999) states that forecast GDP should be used to proxy for the long run dividend growth rate. Cornell (p107) also argues for the use of analysts' forecasts to estimate the short run dividend growth rate and recognises that "*In most cases, the IBES [i.e. analysts'] forecasts are greater that the long run economic growth rate*". Cornell argues that "*Such high growth rates clearly cannot be maintained forever*", but the implication of these statements is that GDP growth is an underestimate or lower bound for dividend growth.

[12] Since NERA (2004) where a 2.2% long run real GDP forecast was assumed, based on October 2004 Consensus Economics data, long run real GDP forecasts have increased to 2.4% (October 2005). We therefore use this forecast in estimating the cost of equity using DGM for 2005 and 2006.

Table 4.2
Estimates of the Real Cost of Equity for NG, SSE and SP Based on DGM

	NG	SSE	SP	Average
FY 2001	5.6%	7.8%	8.2%	7.2%
FY 2002	6.1%	8.1%	8.5%	7.6%
FY 2003	7.3%	8.9%	7.4%	7.9%
FY 2004	8.1%	7.9%	8.6%	8.2%
FY 2005	7.6%	7.2%	8.5%	7.8%
FY 2006	7.1%	7.2%	7.2%	7.2%
Average	**7.0%**	**7.9%**	**8.1%**	**7.6%**

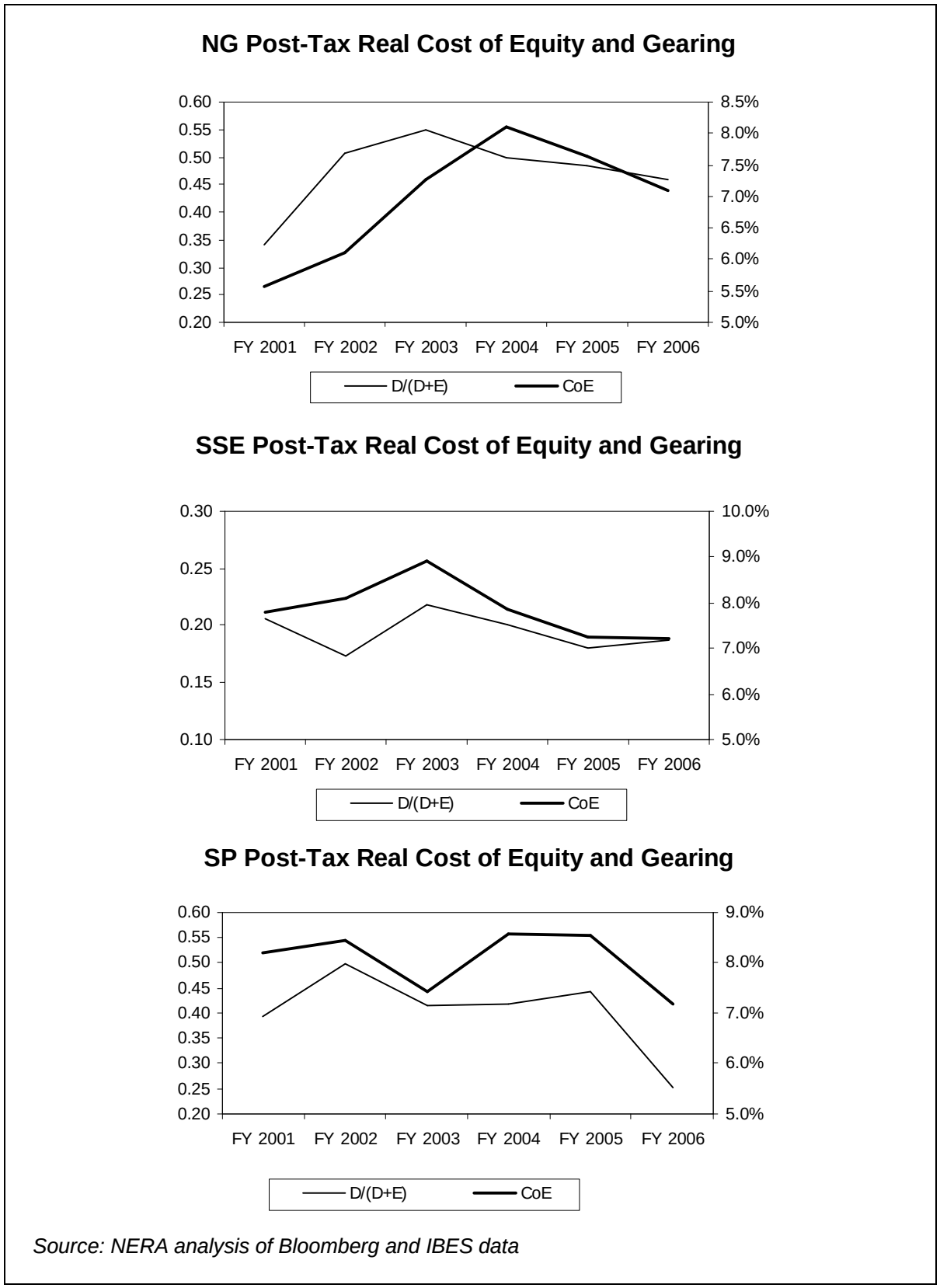
Source: NERA analysis of Bloomberg and IBES data.

SSE and SP have generally higher estimates of the cost of equity than NG, and their estimates have declined over the past three years. However, these results show the cost of equity consistent with the actual gearing levels of these companies over the period 2001-06. We cannot analyse changes and differences in the cost of equity without adjusting for changes and differences in gearing levels over time and between companies. These results are not therefore directly relevant for the cost of equity that Ofgem should be using in estimating the WACC.

In Section 4.5 we adjust the cost of equity estimates shown in Table 4.2 for the higher notional level of gearing (60%) consistent with Ofgem's proposals on the cost of capital for the transmission companies.

The Figures below show the time series cost of equity and gearing for NG, SSE and SP. There are two key features. Firstly, the cost of equity peaks in the middle of our measurement period for all three companies; 2004 for NG and SP and 2003 for SSE. Secondly, movements in gearing and the cost of equity track each other closely over the period for all three companies.

Figure 4.1
Cost of Equity and Gearing for NG, SSE and SP



Source: NERA analysis of Bloomberg and IBES data

4.5. 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. This is 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 this is borne out in transmission company cost of equity and gearing over the period 2001 to 2006.

As discussed in Section 3 Ofgem's failure at DPCR 2004 to adjust the cost of equity estimate for consistency with the gearing assumption used in calculation of the WACC led to Ofgem's underestimation of the DGM cost of equity for UK DNOs.

In this section we "re-lever" our post tax cost of equity estimates for NG, SSE and SP to be consistent with Ofgem's (2006) proposed gearing assumption of 60%. Our method of doing this is explained in Appendix C.

Table 4.3 shows the implied cost of equity for NG, SSE and SP over the period 2001-2006 "re-leveraged" for Ofgem's proposed notional 60% gearing assumption.

Table 4.3
Estimates of the Real Cost of Equity for NG, SSE and SP Based on DGM, Adjusted for 60% Gearing

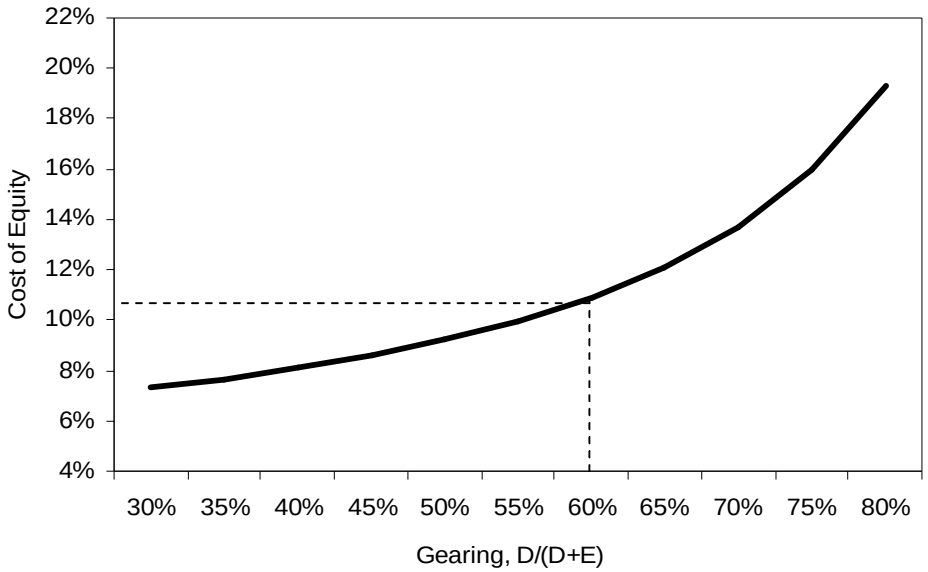
	NG	SSE	SP	Average CoE
FY 2001	7.3%	12.6%	10.9%	**10.3%**
FY 2002	6.9%	13.6%	9.9%	**10.1%**
FY 2003	7.9%	14.6%	9.5%	**10.7%**
FY 2004	9.5%	13.2%	11.3%	**11.3%**
FY 2005	9.1%	12.2%	10.9%	**10.7%**
FY 2006	8.7%	12.1%	11.2%	**10.7%**
Average	**8.2%**	**13.1%**	**10.6%**	**10.6%**

The average re-levered DGM estimate of the cost of equity for all companies is 10.6% over the period; our preferred estimate based on NG is 8.2%. The table illustrates that when the cost of equity estimates derived in Section 4.4 are "re-levered" for a higher level of gearing, the estimates are relatively stable across the period. As expected, the cost of equity for SSE and SP is higher than for NG. This is because SSE and SP are both engaged in a significant level of activities which are higher risk than transmission (and distribution) such as generation and retail.

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 NG, SSE and SP over a range of gearing from 30% to 80%.[13]

[13] Our key assumptions in deriving the relationship shown in Figure 4.2 are based on the average implied asset beta for NG, SSE and SP for 2004-06, an updated equity risk premium of 5.2% and a risk free rate of 2.5%, consistent with updated WACC parameters. Appendix C presents the formal derivation of this relationship.

Figure 4.2
NG, SSE and SP Real Post-Tax Cost of Equity and Gearing (2004-2006)



Source: NERA analysis of Bloomberg and IBES data

5. Conclusions and Comparisons with Ofgem WACC Proposals

Our concluding estimate of the DGM cost of equity for the transmission companies is 8.2% (excluding issuance costs). This is based on the following:

- **Use of a two-step DGM** which incorporates short-term analyst forecasts for years 1 to 4/5 and long term expectations of GDP growth thereafter;
- **NG as our primary source of evidence.** Estimates of the re-levered DGM cost of equity for SSE and SP are significantly higher than for NG, owing to the higher proportion of more risky activities undertaken, such as generation and retail. The cost of equity for these companies may therefore overstate the cost of equity for transmission activities.
- **A gearing assumption of 60%.** We "re-lever" our observed DGM cost of equity for Ofgem's notional gearing assumption of 60%.
- **Estimates are based on five years of historical evidence.** Our concluding estimate of the DGM cost of equity is based on estimates made over the period 2001-06, consistent with our recommended approach of using long term time series data set out in NERA (2006a).

As set out in this report, the cost of equity must include an issuance costs premium. In 2004 we estimated this premium to be 0.3% for the distribution companies. Our concluding estimate of the cost of equity for the transmission companies including this premium is set out in Table 5.1.

Table 5.1
NERA Real Post-Tax Cost of Equity Estimates for UK Transmission Companies

	NERA DGM	Ofgem Initial Proposals
Gearing	60%	60%
Real post-tax cost of equity (exc issuance costs)	**8.2%**	**7.0%**
Issuance Costs	0.3%	-
Real post tax cost of equity (inc issuance costs)	**8.5%**	**7.0%**

Source: NERA analysis of Bloomberg and IBES data.

Our concluding estimate of the cost of equity for the transmission companies is 8.5%. This is significantly higher than Ofgem's initial proposals, which indicate a cost of equity of 7.0%. Ofgem has not set out details of its analysis so we cannot compare estimates on the basis of the DGM. However, this report shows clear reasons why Ofgem's previous use of the DGM at DPCR 2004 resulted in an underestimate of the cost of equity. Any repetition of these methodological errors in estimating the cost of equity at TPCR 2006 would explain Ofgem's lower estimate vis-à-vis NERA. Insofar as Ofgem's estimate of the cost of equity is based on evidence from CAPM analysis, our review of TPCR 2006 shows that this estimate is also downwardly biased.[14]

[14] See NERA (2006) "Review of Ofgem's Initial Proposals for TPCR. A Report for EdF Energy", July 2006.

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 Transmission Companies. A simplified version of this model is presented below.

$$(A.1)^{15} \quad P_0 = \sum_{t=1}^{5} \frac{D_t}{(1+r)^t} + \left(\frac{D_5 * (1+g)}{r-g} \right) \left(\frac{1}{1+r} \right)^5$$

Where:

D_t is the expected real post-tax dividend per share for time t;[16]
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.[17]

[15] The availability of forecasts for each company varies for the period 2004-06. Forecasts were only provided for NG and SSE for financial years 1-4 and for financial years 1-3 for SP over our updated measurement period of 2004 to 2006.

[16] Having investigated reliability and availability of dividend per share forecasts on a daily basis we have refined our methodology since NERA (2004) by using dividend forecasts made on the ex-date (or "spot" forecasts). DGM estimates of the cost of equity for 2004, 2005 and 2006 presented in this report reflect this refined methodology.

[17] It should be noted that SP moved to a quarterly dividend distribution from 2001 onwards, whilst all other companies have consistently adopted a bi-annual distribution. NERA (2004) presented cost of equity estimates for SP using a bi-annual dividend distribution assumption. In refining the methodology used to update the cost of equity we have modelled the quarterly dividend distribution for SP in estimating the DGM cost of equity for 2004, 2005 and 2006.

(A.2)

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

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.

Appendix B. Prospective Dividend Yields

Table B.1
UK Transmission Company Prospective Dividend Yields (2001-2006)[(1)]

Company	2001	2002	2003	2004	2005	2006
NG	2.8%	3.4%	4.4%	5.5%	4.9%	4.5%
SSE	4.9%	5.1%	6.0%	5.5%	4.5%	4.2%
SP	5.6%	7.0%	6.2%	6.4%	6.2%	4.9%
Average	**4.4%**	**5.2%**	**5.5%**	**5.8%**	**5.2%**	**4.5%**

Source: Bloomberg and IBES. (1) Prospective dividend yields calculated as D_1/P_0

Appendix C. De-Levering DGM Cost of Equity Estimates

C.1. 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):

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

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:

$$(C.2) \quad CoE = (b_{equity} * (ERP)) + RFR$$

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.

For estimates for the period 2001-2003, the re-levering methodology is based on assumptions about the risk-free rate (2.9%) and equity risk premium (5%) made in our 2004 reports. Since then we have updated these assumptions (2.5% and 5.2%). Our re-levering methodology based on the risk-free rate and equity risk premium assumptions is set out below.

$$(C.3) \quad CoE_{notional} = [b_{asset} * (1 + (D/E)_{notional}) * ERP] + RFR$$

Where;

- $D/E_{notional}$ is notional D/E consistent with the notional gearing assumption;
- ERP is the equity risk premium assumption;
- RFR is the real risk-free rate assumption; and
- β_{asset} is the asset beta derived from the observed DGM cost of equity.

The β_{asset} term is derived by "backing out" the asset beta implied by the observed DGM cost of equity, assumed risk-free rate and equity risk premium and *actual* gearing observed at the point of measurement of the cost of equity, as shown below.

$$(C.4) \quad CoE_{observed} = [b_{asset} * (1 + (D/E)_{actual}) * ERP] + RFR$$

Where:

- $CoE_{observed}$ is the observed cost of equity using the DGM at time *t*.
- D/E_{actual} is the observed debt/equity at time *t*.

Rearranging equation D.4 gives us an expression for the implied asset beta, β_{asset}, which can then be used in equation D.3 to derive the notional cost of equity consistent with the notional gearing assumption.

NERA
Economic Consulting

NERA Economic Consulting
15 Stratford Place
London W1C 1BE
United Kingdom
Tel: +44 20 7659 8500
Fax: +44 20 7659 8501
www.nera.com

NERA UK Limited, registered in England and Wales, No 3974527
Registered Office: 15 Stratford Place, London W1C 1BE