Report for the CAA by Europe Economics

Cost of capital for NATS (En Route) plc for CP3

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EXECUTIVE SUMMARY

1 Europe Economics has been commissioned by the CAA to advise on the appropriate cost of capital that NATS (En Route) plc (NERL) is allowed to charge over the third price control period CP3.[1] This report is based on data up until 31st August 2009.[2]

2 We have used the Capital Asset Pricing Model (CAPM) and the Weighted Average Cost of Capital (WACC) framework to derive our cost of capital estimate.[3] Below, we summarise our views for each WACC parameter in turn, and then conclude by setting out our view on the overall WACC range.

Risk free rate

3 For the risk free rate our range estimate is 1.5 to 2.25 per cent with a working point estimate of 1.75 per cent. Our examination of yields on UK index-linked gilts (ILGs) shows that there is a long-term declining trend in gilt yields, and consideration of ILG yields and other evidence (including the most recent), in isolation of past regulatory precedent, would suggest a risk-free rate below our recommended figure. However, we have placed some weight on the idea that regulatory responses to falls in ILG yields should follow a Bayesian updating process, in which the assumptions made by various regulators on the risk-free rate should fall gradually over time as new data confirms that lower gilt yields are persistent.

4 We recognise that a risk-free rate assumption of 1.75 per cent is lower than the figures used by regulators previously. We have placed some weight on the Smithers & Co view, and the view expressed in the recent Competition Commission recommendations on the cost of capital for Stansted airport, that the sum of the risk-free rate (RFR) and equity risk premium (ERP) is more stable than the individual components. Hence, our ERP assumption (discussed below) is higher than has typically been assumed by regulators in the past.

Equity betas

5 To estimate NATS' asset beta we employed a comparator approach. We reviewed and updated the work by First Economics, calculating the most recent asset betas and reviewing the most relevant regulatory precedents for airlines, UK airports and utilities.

6 Our range estimate for the equity beta is 1.10 to 1.45. We recommend a working point estimate of 1.35, after re-leveraging to a notional gearing level of 60 per cent with an assumed debt beta of 0.1.

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1 This work was undertaken on the assumption that CP3 would be 5 years, spanning 2011-16. It is now understood that CP3 may be 4 years, if this is the case how this would affect the cost of capital would be considered in the next version of this paper.

2 There will be a further version of the paper which will update the analysis using data up until February 28th 2010.

3 The CAPM-WACC framework is briefly explained in the introduction to the report (section 1).

Equity risk premium

7 Our view of the long-term evidence, particularly the long-term academic studies (such as DMS 2007), is that a working point estimate for the ERP of 5.2 is appropriate. There is some evidence to suggest that the ERP rises in periods of recession or significant financial crisis – rising by the order of 20 per cent. In the light of this, our recommended range for the ERP is 5 to 6.

Capital structure

8 We assess NERL's cost of capital based on a notional gearing ratio of 60 per cent. This is consistent with a credit rating of A-/A3, which NATS has stated that it targets. It is also consistent with NERL's' current gearing and its target gearing over CP3.

Cost of debt

9 In deriving our cost of debt assumption, we looked at spreads on both nominal and index-linked comparators' bonds, spreads on recent new bond issues, and spreads for broader market bond indices.

10 For cost of debt our range estimate is 3.35 to 4.1 per cent for pre-tax cost of debt with a working point estimate of 3.6 per cent.

11 The cost of debt estimate of 3.6 per cent is obtained by adding a debt premium of 1.85 per cent to the risk free rate of 1.75 per cent.

Overall WACC range

12 Our recommendation on the range for the WACC for NERL for CP3 is 6.3 to 9.2 per cent on a real pre-tax basis, with a working point estimate of 7.6 per cent.

1 INTRODUCTION

1.1 This is Europe Economics' report for the Civil Aviation Authority (CAA) setting out our views on the appropriate cost of capital that NATS (En Route) plc (NERL) is allowed to charge over the third price control period CP3.[4] This report considers data up until 31st August 2009.[5]

1.2 Below, we briefly summarise the methodological framework used in this report.

Overview of Methodology

The CAPM-WACC framework

1.3 We have used the Capital Asset Pricing Model (CAPM) and the Weighted Average Cost of Capital (WACC) framework to derive our cost of capital estimate. For the purpose of introduction, we briefly rehearse what this framework is.

1.4 The cost of capital allowed by a regulator in setting price limits should reflect the opportunity cost of the funds invested in assets; it represents the rate of return that an investor would be likely to require in order to invest in a company, given its risk profile compared with other potential investments. It can also be thought of as the discount rate which an investor would use in evaluating the income stream to be expected from investing in the company.

1.5 For the purpose of the price control we need to derive a real WACC, and hence we carry out our analysis in real terms rather than nominal terms.

1.6 The weighted average cost of capital (WACC) is computed from (a) the average cost of debt for the various forms of debt held by the company, and (b) the cost of equity. This is the return that investors (shareholders and lenders of various types) require in order to invest in the company.

1.7 Mathematically, the following formula is used:

$$WACC = r_E \cdot \frac{E}{D+E} + r_D \frac{D}{D+E} \qquad [1]$$

where r_E is the cost of equity, r_D is the cost of debt, and E and D are the total values of equity and debt respectively used to determine the level of gearing in the company, so giving the relative weights between the cost of equity and debt finance.

4 This work was undertaken on the assumption that CP3 would be 5 years, spanning 2011-16. It is now understood that CP3 may be 4 years, if this is the case how this would affect the cost of capital would be considered in the updated version of this paper.

5 There will be a further version of the paper which will update the analysis using data up until February 28th 2010.

Cost of debt

1.8 The cost of debt measures the combination of interest rates charged by banks to the company and the return paid by the company on any corporate bonds or other loan instruments issued. It is standard practice to think of this as being made up of a risk free component and a company-specific risk premium.

$$r_D = r_f + debtpremium \qquad [2]$$

1.9 Since payments on debt are generally fixed (in contrast to the variable returns on equity), "risk" in this context principally means the risk of non-payment. One potential measure of the risk of non-payment is the rating on the company's debt, provided by ratings agencies. Thus, one way to calculate a company's debt premium is to consider the rating(s) of its debt and then take market data on spreads on bonds with this rating. For companies which do not have listed bonds and which are not rated, one can make a reasonable assumption about the rating that they might have were they to be rated, based on other similar companies.

Cost of Equity

1.10 The capital asset pricing model (CAPM) is used to determine the cost of equity, r_E, applying the following equation:

$$r_E = r_f + \beta_E * MRP \qquad [3]$$

- r_f is the return on a risk free asset, usually proxied by a measure of the rate on medium to long-term government bonds.

- β_E is the correlation between the risk in company returns and those of the market as a whole, which can be estimated from primary market data for listed companies, or by analysing the betas of comparators for companies which are not listed.

- *MRP* is the market risk premium over the risk free rate, an economy-wide parameter.

1.11 Thus in the standard CAPM there are three determinants of the expected return on any asset: the return on a riskless asset: the market premium over that riskless rate that is earned by investors as a whole, reflecting systematic risk; and the particular company's exposure to systematic risk. As discussed further below, company specific risks do not enter the cost of capital in the CAPM model, as they can, by definition, be diversified away by investors.

Approach to risks

1.12 Under CAPM, risks are divided into two major categories:

(a) Systematic risks; and

(b) Specific risks.

1.13 Systematic risks are risks that affect the whole market. Systematic risks relate to outcomes that cause the whole market to move, such as economic growth or recession, or wars. Even fully diversified investors are subject to systematic risk, and require a compensation for it through the cost of capital. The amount of compensation (the level of the cost of capital) they require from a particular company or a project depends on how exposed that company is to systematic risks.

1.14 The specific risks affecting an individual firm are those risks that can be offset by investors diversifying their investments. These are not taken into account in CAPM because it is assumed that in an efficient capital market investors can protect themselves against such risks by holding a diversified portfolio — implying that specific risks do not affect the rate of return to investors that the company has to cover through its cost of capital.

1.15 Consider an industry in which there is no systematic risk (and no industry-specific risk), but each of the companies in the industry faces company-specific risk. CAPM predicts that the rate of return in this industry would be the risk-free rate. Since there is no systematic risk, an investor with equal shares in all the companies in the industry would be guaranteed to receive the risk-free rate every period — the company-specific risks taken that turned out badly in some companies would exactly balance those that turned out well in others (that is precisely what it means to say that there is no systematic risk).[6]

Structure of Report

1.16 This rest of this report is structured as follows:

(a) Section 2 analyses the risk-free rate

(b) Section 3 assesses the cost of debt

(c) Section 4 contains our comparator beta analysis

(d) Section 5 considers the equity risk premium

(e) Section 6 considers capital structure

(f) Section 7 presents our view on the overall WACC range.

[6] Note that industry-wide industry-specific risks can be diversified by investors, in an analogous way to that set out in the thought experiment above, through holding shares across industries.

2 RISK-FREE RATE[7]

2.1 This section discusses evidence on the risk-free rate and sets out our recommendation on the figure that should be used by the CAA. It is structured as follows:

(a) the use of index-linked gilt yields

(b) the use of nominal gilt yields

(c) regulatory precedents

(d) conclusion – our suggested range and point estimate.

Index-linked Gilt (ILG) Yields

2.2 The yields on UK government index-linked gilts (ILGs) have traditionally been regarded as a good proxy for the risk-free rate because governments were considered to be one of the entities least likely to default on a loan, and so the rate of interest is considered to be about as close to risk-free as it is possible for a borrower to obtain. In addition, the use of index-linked gilts means that observed yields are already in real terms, without the need to strip out expectations of inflation. Previous regulatory decisions in the UK have tended to focus on ILG yields.

2.3 The following Figure shows Bank of England data on the yields on index linked gilts[8] for terms to maturity of 5, 10 and 20 years.

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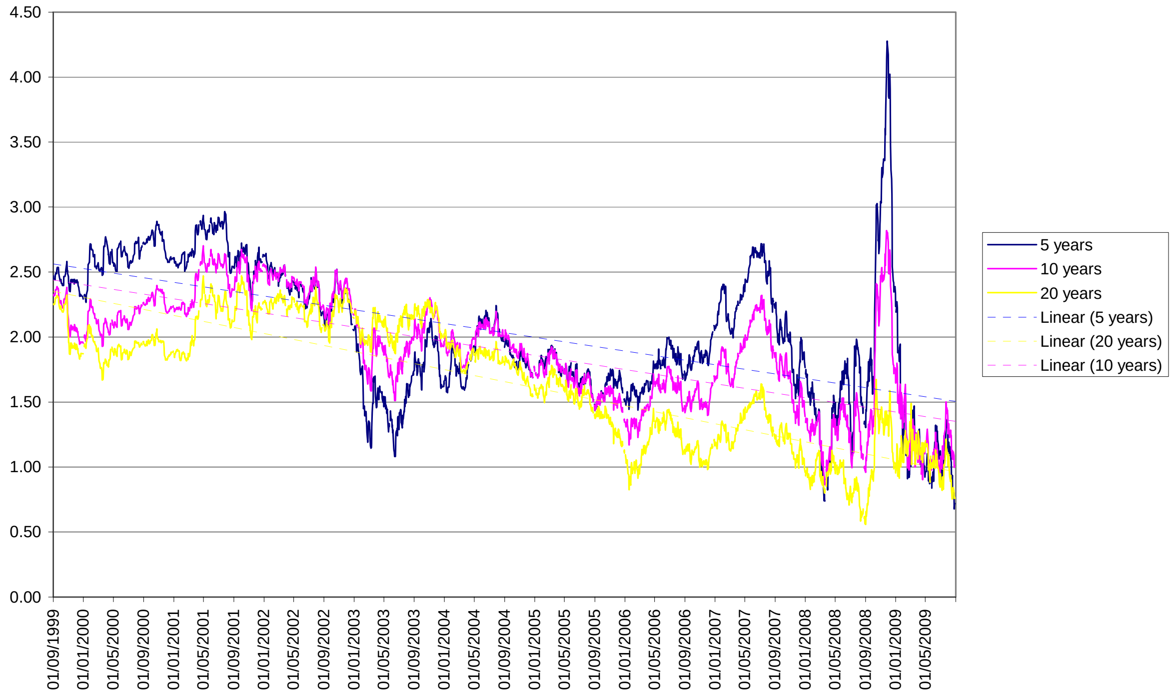
7 Please note that unless otherwise stated the data used in this and later sections is subject to a cut-off as at 31 August 2009. However, due to the August Bank Holiday weekend in the UK, the last available data point for UK gilt data is 28th August 2009.

8 These data are real spot curve rates — these are the interest rates calculated for index-linked zero coupon gilts where the principal is indexed to the RPI index.

Figure 2.1: UK ILG yields for the 10 years to 31 August 2009



Source: Bank of England

2.4 The above figure shows real gilt yields. As can be seen from the figure, yields for the three maturities have tended to move together with, apart from a period in 2003/04, shorter term yields tending to be higher than yields on longer term gilts.

2.5 There has been a declining trend with yields on 5, 10 and 20 year ILGs declining over time (shown by dashed lines on the chart). To verify that the clear visual trend was statistically robust, we carried out a linear regression of yield on a time trend for each maturity. This confirmed a statistically highly significant declining trend which became more pronounced as maturity increased (i.e. there was a greater declining trend for maturities of 20 and 10 than for 5 years).[9]

2.6 The following table summarises real gilt yields in the UK over different time periods.

9 When yield was regressed against time (as represented by daily data) t-statistics were as follows: 5-year ILGs:--34.77; 10-year ILGs: -55.94; 20-year ILGs: -82.16. This represents average yearly decreases of 0.102 per cent for 5-year; 0.106 for 10-year; and 0.135 per cent for 20-year ILGs.

Table 2.1: UK Index-linked Gilt Yields

	5 years	10 years	20 years
Latest market data			
Spot rate on August 28th 2009	0.72	1.01	0.76
October 2008 onwards	1.70	1.50	1.13
Longer run averages			
September 08 to August 09	1.70	1.47	1.10
April 05 to July 07	1.88	1.65	1.31
September 04 to August 09	1.79	1.59	1.25
September 99 to August 09	2.03	1.90	1.66

Source: EE calculations using BOE data from up until 31st August 2009. In the Competition Commission (CC) recommendations for the cost of capital for Stansted airport, the CC explained the falling yields on longer term ILGs in recent years by reference to pension fund regulatory requirements such as the minimum fund requirement which have encouraged pension funds to hold longer term gilts, and have thus, according to the CC, depressed their yields.

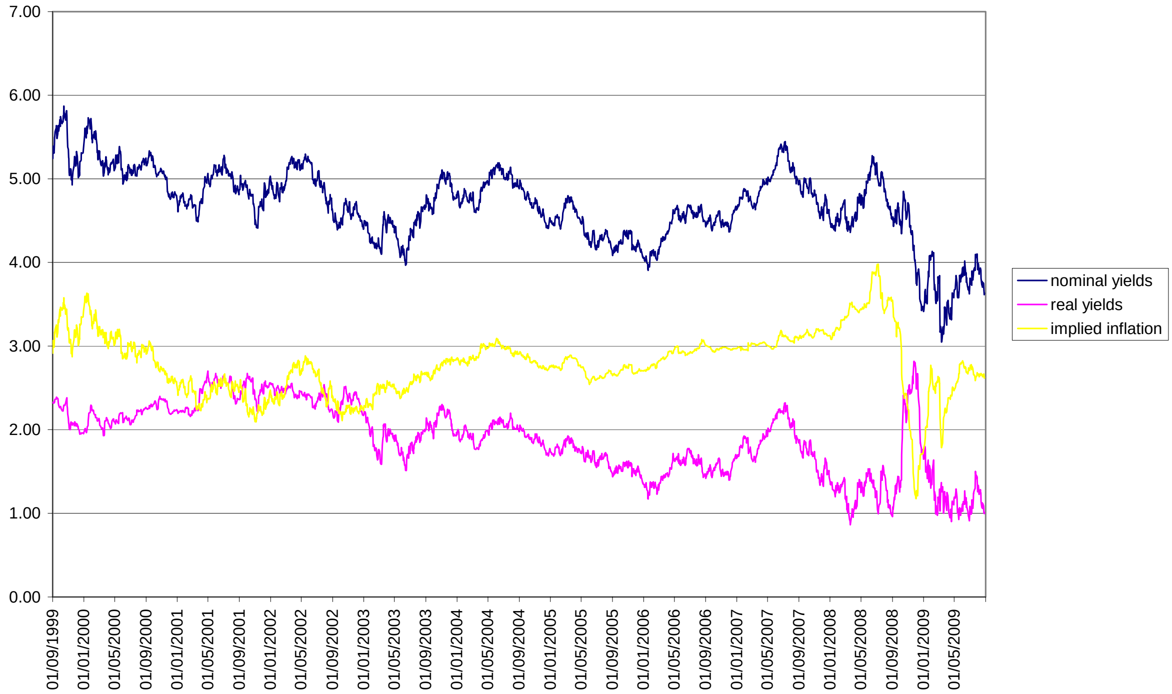
Nominal Gilts Deflated using Inflation Expectations

2.7 Theoretically the yields on index-linked gilts should equal the yields on nominal gilts minus inflation expectations and an inflation risk premium. Therefore nominal gilt yields can be used as a cross-check for the risk-free rate indicated by yields on index-linked gilts if inflation expectations are estimated or assumed, and then stripped out.[10]

2.8 The following Figure shows implied inflation (RPI) expectations calculated as the difference between yields on nominal and index-linked gilts with term to maturity of 10 years along with implied inflation (calculated as the difference between nominal and real yields).

[10] In theory, an inflation risk premium should also be deducted from nominal yields. However, given the difficulty in quantifying the inflation risk premium and the fact that we are only using nominal yields as a cross-check, we do not carry out this step.

Figure 2.2: Comparison of nominal and index-linked UK gilt yields with maturity of 10 years



Source: BOE data

2.9 As can be seen from the above Figure, there has been some volatility in implied inflation in recent months.

2.10 An alternative view of inflation prospects is shown in the following table, which gives the Treasury's RPI projection for the following 5 years. This is shown as a percentage change on previous years.

Table 2.2: Projected UK RPI over the next 5 years

	Outturn 2007-08	**Estimate 2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**
RPI (September)	4	5	-3	1.75	3.75	3.75	3

Source: 2009 Budget report

2.11 As can be seen from the above table the Treasury view is that there will be significant RPI deflation in 2009-10. As index linked gilts are linked to movements in the RPI index this would have the effect of causing nominal yields on gilts of one year maturity to fall below real yields.

2.12 The average RPI inflation rate, over five years, implied by these figures is 1.82 per cent. This is 14 bps above the average of the independent forecasts of the RPI for the next 5 years (collated by the Treasury in its publication "Forecasts for the UK economy: a comparison of independent forecasts"[11]) — at 1.68 per cent.

Nominal yields and inflation expectations as an estimate of the risk free rate

2.13 In the current volatile and uncertain inflation environment, we have doubts about whether inflation forecasts can be used to produce a robust cross-check on risk-free rate estimates obtained from index-linked gilts. However, we have made a number of comparisons using gilts with maturities of 5, 10 and 20 years and inflation forecasts for different time periods.

2.14 Our first comparison compares the latest spot rates for nominal gilts with a term to maturity of 5 years minus the average of the "independent forecasts" of the RPI for the next 5 years with the current spot rate for index linked gilts. This is shown in the following table.

Table 2.3: Comparison using nominal ILG yield and inflation forecast – 5 years

	Yield (%)
5 year average RPI (average of "independent forecasts")	1.68
Spot rate (28 August 09) nominal 5 year gilt	2.69
Calculated risk-free rate (nominal spot rate — inflation expectations)	1.01
Spot rate (28 August 09) index linked 5 year gilt	0.72

Source: EE calculations with BOE and Treasury collated data on independent forecasts

2.15 Deducting average inflation of 1.68 per cent from the spot rate of 2.69 per cent gives a calculated risk-free rate of 1.01 per cent. The rate of 1.01 per cent is 0.29 per cent higher than the latest available spot rate on index linked gilts.

2.16 The following two tables show the same exercise, this time for gilts with maturities of 10 and 20 years. The inflation forecasts used are based on the latest RPI forecasts available for 5 years, adjusted for the longer time periods according to the RPI rates consistent with the BOE target of 2 per cent for CPI.[12]

[11] HM Treasury: Forecasts for the UK economy – A comparison of independent forecasts, August 2009. No 268.

[12] We assume a CPI target of 2.0 per cent equates to an RPI value, on average over time, of 2.8 per cent.

Table 2.4: Comparison using nominal ILG yield and inflation forecast — 10 years

	Yield (%)
Expected 10 year average RPI	2.24
Spot rate (28 August 09) nominal 10 year gilt	3.63
Calculated RFR (nominal - inflation expectations)	1.39
Spot rate (28 August 09) index linked 10 year gilt	1.01

Source: EE calculations with BOE data and inferences based on Treasury collated data on independent forecasts

Table 2.5: Comparison using nominal ILG yield and inflation forecast — 20 years

	Yield (%)
Expected 20 year average RPI	2.52
Spot rate (28 August 09) nominal 20 year gilt	4.11
Calculated RFR (nominal - inflation expectations)	1.59
Spot rate (28 August 09) index linked 20 year gilt	0.76

Source: EE calculations with BOE data and inferences based on Treasury collated data on independent forecasts

2.17 The calculated risk free rate using gilts with a maturities of 5, 10 and 20 years are higher than the relevant ILG rate. The differences range from 0.29 bps (5 year gilts) to 0.83 bps (20 year gilts).

2.18 As shown by the above tables, our estimates of the risk free rate using nominal gilts stripped of inflation expectations differ materially from the rates implied by ILG yields. One interpretation is that market expectations (as indicated by gilt yields) are currently at odds with independent forecasts of inflation — and in a period of considerable uncertainty over the inflation outlook that is an explanation that it is difficult to gainsay.

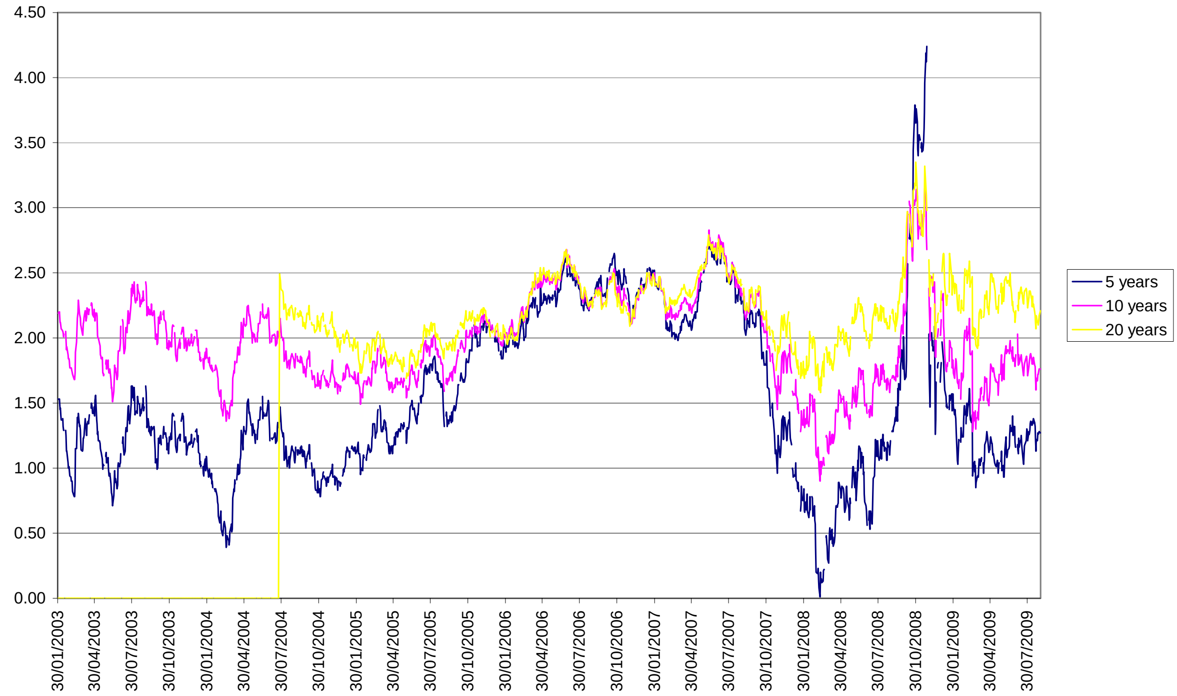
International Perspective

2.19 If capital markets are internationally competitive, if there is perfect mobility of capital across borders, and if there is limited lumpiness in uncertainty (e.g. that it is not the case that, in each country, uncertainty about international conditions, about the interpretation of data, and the robustness of financial contracts is very much greater than uncertainty about the same things domestically), and if other issues such as tax differences do not create market segmentation, there will be a meaningful common international risk free rate. Though it is highly doubtful whether all these conditions are met — a fact acknowledged by, for example, regulatory programmes, such as the EU's Financial Services Action Plan, the point of which is to attempt to increase integration at the EU level (and if capital markets are not near-fully integrated even at the pan-EU level, integration will of course probably be even less at the global level) — for reference, we now compare yields on UK ILGs with those in the US.

US index-linked gilt yields

2.20 The figure below shows real gilt yields for the US.[13,14] (We note that, as in the UK, there was a short-lived spike in US gilt yields at the peak of the financial market chaos that followed the nationalisation of Fannie Mae and Freddie Mac and the subsequent bankruptcy of Lehman's. However, gilt yields have now returned to levels typical of or even below those in the period before the credit crunch began in the summer of 2007)

Figure 2.3: US gilt yields



Source: US Treasury data

2.21 The following table summarises real gilt yields in the US over different time periods[15].

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[13] Note that the data for 20 year gilts starts in 2004.

[14] For the index linked gilts the principal is indexed to the US CPI rather than RPI as with UK index linked gilts.

[15] Note that we only have data available for 5 and 10 year US gilts from 2003 and so no 10 year average is given. Data for 20 year gilts starts in 2004.

Table 2.6: US Index-linked Gilt Yields

	5 years	10 years	20 years
Latest market data			
Spot rate on August 31st 09	1.27	1.76	2.21
October 2008 onwards	1.63	1.99	2.42
Market data excluding recent months			
September 2008	1.55	1.85	2.27
Over 3 months (July to Sept 2008)	1.18	1.70	2.17
Over 6 months (April to Sept 2008)	0.98	1.59	2.10
Over 1 year (Oct 2007 to Sept 2008)	1.03	1.61	2.03
Over 3 years (Oct 2005 to Sept 2008)	1.85	2.08	2.24
Over 5 years (Oct 2003 to Sept 2008)	1.58	1.97	

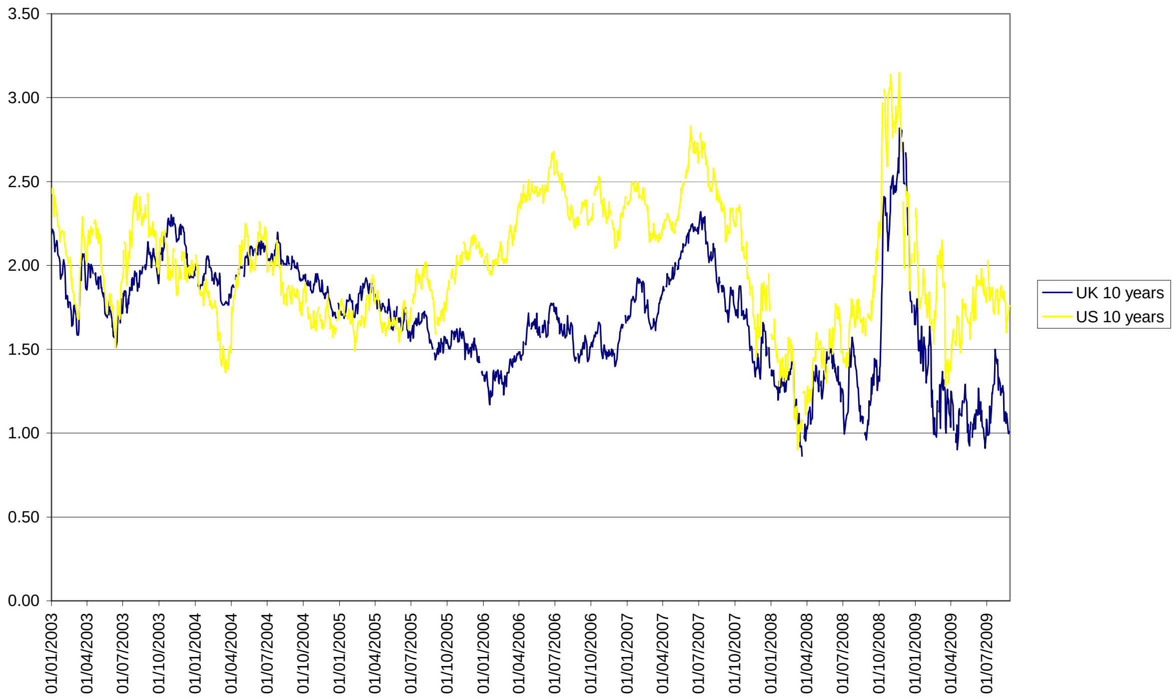
Source: US Treasury data

2.22 The above table shows that yields on longer term gilts in the US tend to be higher than on shorter term gilts (in contrast to the "hump-backed" situation in the UK in which ten year yields are higher than either five year or twenty year yields). For the 3 years up to the period of extreme volatility in Autumn 2008, the average for 5 year gilts was 1.85 per cent; for 10 year gilts it was 2.08 and for 20 year gilts it was 2.24. These figures are higher than the averages in the past 11 months for 5 and 10 year gilts, which are 1.63 per cent for 5 year gilts, 1.99 per cent for 10 year gilts but lower than the average for the past 11 months for 20 year gilts of 2.42 per cent.

2.23 The following Figure compares yields for index linked gilts with a maturity of 10 years in the UK and US.[16]

[16] Note that index-linked gilts in the US are indexed against US CPI rather than RPI as in the UK.

Figure 2.4: Yields on UK and US index-linked gilts with maturity of 10 years



BOE and US Treasury data

2.24 As emphasized above, we do not believe that it should be expected that the US data should match the UK. Nonetheless, we note two points of potential interest:

(a) If US gilt yields have any downward trend since the early 2000s, it is neither so pronounced nor so clear as that for the UK.

(b) US 5- and 10-year index-linked gilt rates are comfortably below 2 per cent on almost all measures and time periods, with the exception of the period of extreme volatility since the Autumn of 2008.

Regulatory Precedents

2.25 We now review estimates of the risk-free rate used in previous regulatory decisions. The following table summarises regulatory decisions on the risk-free rate.

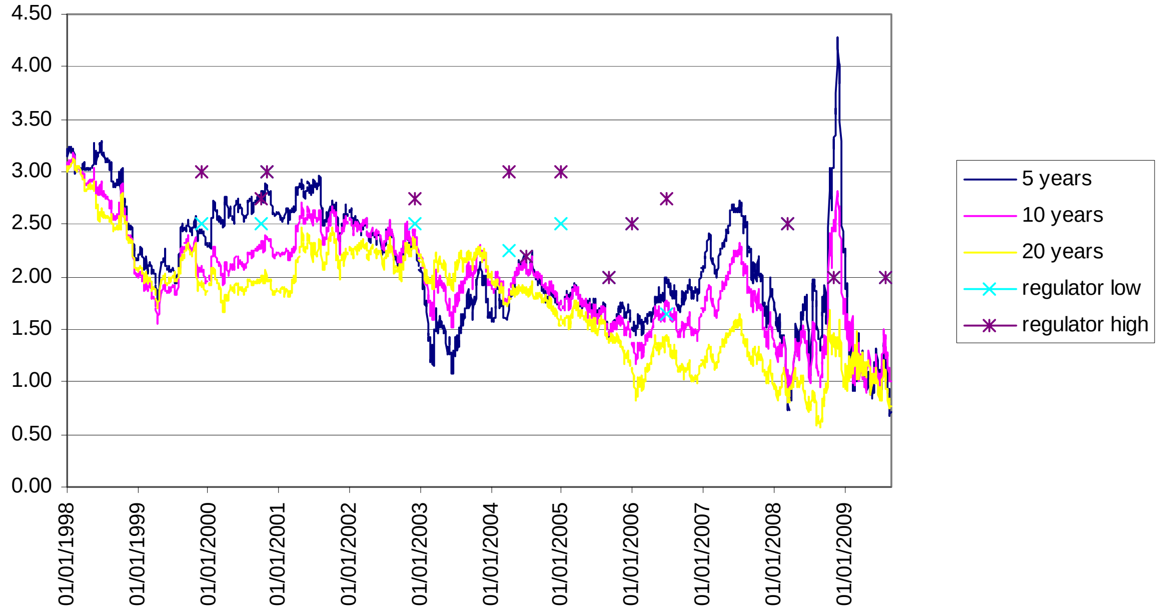
Table 2.7: Previous regulatory decisions on the risk-free rate

Regulator	Case	Real risk-free rate (%)
Ofgem	Electricity distribution (2009)	2.0
CC	Stansted (2008)	2.0
CAA	Heathrow and Gatwick (2008)	2.5
CC	Heathrow and Gatwick (2008)	2.5
Ofgem	Transmission (2006)	2.5
Ofcom	General approach – applied to BT (2005)	2.0
CAA	NATS (2005)	2.5
Postcomm	Royal Mail (2005)	2.5
Ofwat	Water and sewerage (2004)	2.5-3.0
Ofgem	Electricity distribution (2004)	2.25-3.0
Competition Commission	BAA (2002)	2.5-2.75
ORR	Access charges (2000)	3.0
Competition Commission	Mid Kent Water (2000)	3.0
Ofgem	Transmission (2000)	2.5-2.75
Ofwat	Water (1999)	2.5-3.0
Lowest figure		2.0
Highest figure		3.0

Source: Regulatory determinations

2.26 These are also shown in the following Figure which illustrates the relationship between the return on UK ILGs and the risk-free rate used in previous regulatory decisions.

Figure 2.5: Previous regulatory decisions on the risk-free rate



Source: BOE data and EE review of regulatory determinations

2.27 As can be seen from the Figure, regulators have frequently used ranges above government gilt yields. In general these have been a material number of basis points — in some cases more than 100 — above the risk-free rate as measured using ILG data. Nonetheless, over time, regulatory decisions have fallen from a range of 2.5–3.0 early in the decade to a range of 2.0–2.5 in more recent years, as shown in the table.

2.28 One interpretation of this evidence is that regulators have implicitly engaged in a form of Bayesian updating of beliefs, in which a prior belief about the risk-free rate has been only gradually lowered as sustained reductions in ILG yields have provided evidence that the risk-free rate has fallen.

2.29 It is useful to dwell on this issue of Bayesian updating for a moment. If one had a prior belief that the average height is 5’10”, but then sees ten people in a row who are 5’4” or less, that might not initially drive one to reduce one’s view of the average height. Perhaps the people one had seen were unusual in some way. But, eventually, sustained observation of figures far below one’s prior must, if that evidence carries any weight at all, lead to some updating downwards in one’s view.

2.30 This is where we believe things lie in regulatory judgement. Regulators began believing that risk-free rates were around 2.5 to 3 per cent. Then gilt yields fell. When yields first fell it was reasonable for regulators to hold on to their prior belief in a higher value for the risk free rate — after all, perhaps the lower gilt yields were a random statistical result or the consequence of some passing distortion as markets adjusted to some investment regulation or other? But, as index-linked gilt data consistently lay well below the regulatory judgements made before, and indeed fell further and further below, the gap between regulatory judgements and the data become anomalous. This led some commentators to suggest that the regulators had implicitly ceased to base their view primarily on the index-linked gilts data and had come to accept some flaw in the use of these figures. Indeed, some regulators, perhaps, become concerned on this point and came to place greater weight upon past regulatory judgements than upon the index-linked gilts data themselves.

2.31 Our view is that there is no good reason to doubt the index-linked gilts data, and that the period for being concerned that the drop in gilts yields was a passing phenomenon is now long expired. Regulatory judgements should accept the consistent and sustained message of the gilts data that the risk free rate has fallen considerably.

2.32 Nonetheless, given the large gap between past regulatory judgement and the current data, there may still be some case for not moving all the way to the index linked gilts data, retaining some limited inertia in estimation to reflection the Bayesian concern.

Assessing the Risk Free Rate — Alternatives to Government Gilts

The Smithers & Co approach

2.33 The Joint Regulators Study[17] by Smithers & Co (2003), although it did not set out explicitly a way to estimate the risk-free rate for regulatory purposes, did investigate a number of related issues. Smithers & Co urged that the risk-free rate and the equity risk premium should be forward-looking and based on international data, not simply UK data. They also contended that estimates of the sum of the risk-free rate and the equity risk premium will be subject to markedly less volatility and uncertainty than estimates of the parameters separately.

2.34 To determine the "safe rate" the authors propose different alternatives.

(a) Future prices;

(b) Non market forecasts;

(c) Government bond yields;

2.35 For estimation purposes they offered the following solution:

(a) If the relevant time horizon for measuring returns is one day, the safe asset used is the overnight money market rate (e.g. LIBOR);

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17 Note that the CAA was one of these Joint Regulators.

(b) With monthly data, both the monthly LIBOR and the return on one month treasury bills are used for robustness checks. The results do not change. Although the real return on such assets is not certain, because inflation is not entirely predictable, with very short time horizons of under a month the divergence between the degree of certainty of real and nominal returns is small; with daily data it would only be an issue in times of hyperinflation.

NERA Critiques

2.36 In a number of recent determinations, an alternative approach has been offered by NERA based on the use of swap rates. For example, on behalf of EdF energy NERA made a third-party submission to the 2007 Airport Price Control Review.[18] This critique was developed further in NERA's report for Water UK[19], which is the fullest and most recent statement of this approach.

2.37 NERA claims that ILG yields do not provide a reliable basis for estimation of the risk-free rate, for two reasons:

(a) The impact of regulations and accounting requirements such as the Minimum Funding Requirement (MRF), FRS17 and IAS19, which had created high and inelastic demand for government gilts.

(b) A flight to safety effect, driving investors into safe assets following the bursting of the dotcom "bubble".

2.38 NERA believes that these factors "have caused yields to be distorted from the true risk-free rate…because they are not related to fundamental changes in investors' preference over risk". A Bank of England statement dated 1999[20] is offered as evidence to confirm this interpretation of the collapse in real yields.

2.39 NERA presented an alternative method to estimate the "true" risk-free rate based on swap rates. The risk free rate is constructed by subtracting a measure of the interbank risk[21] (or AA credit risk) from the implicit swap rate. The real rate is obtained by stripping out expected inflation from the nominal rate.[22]

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18 http://www.competition-commission.org.uk/inquiries/ref2007/airports/pdf/third_party_submission_edf_sub.pdf

19 NERA, 2008, *Cost of capital for PR09 Final Report for Water UK*, p.20.

20 Bank of England, 1999, Quarterly Bulletin, May.

21 Measures of the interbank risk can be extracted from market data on Credit Default Swap (CDS) contracts or market indices thereof.

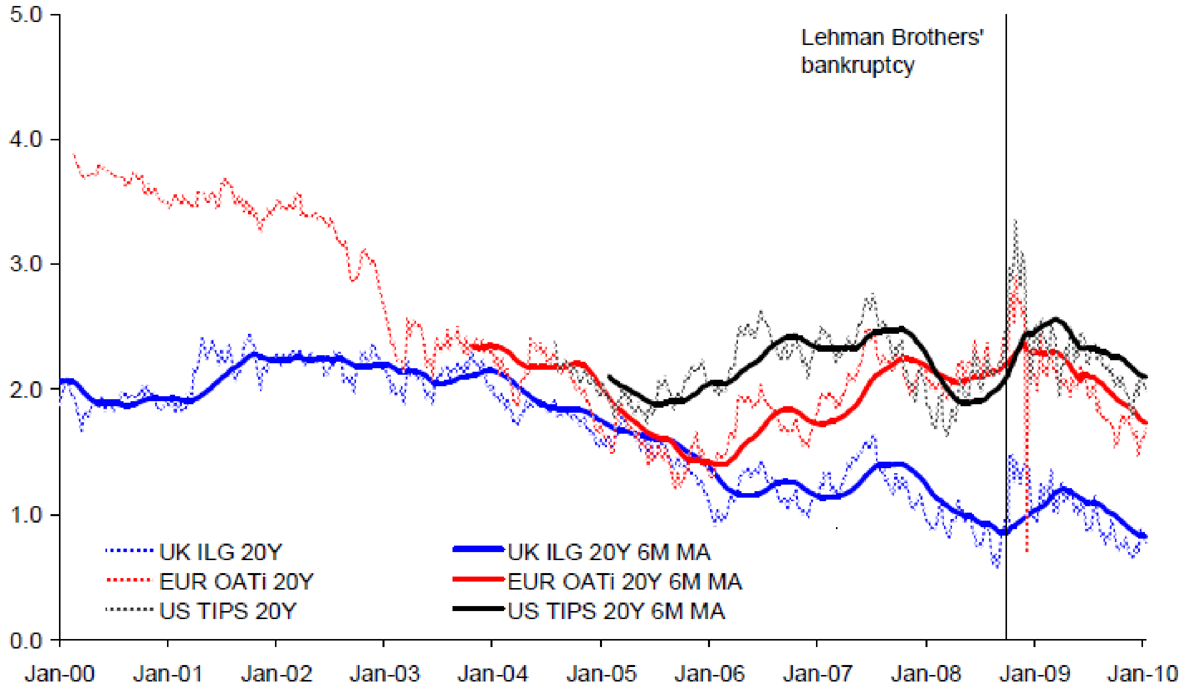
22 This is done using the Fisher equation, which specifies the relationship between the real interest rate, the nominal interest rate and the rate of inflation.

2.40 The report stated that the swap market does not suffer from the same distortions as the government gilts market — namely illiquidity, even on long-dated maturities, and supply constraints. Hence "the swap curve can be regarded as lying at fair value".[23]

NERA's additional evidence in support of the use of swaps

2.41 NERA provided the CAA with some additional evidence in support of the use of risk-adjusted swaps rates.[24] NERA's note included an analysis of international evidence on real yields as a cross-check for the UK real risk free rate. Their analysis included the following two Figures showing real yields based on inflation protected government bonds and swaps respectively[25]:

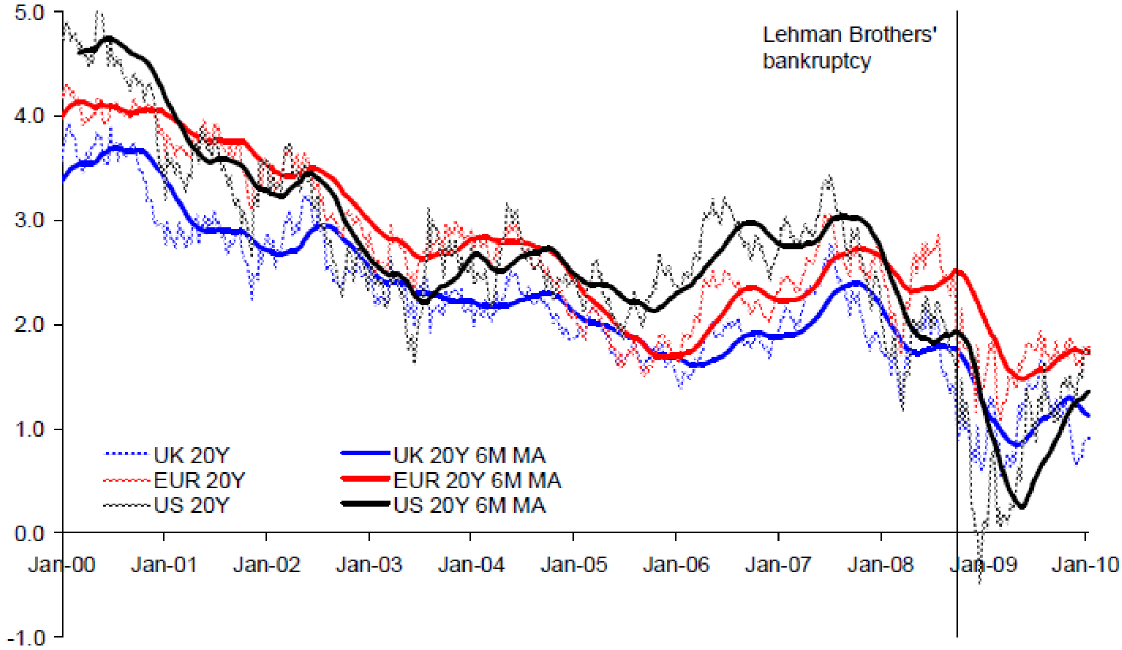
Figure 2.6: Real yields (20 year maturity) based on inflation protected bonds



NERA, 2010, Updated evidence on measures of the risk free rate, a note for NATS En Route ("NERL"), p 10

23 NERA, 2008, Cost of capital for PR09 Final Report for Water UK, p.20.
24 NERA, 2010, Updated evidence on measures of the risk free rate, a note for NATS En Route ("NERL"),
25 NERA also provided a figure illustrating yields based on deflated nominal bonds which we do not include here.

Figure 2.7: Real yields (20 year maturity) based on swaps



NERA, 2010, Updated evidence on measures of the risk free rate, a note for NATS En Route ("NERL"), p 11

2.42 NERA calculate averages over two time periods: the last 10 years and the 5 years "pre-Lehman".[26] The results of this analysis is shown in Table 2.8:

Table 2.8: International evidence: summary of real yields (%) (20 year maturity)

	5Y Average "Pre-Lehman"			10Y Average		
	ILG	Real from Nominal	Swap-Based	ILG	Real from Nominal	Swap-Based
UK	1.4	1.7	2.0	1.6	1.9	2.2
EUR	1.9	2.4	2.4	na	2.7	2.7
US	2.2	2.4	2.5	2.2	2.5	2.6

Source: Bloomberg, Bank of England, US Federal Reserve Bank, HMT, ECB and NERA analysis (13/01/2010)

NERA, 2010, Updated evidence on measures of the risk free rate, a note for NATS En Route ("NERL"), p 12

26 This refers to the 5 year period prior to the collapse of the Lehman Brothers bank.

Europe Economics' view

2.43 Europe Economics acknowledges the attraction of using alternative methods of calculating the risk free rate as a cross-check to ILGs, and believes that consideration of swaps data is one potential candidate for such cross-checking. However, we are not convinced that swaps provide a preferable method of calculating the risk free rate, or indeed that NERA's swaps analysis necessary leads to a conclusion of a higher risk free rate than that suggested by an analysis of ILG yields.

2.44 As discussed earlier in this section (under regulatory precedents and also illustrated by the trend in Figure 2.1) we believe that there is a long term declining trend in risk free rates. We therefore do not agree with NERA's decision to calculate 5 year averages excluding data "post-Lehman". We do not believe that this "post-Lehman" data represents a distortion but instead that the lower yields are indicative of long term trends.

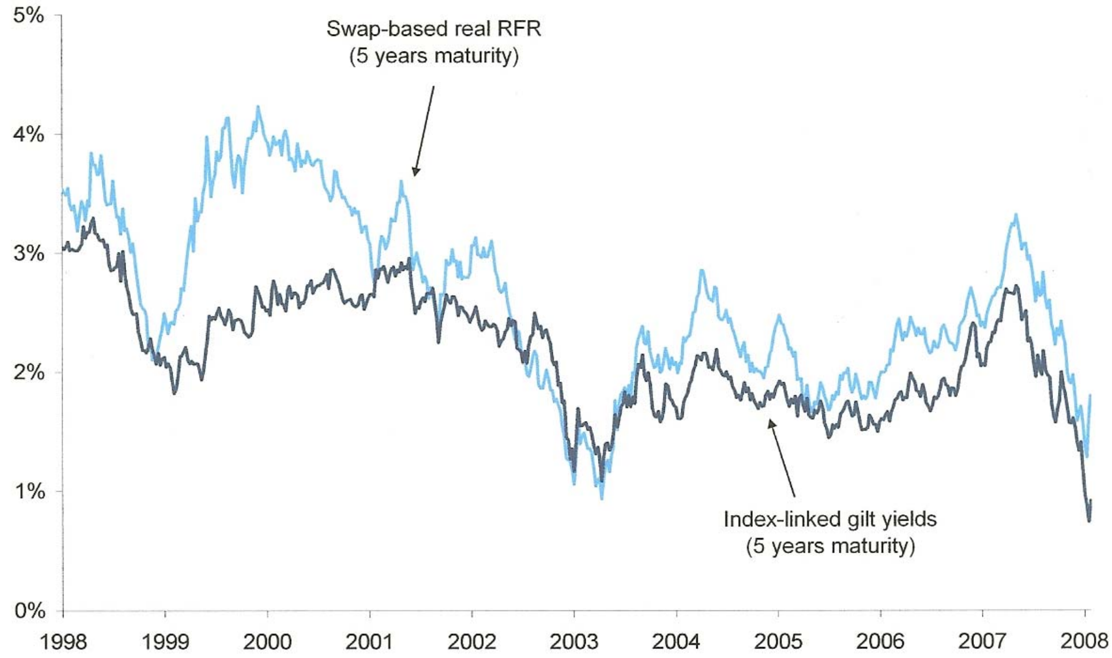
2.45 Considering NERA's chart of real yields based on swaps (Figure 2.7 above), it is not clear that if the "post-Lehman" data were included, the averages calculated based on swaps would be outside the range we would opt for on the basis of gilts data alone.

2.46 The 10 year averages calculated by NERA (which we understand do include the "post-Lehman" data) we suggest should be interpreted in light of the observed long term declining trend in both ILG yields and real yields calculated using swaps. Our view is that the most important data are the recent point estimates, for the risk-free rate (and the cost of capital as a whole) is a forward-looking concept. (Of course, there may be some volatility day-to-day, and hence we believe that some smoothing of recent figures is appropriate, but the principle remains that the latest data provide the best forwards-looking estimate. Thus, for example, we might prefer a three- or six-month moving average. And the latest six-month moving average swaps-based estimate, as shown in NERA's graph above, is well below NERA's recommended estimate for the risk-free rate.)

2.47 We should also note that we do not accept that 20-year gilts or swaps should be considered the key maturity for the assessment. Our approach is to form a judgement based on a mix of different maturities.

2.48 There are a number of additional issues relating to NERA's analysis. In particular, we do not accept that NERA's arguments demonstrate a fundamental superiority of the swaps-based approach over the index-linked-gilts-based approach. Consider the diagram below, drawn from NERA's Water UK report. (Note that this chart is based on five-year data, whilst some of NERA's discussion concerns longer maturity debt, but we believe that it illustrates our core points nonetheless.)

Figure 2.6: Swap based real risk-free rate and IL gilt yields



Source: NERA, 2008, Cost of capital for PR09: Final report for Water UK, p.25, Figure 2.5

2.49 Since the motivation for using the swap-based approach was purportedly to correct for distortions created by pension funding rules and the collapse of the dotcom "bubble", it is problematic that the swap-based approach estimate shows downward dips at precisely those points the ILG series is alleged by NERA to be downward-distorted (i.e. 1998-1999 and 2002-2003). The natural conclusion is that either the swap markets share the same distortion as ILG markets (in which case is there really any advantage to using them?) or the alleged distortion does not exist.

2.50 Next, NERA acknowledged that the swap-rate based series appears to decline over the past ten years.[27] Despite this they employ an average over the period — thereby materially increasing their estimate. A key driver for this is the brief period from 1999-2001 in which the average gap between the ILG yields and the swap base risk-free rate was considerably elevated. It seems inconsistent to argue for the use of a swaps-based approach on the basis of avoiding distortions, then choose an implementation of the approach that makes the final answer highly dependent on a rather old apparent distortion from 1999-2001. Indeed, if the swap rate point estimate from the end of the data series were used, reflecting the forwards-looking nature of the risk-free rate, a figure below 2 per cent would be recommended. (And note that the same case applies against the use of 10-year averages for the 20-year maturity swaps data — as can be seen from

[27] NERA, 2008, Cost of capital for PR09 Final Report for Water UK, p.24.

Figures 2.6 and 2.7, the most significant wedge between the swaps- and index-linked-gilt-based estimates comes in the period 2000-2003.)

2.51 In addition NERA offer the phenomenon of yield curve inversion (described as "contrary to economic theory"[28]) as a proof that risk-free rate estimates based on ILGs are unreliable. However, this type of yield curve is not contrary to economic theory. Yield curves are usually considered to be upwards-sloping reflecting the risk of inflation being higher out into the future, and have only been "normal" since the Second World War. In the late nineteenth century, for example, in an era of ongoing deflation, yield curves were consistently downwards-sloping. An inverted yield curve merely implies a different expected path for future interest rates from a downwards-sloping curve, and even in inflationary times an inverted yield curve has been considered a good predictor of economic downturn (and hence interest rate cuts). A recent example is when the U.S. Treasury yield curve inverted in 2000 just before U.S. equity markets collapsed. An inverse yield curve predicts lower interest rates in the future as longer-term bonds are in demand, driving yields down.

2.52 The CC, in the Airports inquiry, considering the evidence presented by NERA, was not persuaded that the swap rates provided a stronger basis for determining the risk-free rate than ILGs.

2.53 It is therefore our view that though other sources of evidence may well be relevant and useful, including swap rates (and we find NERA's case interesting and valuable — indeed, we interpret the recent twenty-year maturity data presented in Figure 2.7 as broadly supportive of (albeit rather lower than) the risk-free rate estimate we shall reach below), evidence of the yields on index-linked gilt securities should continue to represent the single most important piece of evidence in assessing the risk-free rate.

Quantitative Easing and Sovereign Rating Concerns

2.54 From February 2009 to January 2010, the Bank of England pursued a programme of "quantitative easing". This is believed to have depressed 5-year gilt yields by around 75 basis points.[29] Very recent data (from the end of 2009) might arguably be elevated by perceived risks that the UK might lose its AAA credit rating, as per the warnings by, for example, ratings agency Standard & Poor's. However, it should be noted that the main bulk of this report was produced in September 2009 and the data cut-off point was August 31st 2009.

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28 NERA, 2008, *Cost of capital for PR09 Final Report for Water UK*, p.19.
29 Fathom Financial Consulting, *BEST UK Forecast*, February 2010, p10.

Conclusion

2.55 There is no precise method for determining the risk-free rate and a certain amount of judgment is necessary. Recent market turbulence resulted in sharp rises and falls in the yields on ILGs in the latter months of 2008 and early months of 2009. However, the latest gilt yield data has been more stable, and is in line with the downwards trend that pre-dated that period of turbulence.

2.56 The following table presents the latest market data as of 28th August 2009.

Table 2.9: Summary of ILG rates

Rates on 28th August 2009	%
5 year UK ILG spot rate	0.72
10 year UK ILG spot rate	1.01
5 year US ILG spot rate[30]	1.27
5 year UK ILG, 5 year average September 04 to August 09	1.79
10 year UK ILG, 5 year average September 04 to August 09	1.59
20 year UK ILG, 5 year average September 04 to August 09	1.25

Source: BOE; US Treasury; Bloomberg; and UK Treasury data

2.57 Our preferred point estimate for the risk free rate is **1.75 per cent**. If one were to set aside previous regulatory precedent and look at the data afresh, our view is that the natural conclusion would be for a risk free rate of 1.5 per cent or perhaps even less. (A figure of around 1.5 per cent might be obtained, for example, by adding the 75 basis point effect of quantitative easing on five year gilts to the spot five-year gilts figure.) However, as explained above we continue to place some weight upon the Bayesian updating implicit in past regulatory decisions, and for that reason, despite the recent data, we recommend a 1.75 per cent figure for the regulatory judgement. Although this figure is higher than current yields as shown in Table 2.8 above, it is supported by longer-term averages (see Table 2.1).

2.58 The 1.75 per cent figure is lower than that used in previous regulatory decisions. However, as discussed at length earlier we believe there is a long term trend for the risk free rate to decline and that there is no good empirical reason not to broadly reflect this fall in the regulatory judgement.

2.59 This estimate of the RFR has an effect on the ERP given we place some weight on the Smithers & Co view, and the view expressed in the recent CC recommendations on the cost of capital for Stansted airport, that the sum of the RFR and ERP is more stable than the individual components. This is one factor in our choice of ERP in a later section –

30 Spot rate given is for 31st August 09 as unlike the UK, the US did not have a non-trading day on 31st August.

where we recommend a higher ERP than has typically been used by regulators in the past.

2.60 The range of risk-free rates from which we believe a regulatory judgement might be plausible is 1.5 to 2.25. The lower figure reflects more of the underlying downward trend than does our point estimate, whilst the upper figure places more weight upon past regulatory precedent and upon the data in the period October to December 2008.

3 COST OF DEBT

3.1 This section analyses the cost of debt for NERL. This is a crucial part of the analysis in the context of current constraints in capital markets, which saw bond spreads rise to historically high levels, particularly in the autumn of 2008.

3.2 The discussion in this section is set out under the following headings:

(a) Our approach to estimation of the cost of debt;

(b) Evidence from spreads on comparators' company bonds;

(c) Evidence from wider market indices;

(d) Conclusions on the cost of debt.

Our Approach to Estimation of the Cost of Debt

3.3 There are a number of methodological choices which need to be made when deciding how to estimate the cost of debt.

3.4 The first issue relates to the credit rating which should be assumed for NERL. We note that NERL's rating has been recently upgraded to A2 by Moody's and A+ by S&P, from the previous A3/ A- split. Latest credit ratings agencies' reports (Moody's December 2008, S&P June 2009) have confirmed a rating of A+/A2 for NERL. In its report on NERL's cost of capital for CP3 (December 2008) NERA[31] concluded on an optimal capital structure of 60 per cent gearing, compatible with the target credit rating.

3.5 Our working assumption for estimation of the cost of debt is that, for non-securitised financing structures, NERL will be able to issue bonds with a rating of A or above.

3.6 At the highest level, there are two alternative ways in which an estimate of the cost of debt can be derived:

(a) The total cost of debt can be observed directly from market data on bond yields.

(b) The cost of debt can be built up by adding a debt premium (informed by market data on bond spreads) to the risk-free rate.

3.7 We have adopted the second of these two approaches on the grounds that it best ensures consistency between the way in which the cost of equity and the cost of debt are determined. In particular, the second approach means that in cases in which the chosen

[31] See NERA (2008) "NAT's Cost of Capital at CP3: Final Report".

risk-free rate is above market data on ILG yields (as discussed in section 2), the uplift will apply equally to both the cost of debt and the cost of equity.

3.8 We have based our judgement on evidence from bonds markets, NERL's primary source of debt (bonds constituted around 85 per cent of total debt at the end of March 2008). We have looked at both historical time series and current market evidence on the cost of debt, placing more weight on latest market figures to produce a forward looking figure, which could take into account the likely evolution of the financial turmoil.

Embedded debt

3.9 Regulators have sometimes made adjustments within their cost of debt estimates to take account of embedded debt. Different approaches can be adopted with regard to embedded debt:

(a) make full allowance on a company-by-company basis (if the regulator is setting price limits for multiple companies)

(b) make an allowance based on a industry average

(c) make no allowance

3.10 We adopt the third approach — making no allowance for embedded debt. The idea is that firms should have the opportunity to choose their debt portfolio efficiently (in particular, deciding upon the appropriate mix of maturities), and just as they are able to make gains over the price control period if they can work out how to finance their operations at below the determined WACC, so they bear the costs if their past financing decisions prove misguided.

3.11 A fairly obvious example to see why embedded debt adjustments are unattractive might be the following. Suppose that the WACC determined for a company in some past period had been based on a cost of debt of 5 per cent. Suppose that the price of short- to medium-term debt were indeed 5 per cent at the time the company needed to raise financing, but the yield curve on the date of sale were such that the company managed to securing debt finance for 4 per cent by locking itself in to a long-term arrangement (e.g. selling a twenty-year bond). So over that price control, the company made a profit out of its financing decision. But suppose that the cost of debt then fell, so that at the next price control the market rate for debt of the term used for the WACC determination were 3 per cent. If the price control were to say that because the company had embedded debt at 4 per cent, the cost of debt should therefore be above 3 per cent, that would mean that the company had been allowed to make a straight gain out of its decision to lock in its financing for the long-term but without bearing any of the consequences of so doing. This is clearly unattractive in terms of regulatory incentives.

3.12 The one curlicue that might arise here would be if the regulatory process had not, at the time the debt were taken out, allowed freedom of financing. Suppose, for example, that the company were required to hold a certain level of debt (or, near-equivalently, if it were subject to a gearing cap that was below the market level of gearing). Then it might be argued that the regulatory structure did not encourage financing efficiency and thence that the structure of finance reflected (to some extent) past regulatory requirement. Provided that freedom over the mix of maturities were maintained, we believe that the case for ignoring embedded debt adjustments would normally remain.

3.13 The other scenario in which one might wish to adjust for embedded debt would be if past determinations had included such an adjustment and there were a cycle in play — e.g. if the previous determination had an embedded debt adjustment and the consequence had been that prices were lower (because the embedded debt adjustment at that time had dragged down the cost of debt) and if there were an embedded debt adjustment on this occasion it would run in the opposite direction. Investors and consumers might reasonably expect parity of treatment over a cycle. We would still recommend ceasing to employ embedded debt adjustments, even in this case, but we accept that the opposite judgement might reasonably be reached.

3.14 We thus consider that our approach ensures the WACC gives appropriate investment incentives at the margin as well as providing the incentives to NATS to raise finance efficiently. Indeed from an incentive theory perspective it appears clear that the no-embedded-debt-allowance approach provides the strongest incentives, since companies bear the full costs of inefficient financing decisions.

3.15 We do not accept the argument that the adjustment is needed for financeability reasons. If the cost of debt (and the cost of capital) is correctly set the company is able to raise finance at that rate. In addition it is possible to employ financebility tests and adopt *ad hoc* financebility adjustments, which would represent a more coherent and direct solution.

3.16 An alternative used sometimes in regulatory contexts is to construct a notional debt portfolio to sit alongside the notional gearing. This is the approach the CC/CAA took in airports. The notional debt portfolio reflects a mixture of debt, taken out at different times, with different maturities. The cost of this debt is assumed to be the market rate at the time it was issued. The notional debt portfolio also would include debt that to be raised in future the forecast cost of which is likely to be based on current market rates. While it can be argued that using market data (relying on both historical and current rates) on NATS' traded bond is practically very similar to the portfolio approach it is important to stress that it is very different from a conceptual point of view. Our approach to cost of debt estimation is justified on a forward-looking basis. That is to say, the reason we place some weight on longer-term historic averages is to inform our forward-looking estimate of what the "post crisis" cost of debt may be once the credit crunch comes to an end.

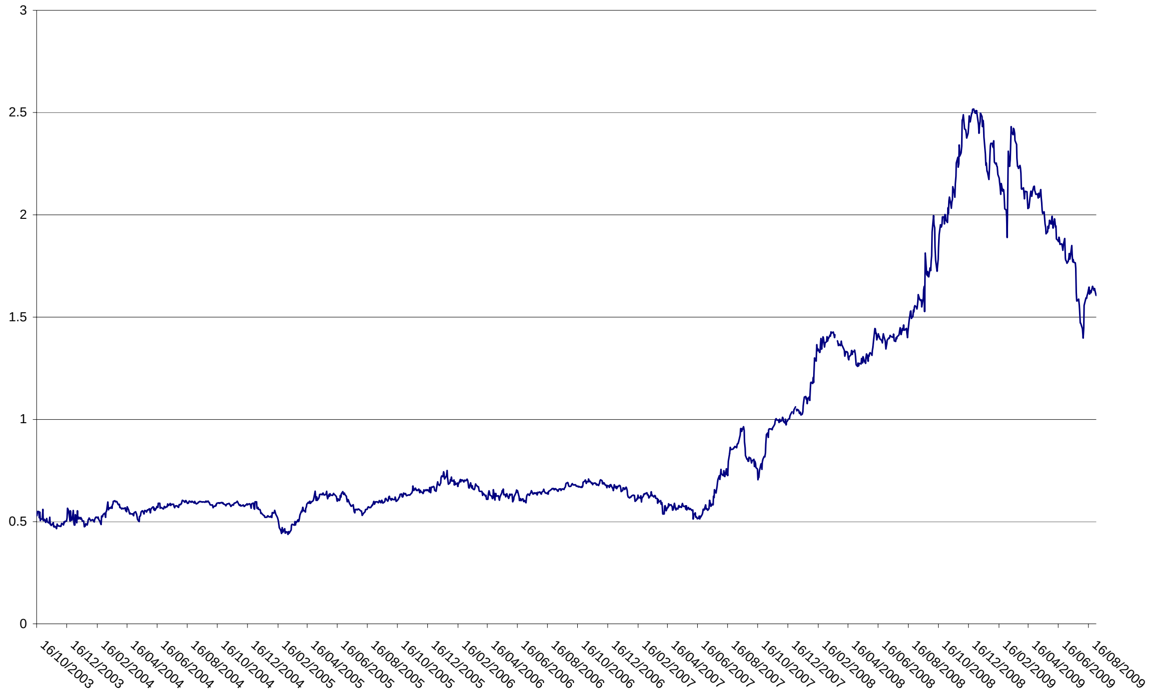
Evidence from Spreads on Bonds

Spreads on NATS' and airport operators comparable bonds

3.17 NATS has only one listed bond for which data are available from Bloomberg (maturity 2026). Spread data over a UK Government gilt of the same maturity from 2003 up to 31st

August 2009 are reported in Figure 3.1. The 2 year average spread (August 2007 – August 2009) has been 1.4 per cent, a level considerably higher than its pre-crisis values (from 2003 to 2007 the spread has almost always been between 0.5 and 0.4 per cent). As at 31st August 2009 the latest point figure is around 1.6 per cent.

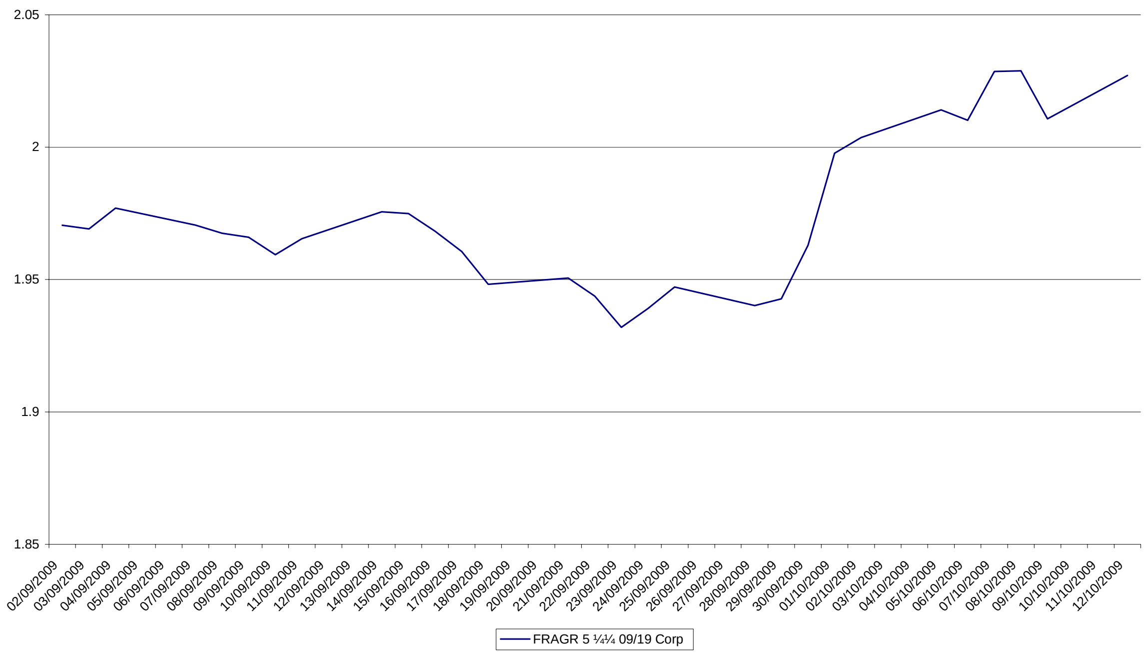
Figure 3.1: Spread on NATS corporate bond maturity 03/2026



Source: Bloomberg

3.18 Unfortunately the only airport (or air business operator) with a traded bond and target rating is Frankfurt Airport (A rated). We report available spread data for this company's bond in the next figure:

Figure 3.2: Frankfurt Airport spread[32]



Source: Bloomberg

3.19 The most recent point estimate is 2 per cent, but most of the time the spread has floated between 1.8 and 1.9 per cent (12 October 2009).

Recent new issues by comparable companies

3.20 In the absence of airport or air traffic business bonds we examine the bonds of comparator companies in other sectors. The crisis in financial markets has affected the availability of debt finance as well as its pricing, and there have been periods in which debt markets have been temporarily closed to new issuance. Nonetheless, there have been a number of bond issues by utility companies during 2008 and in the first six months of 2009.

3.21 Table 3.1 and Table 3.2 give a non-exhaustive list of the details of utility bond issues in sterling and euros respectively.

3.22 Of those bonds for which spread data are presented in these tables:

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32 Data for this bond are available only from September 2009 and are therefore given up until 12th October 2009. Other data used in the report is subject to a 31st August 2009 cut off point.

(a) The most recent issuance with an A+/A2 rating had a spread of 187 basis points (EDF on 21st May 2009, sterling issue);

(b) The most recent issuance with an A rating had a spread of 130 basis points (Verbund on 8th July 2009, euro issue);

(c) The most recent issuance with a rating of A- had a spread of 200 basis points (Yorkshire Water on 14th July 2009, sterling issue);

3.23 Recent issues data suggest that the spread between A+ and A rated bonds is less than 0.50 basis points.

Table 3.1: Utility bond issuances (sterling)

Issue Date	Issuer	Sector	Ratings	Size (GBPm)	Coupon	Tenor	Spread vs UKT	
2008								
18-Dec-08	United Utilities Water	Utility	A3/A-	250	6.125%	7y	295	
15-Dec-08	TMS Water Utilities Cayman Finance Ltd	Utility	A3/BBB+	50	3.853%	32y	Index Linked	
09-Dec-08	ENI	Utility	Aa2/AA-	150	6.125%	10y	250	
02-Dec-08	EDF	Utility	Aa1/AA-	400	6.625%	14y	295	
07-Nov-08	SSE	Utility	A2/A-	500	8.375%	20y	350	
28-Oct-08	EDP Finance	Utility	A2/A-	325	8.625%	16y	370	
22-Oct-08	GDF Suez	Utility	Aa3/A	500	7.000%	20y	220	
09-Sep-08	Centrica	Utility	A3/A	300	7.000%	25y	253	
10-Sep-08	Centrica	Utility	A3/A	450	7.000%	10y	250	
08-Aug-08	SSE	Utility	A2/A-	350	6.250%	30y	170	
12-Jun-08	SPI	Utility	A1/A-	250	7.125%	10y	195	
23-May-08	EDF	Utility	Aa1/AA-	500	6.250%	20y	127	
06-May-08	Nat Grid Gas	Utility	A3/A-	300	6.000%	30y	153	
01-May-08	SGN	Utility	Baa1/BBB	225	6.375%	32y	177	
27-Mar-08	Thames Water	Utility	A3/BBB+	400	7.241%	50y	260	
18-Feb-08	Nat Grid Gas	Utility	A3/A-	300	6.375%	12y	170	
2009								
06-Jan-09	National Grid	Utility	A3/A-	379	7.500%	22y	320	
13-Jan-09	Severn Trent Utilities Finance	Utility	A2/A	400	6.000%	9y	285	
13-Jan-09	E.ON Int Finance	Utility	A2/A/A+	700	6.750%	30y	280	Tranche 1
14-Jan-09	E.ON Int Finance	Utility	A2/A/A+	350	5.125%	5y	245	Tranche 2
20-Jan-09	Iberdrola	Utility	A3/A-	500	5.000%	15y	290	
23-Jan-09	SSE	Utility	A2/A	700	8.625%	5y	290	
28-Jan-09	National Grid Plc	Utility	Baa1/BBB+	400	6.125%	5y	335	
03-Feb-09	GDF Suez	Utility	Aa3/A	700	5.431%	12y	210	
23-Feb-09	Southern Water Services Finance	Utility	A3/A-	300	6.125%	10y	265	
27-Feb-09	Centrica	Utility	A3/A/A	250	5.125%	5y	260	Tranche 1
27-Feb-09	Centrica	Utility	A3/A/A	400	6.375%	13y	270	Tranche 2
25-Mar-09	United Utilities Water	Utility	A3/A-	200	5.750%	13y	240	
01-Apr-09	Vattenfall	Utility	A2/A-	350	6.125%	10y	295	Tranche 1
01-Apr-09	Vattenfall	Utility	A2/A-	1000	6.875%	30y	275	Tranche 2
23-Apr-09	E.On Intl	Utility	A2/A/A+	250	6.000%	10y	215	
21-May-09	EDF	Utility	Aa3/A+	1500	6.125%	25y	187.5	
21-May-09	BG Energy	Utility	A2/A/A+	500	5.125%	8yr	205	
28-May-09	Anglian Water	Utility	Baa3/BBB	100	6.750%	15yr	425	
24-Jun-09	Northern Gas Networks	Utility	Baa1/BBB+	200	5.875%	10	220	
25-Jun-09	RWE AG	Utility	A1/A	500	5.500%	13yr	185	Tranche 1
25-Jun-09	RWE AG	Utility	A1/A	1000	6.125%	30yr	165	Tranche 2
03-Jul-09	Wales & West Utilities	Utility	Baa1/NR	250	6.250%	12yr	245	
10-Jul-09	ENW	Utility	NR/BBB	300	6.750%	6yr	375	
10-Jul-09	ENW	Utility	NR/NR	200	6.125%	12yr	240	
14-Jul-09	Yorkshire Water	Utility	A-/A3	275	6.000%	10yr	230	Tranche 1
14-Jul-09	Yorkshire Water	Utility	A-/A3	200	6.375%	30yr	200	Tranche 2
14-Jul-09	Yorkshire Water	Utility	A-/A3	175	2.718%	30yr	ILG + 200	Tranche 3
21-Jul-09	United Utilities Water Plc	Utility	A-/A3	70	2.400%	30yr	Index Linked	
03-Sep-09	Wessex Water	Utility	BBB+/A3	50	2.186%	30yr	Index Linked	

Source: Reuters

Table 3.2: Utility bond issuances (euro)

Issue Date	Issuer	Sector	Ratings	Size (EURm)	Orderbook Size (EURm)	Tenor	Spread vs ms
2008							
03-Dec-08	REN	Utility	A3/A-	500	na	5y	325
01-Dec-08	Nat Grid Electricity	Utility	A3/A-	600	1,500	5y	330
27-Nov-08	Centrica	Utility	A3 / A	750	1,800	5y	380
25-Nov-08	Vattenfall	Utility	A2/A-	850/650	3,179 / 2,572	5y / 10y	230 / 280
18-Nov-08	EDF	Utility	Aa1/AA-	2000	5,500	4y	210
17-Nov-08	E.ON	Utility	A2/A	1000	NA	2y	150
13-Nov-08	EnBW	Utility	A2/A-	750/750	NA	5y / 10y	230 / 270
13-Nov-08	Iberdrola	Utility	A3/A-	1,000/600	NA	3y / 7y	290 / 365
12-Nov-08	RWE	Utility	A1/A	1,000/1,000	4,000/3,500	5y	215/255
23-Oct-08	Gasunie	Utility	Aa2/AA-	1,000	1,850	5y	195
17-Oct-08	GDF-Suez	Utility	Aa3/A+	1,000/900	1,600/1,700	5y / 10y	200/240
28-Aug-08	RTE	Utility	AA-	1,000	NA	10y	52
26-Aug-08	E.ON	Utility	A2 / A	750 / 1,000	3,500	3y / 7y	45 / 72
10-Jul-08	SSE	Utility	A2/A	600	1,250	5y	123
09-Jul-08	CEZ	Utility	A2/A-	600	1,250	6y	120
16-Jun-08	Anglian Water	Utility	A3/A-	500	1,000	8y	120
27-May-08	E.ON	Utility	A2/A	1000	2,500	6y	75
23-May-08	EDF	Utility	Aa1/AA-	600/ 1250	5,200	6,12y	47/ 67
07-May-08	National Grid Gas	Utility	A3/A-	750	3,200	5y	77
30-Apr-08	Iberdrola	Utility	A3/A-	1000/ 750	7,700	5/ 10y	83/ 110
23-Apr-08	E.ON	Utility	A2/A	1500/ 1000	11,000	5/ 12y	73/ 110
22-Apr-08	RTE	Utility	NR/AA-	1,250	2,100	7y	48
04-Mar-08	Severn Trent	Utility	A2/A	700	1,400	8y	115
18-Jan-08	EDF	Utility	Aa1/AA-	1,500	6,000	10y	70
2009							
13-Jan-09	National Grid Plc	Utility	Baa1/A-/BBB	500	2000	5y	365
16-Jan-09	EDF	Utility	Aa3	2000	7000	6y	205
	EDF	Utility	Aa3	2000	6000	12y	255
27-Jan-09	TMS Water Cayman Finance	Utility	A3/BBB+	500	1300	4y	330
03-Feb-09	RWE	Utility	A1/A	2000	9500	6y	190
	RWE	Utility	A1/A	1000	4300	12y	255
20-Mar-09	E.On	Utility	A2/A/A	750	3700	13y	155
15-Apr-09	Veolia Environnement	Utility	A3/BBB+	750		10y	330
	Veolia Environnement	Utility	A3/BBB+	1250		5y	250
06-May-09	Vattenfall	Utility	A2/A-	1350		5y	165
18-May-09	E.On	Utility	A2/A	750		2.5y	85
23-Jun-09	BEWAG	Utility	NR/NR	200		5yr	190
24-Jun-09	Gas Natural	Utility	Baa2/BBB+	2000	6000	5yr	235
24-Jun-09	Gas Natural	Utility	Baa2/BBB+	500	3000	10yr	275
01-Jul-09	ENBW	Utility	A2/A-	600	3400	30yr	215
01-Jul-09	ENBW	Utility	A2/A-	750	4500	6yr	105
07-Jul-09	EWE	Utility	A2/A-	500	5750	12yr	160
08-Jul-09	Verbund	Utility	A1/A	840	5750	10yr	130
16-Jul-09	Edison	Utility	Baa2//BBB+	700	7000	5yr	145

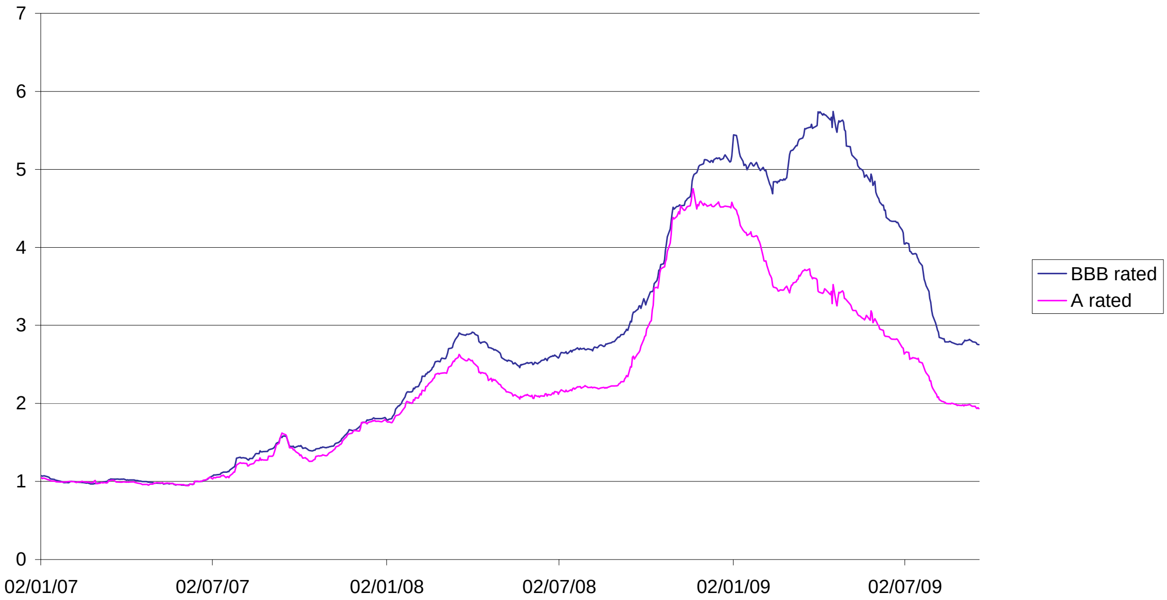
Source: Reuters

Evidence from Wider Market Indices

3.24 We have also examined yields on broader market bond indices.

3.25 Figure 3.3 shows spreads on A and BBB rated corporate bonds since January 2007. (Note that this data does not differentiate between ratings within each category, i.e. the A rated bonds will include bonds rated A+, A and A-.) Spreads were around 1 per cent prior to the onset of the financial crisis, but then rose substantially with spreads on BBB rated bonds peaking at 5.7 per cent in April 2009. Since then, spreads have fallen substantially with spreads on A rated bonds now being in the region of 2 per cent and spreads on BBB rated bonds being in the region of 2.8 per cent.

Figure 3.3: Spread data for A and BBB rated corporate bonds (non-financials) since January 2007

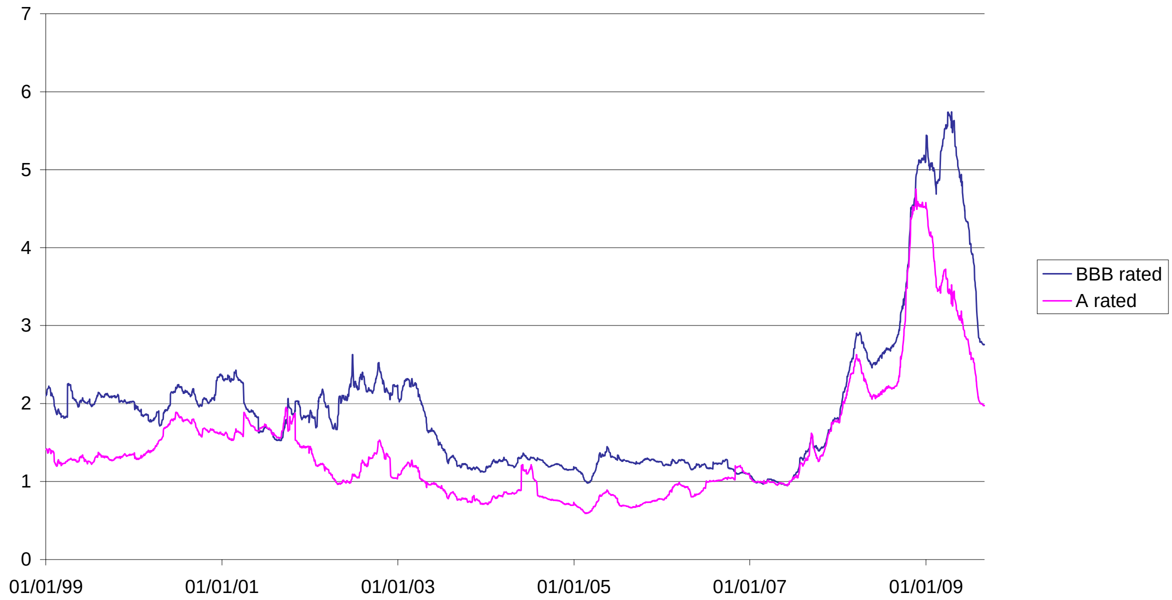


Note: data is for bonds with 7-10 year maturity issued by non-financials.

Source: Europe Economics calculations using data from iBoxx and Bloomberg

3.26 Figure 3.4 shows spread data for the same indices over a longer time period (from 1999 onwards). Broadly speaking, there appear to be three periods in the data. From 1999 to 2002, spreads on BBB rated bonds fluctuated around 2 per cent while spreads on A rated bonds averaged around 1.3 per cent. During 2003 bond spreads fell and remained at low levels from mid-2003 to mid-2007, averaging around 1.2 per cent for BBB rated bonds and 0.9 per cent for A rated bonds. However, as discussed above, from mid-2007 spreads have risen very substantially due to the financial crisis, before declining sharply in recent months.

Figure 3.4: Spread data for A and BBB rated corporate bonds since 1999

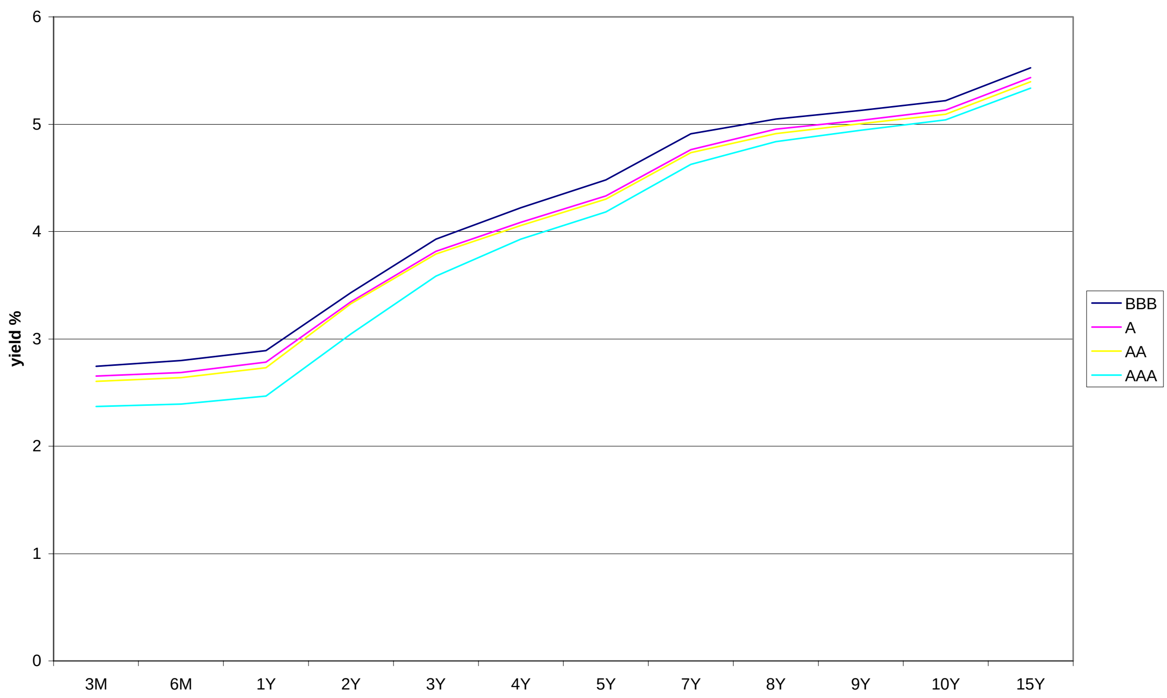


Note: data is for bonds with 7-10 year maturity issued by non-financials.

Source: Europe Economics calculations using data from iBoxx and Bloomberg

3.27 Figure 3.5 shows current differences in yield between bonds of different credit ratings. The indices comprise fixed-rate Euro-denominated debt of UK issuers. Note that the BBB index includes bonds with ratings of BBB, BBB- and BBB+ and the A index includes bonds with ratings of A, A- and A+ and similarly for the AA index.

Figure 3.5: Yield curve for EUR UK bond indices of different ratings on 31st August 2009



Source: Bloomberg

Conclusions on the Cost of Debt

3.28 We have reviewed a range of market data on the bond spreads, including data on nominal and real comparator companies' bonds and data relating to broader market bond indices.

3.29 Based on this evidence, our recommended cost of debt is set out below in Table 3.3. The real cost of debt is calculated by adding our debt premium assumption to our recommended risk-free rate of 1.75 (see section 2).

Table 3.3: Recommended cost of debt

	Risk-free rate	Debt premium	Real cost of debt
working point estimate	1.75	1.85	3.6

Source: Europe Economics elaborations

3.30 The debt premium figure is based on the evidence presented. In particular:

(a) The spread on NATS' sole listed (nominal) bond has been on average 1.4 per cent over the past 2 years, with a most recent point figure of 1.5 per cent. The only (A rated) comparator bond shows a spread of 2 per cent as of August 2009.

(b) Evidence from wider market indices shows that the spread on A rated bonds is now in the region of 2 per cent. This is after a step decline from the sharp increase that characterized the financial crisis.

(c) Evidence from new issues suggest a spread of 187 basis points on A+/A2 rated bonds, confirming the similarity between A and A+ spread data.

3.31 We did not include in our calculation pre-funding costs, as we think that they should be included in the financial modelling within the price review rather than in the cost of capital calculation, or transaction costs, which, as NERA's analysis confirmed[33], would be very small.

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33 See NERA (2008) "NATS' Cost of Capital at CP3: Final Report".

4 EQUITY BETA

Introduction

4.1 This section discusses the estimation of the "beta" parameter, which measures a company's exposure to non-diversifiable risk. It is structured as follows:

(a) Methodological issues

(b) A review of First Economics' work on estimating NATS' asset beta

(c) Updated market evidence on NATS' asset beta from comparator companies

(d) Conclusions

Methodological Issues

4.2 The equity beta measures the covariance between the company return over the safe rate with the market return over the safe rate.[34] The equation to be estimated is usually:

$$R_{it} = \alpha + \beta R_{mt} + e_{it}$$

where R_{it} is the log excess return on asset *i* at day *t* (log return net of the logarithmic safe rate), R_{mt} is the log excess return on the market, α is a constant and β is the equity beta. e_{it} is the random noise error term in estimation — the non-systematic component of the return to the asset. The hypothesis in estimation is that α is zero and β is one (for the average stock).

4.3 The excess return is constructed as a data manipulation prior to estimation, defined more exactly as:

$$R_{it} = \ln\left(\frac{P_t + D_t}{P_{t-1}}\right) - \ln\left(1 + R_{ft}\right)$$

where P_t is the price today, D_t is dividend per share that becomes known today, P_{t-1} is the price yesterday, and R_{ft} is the safe rate available today.

[34] Note that the weaker is this correlation, the greater the contribution that the stock could make to an investor wishing to reduce her exposure to systematic risk, and therefore the lower the expected return required.

Estimation period

4.4 Equity betas vary over time. This might be because of changes in gearing or changes in the underlying correlations between company and aggregate returns (i.e. asset betas). It is sensible, therefore, to choose an estimation window that is as recent as possible, because today's observation is the forward looking estimate, while still giving reasonably accurate estimates.

4.5 Smithers & Co (2003) investigate the matter, noting that gains in estimation accuracy become less as more observations are added. For example, going from one year to two years of daily data (i.e. 250 observations to 500 observations) will reduce the standard error by 40 per cent, but going from three to four years only reduces the error by 15 per cent.

4.6 It is possible to use an explicit time-series estimation technique to account for the time variation. However, these techniques, as noted by Smithers & Co (2003), are susceptible to over-fitting and can find apparent time variation where none exists. The techniques are also non-linear and not widely used for regulatory purposes.

Adjustments to estimated betas

4.7 Two main adjustments, the so-called Bayesian and Blume adjustments have been used in some past estimations of beta, with the effect of bringing the estimated betas closer to one.

4.8 The argument for Bayesian adjustment is that the estimation of beta ignores the fact that the beta of an average company is by definition equal to one.[35] The Bayesian adjustment takes account of measurement uncertainty (as estimated explicitly in the calculation of the raw beta) by employing a weighted average between the beta estimate for the company and a constructed average beta for the market as a whole that would be equal to one. The weights are based on the relative uncertainty in measurement — the higher the uncertainty in the company beta estimates relative to the variance of all betas in the market, the less weight is placed on the company beta:

$$\beta_{adj} = \beta_{OLS} \times \frac{Var(\beta_{pop})}{Var(\beta_{pop}) + Var(\beta_{est})} + 1 \times \frac{Var(\beta_{est})}{Var(\beta_{pop}) + SE^2(\beta_{est})}$$

4.9 The Blume adjustment is based on an empirical observation (made in 1971) that betas tended to move towards one over (long) time. Mean reversion is sometimes offered as an explanation for this observed movement. In later investigations, however, Blume found that the reasons for the movement in the betas had to be explained by some real

35 Note that this concerns the *average* company. It is straightforward to test whether the estimated beta of an individual stock or portfolio is statistically significantly different from one.

changes in the perceived risks of the companies — the tendency for companies to evolve could mean that companies of extreme risk (high or low) tend to have less extreme risks over time.[36]

4.10 Our view is that the use of the Blume adjustment is arbitrary and inappropriate. While a Bayesian adjustment has a stronger theoretical rationale, Smithers & Co (2003) found that in practice it may not make much difference if daily data are used in the estimation.

Use of comparators

4.11 While betas for listed companies are usually straightforward to calculate, the fact that NATS does not have any listed equity means that it is not possible to estimate an equity beta for it directly from stock price data.

4.12 In this context, a natural approach is to use beta estimates for a set of comparators – ideally listed companies carrying out comparable activities and subject to similar price regulation. A comparator approach depends crucially on the selection of sectors and companies which are likely to have a similar risk exposure to NATS. In addition, it is important to take account of any differences in equity betas which may be due to differences in levels of gearing.

4.13 Beta estimates for comparators can either be taken direct from existing sources (e.g. Bloomberg or the London Business School (LBS) Risk Management Service), or they can be estimated from data on company and stock market returns. The advantage of the former is that it is less resource-intensive, whereas the advantage of the latter is that it gives greater control over how the estimation is carried out.

Approach at previous review

4.14 The CAA's approach in the 2006-2010 price review was to:

(a) Identify sectors that have a similar risk profile to NATS

(b) Identify particular companies with a similar risk profile to NATS

(c) Perform historical analysis to avoid placing undue weight on single point estimates

4.15 The chosen comparators were a large group of companies primarily involved in the utilities, airport and airline sectors, across Western Europe. The CAA took as wide an approach to this exercise as possible on the grounds that estimating betas based on a single company observation can be unreliable given the statistical error associated with beta measurement.

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36 Blume, M.E: "Betas and their regression tendencies" Journal of Finance, 1975 and "Betas and their regression tendencies: further evidence", Journal of Finance, 1979

4.16 Adjustments were made to take into account NATS En Route plc (NERL)'s different exposure to risks, such as demand risk, opex/capex risk and political and business risks.

4.17 PwC's analysis suggested that an appropriate asset beta for NERL would be between 0.5 and 0.6. The CAA believed that it would be prudent to use a figure towards the upper end of this range, partially because empirical estimates of asset betas had tended to be unusually low in the recent past. Further, it stated that NERL's relatively high gearing and relatively low regulated asset base (RAB) to turnover ratio made its profits potentially volatile for a regulated company.

4.18 The CAA decided against incorporating a small company risk premium into the CP2 cost of capital. Reasons for this included that NERL is a monopoly provider of UK air navigation services, is significantly larger (in terms of regulatory capital value) than UK regulated companies to which the small company risk premium has been applied and holds equity from large corporate entities.

First Economics work on estimating NATS' asset beta

4.19 Our work builds on the work originally undertaken by First Economics in December 2008.[37] First Economics work is summarised below.[38]

4.20 First Economics' approach involved using two types of comparator data:

(a) calculated betas for comparator firms with a stock market listing; and

(b) the beta estimates that regulators have made in recent periodic reviews.

4.21 The asset beta data collected by First Economics is shown in the following two tables:

37 First Economics: A preliminary estimate of NERL's asset beta, prepared for the CAA, March 2009.

38 Note this is only a summary. For a fuller account one should refer to First Economics' paper.

Table 4.1: Calculated asset betas

	2-year asset beta
Copenhagen airport	0.17
Frankfurt airport	0.46
Florence airport	0.16
Macquarie airports	0.55
Vienna airport	0.63
Zurich airport	1.00
BA	0.74
easyjet	0.92
Ryanair	0.81
National Grid	0.35
Northumbrian Water	0.36
Pennon Group	0.37
Severn Trent	0.41
United Utilities	0.44

Source: First Economics, Thomson Datastream and First Economics' calculations.

Table 4.2: Beta estimates used in recent periodic reviews

	Regulator's estimate of asset beta
Electricity DNOs	0.48
Network Rail	0.46
BT (regulated businesses)	0.56
Gatwick	0.52
Heathrow	0.47
Stansted	0.61

References: First Economics, originally from ORR (2008), Periodic Review 2008: draft determinations; Ofcom (2008), A new pricing framework for Openreach – second consultation; CC (2007), BAA Ltd: a report on the economic regulation of the London airport companies (Heathrow Airport Ltd and Gatwick Airport Ltd); CC (2008), Stansted Airport Ltd: Q5 price control review.

4.22 When calculating the asset betas, First Economics used a debt beta of 0.1, as requested by the CAA.

4.23 First Economics carried out analysis to decide where NERL fitted within the range. They considered four main determinants of the (systematic) risk that NATS' shareholders bear after buying an equity stake in NATS' business.

(a) The fortunes of the UK aviation market

(b) Cost drivers

(c) Regulation – the role that regulation plays in determining the way in which changes in volumes or costs translate into changes in profit.

(d) NATS' cost structure – a final consideration is the sensitivity of profit to out-/underperformance against the CAA's price control assumptions.

4.24 Based on this analysis First Economics filtered out two of the comparator types:

(a) international airports – on the grounds that they operate in markets with different maturity and different demand risk from that of the UK; buy from different labour markets; and are not exposed to the UK system of regulation.

(b) airlines – on the grounds that although UK airlines are better comparators in that they are exposed to similar demand and (wage) cost risk, unlike NERL airlines are not subject to regulation.

4.25 First Economics concluded that they should focus their attention on the following comparators

(a) the betas for other regulated companies – i.e. natural monopolies subject to permanent regulation and five-year price caps;

(b) the betas for BAA and its regulated airports (or strictly speaking, the CC estimates of these betas from the recent airport price control reviews).

4.26 First Economics compared NERL to the regulated utilities, considering the following factors: volume risk; the extent price control arrangements exposed or shielded companies from that volume risk; and the sensitivity of out-turn profits to shocks.

4.27 First Economics decided that: on elasticities alone, NERL is more risky than Heathrow but less risky than Stansted; NATS' price cap design shields it from some of the revenue risk that the airports are exposed to; and NATS' relatively small RAB will magnify the effect that any given reduction in revenues has on shareholders' return on equity.

4.28 Finally First Economics decided to use Gatwick as a comparator. They recommended to the CAA that it should use a range of 0.5 to 0.6 as its starting point for the calculation of NATS' beta.

4.29 They justified their choice with three reasons:

(a) NERL is a more risky business than the regulated utilities by virtue of its exposure to sizeable volume risk and its higher operational gearing. All other things being equal, this means that NATS' beta is likely to exhibit a premium to the betas of regulated utilities, which average around 0.4;

(b) Having seen considerable effort go into the estimation of the betas for Heathrow, Gatwick and Stansted during the last two years, it makes sense that the CAA should try to position NATS' beta logically in relation to the results of this analysis. First Economics claimed to have shown that NATS' risk profile sits somewhere close to that of Gatwick and Stansted, pointing to an asset beta of around 0.5 to 0.6; and

(c) NATS' operational gearing has fallen during the course of CP2, making returns less sensitive to out-/under performance and reducing shareholders' exposure to risk. There is also evidence from BAA's share price prior to its acquisition that investors were becoming more comfortable with the riskiness of regulated UK aviation businesses. If NERL were a listed company, one might expect to see this stability translate into a less volatile share price and a lower asset beta than the 0.6 used in the CP2 review.

Comments on First Economics' approach

4.30 We reviewed the work undertaken by First Economics. Repeating the risk analysis carried out by First Economics was outside the scope of our work. However, we had some comments on their approach, in particular:

4.31 We had doubts about First Economics' approach of excluding data after September 2008. Times of considerable movement in the market as a whole provide important information about relative riskiness.

4.32 We disagreed with First Economics' contention that airlines are more risky than NATS' on the grounds that they are not subject to regulation, as regulation is intended to mimic the competitive market, rather than provide "regulatory protection"

4.33 We had reservations about the use of Gatwick airport as a comparator. We consider that a potentially relevant alternative comparator might be a weighted combination of a (low cost) airline and an airport, on the grounds that both are likely to face similar volume risk factors (although admittedly due to the design of the price cap NATS is not exposed to the full extent of volume risks that airlines and airports are exposed to) and that a low cost airline is likely to face lower volume risk as passengers do not have the option of trading down. In our conclusions on the equity beta we consider the implications of such a weighting.

Our approach

4.34 First Economics used data up to 12th September 2008 stating that they were excluding data from a period in which stock markets around the world were in an unprecedented state of crisis. We update this work using data up to 31st August 2009 for the UK comparators. We think that taking into account the most recent market data is of the greatest importance. We do not however, update the non-UK comparator airlines on the grounds that their risk factors are sufficiently different that they are unlikely to be as useful as comparators as UK airports.

Data and estimation

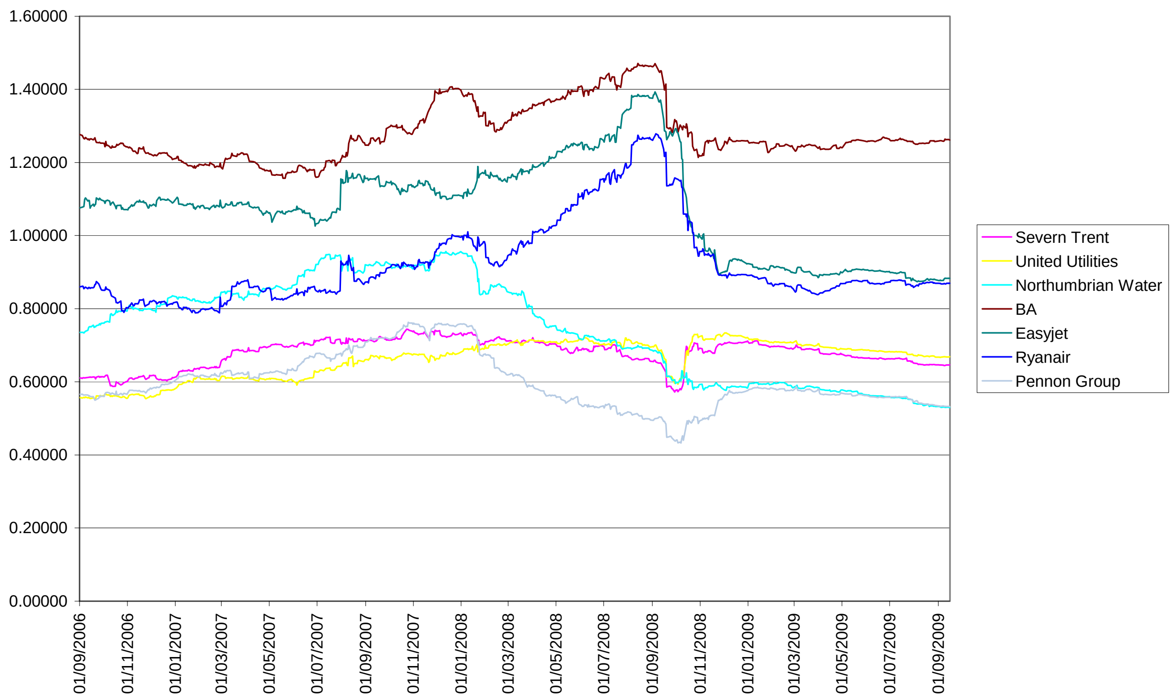
4.35 We used un-levered equity betas and gearing data from Bloomberg to calculate the asset betas of comparator companies. We did not apply any adjustment to raw figures. Our figures were based on two years of daily data.

4.36 In order to decide on the range and point estimate for the suggested asset beta we examined changes to asset betas over time.

Equity betas of UK utilities and airlines 2006-09

4.37 Figure 4.1 shows the equity betas for the UK comparator utilities and airlines over the 3 year period September 2006 – September 2009.

Figure 4.1: Equity betas of UK utilities and airlines



Source: Bloomberg

4.38 Over most of the period, the airlines have tended to have much higher equity betas than the utilities. (The exception to this is Pennon Group which up until late 2007 had a similar equity beta to Ryanair).

4.39 We report de-leveraged equity betas with gearing figures[39] sourced from Bloomberg in Table 4.3.

[39] Total debt/ Total assets

Table 4.3: Asset betas as of 28th August 2009

	Raw beta	Gearing	Asset beta with debt beta=0	Asset beta with debt beta=0.1
Severn Trent	0.65	58.83	0.27	0.32
United Utilities	0.67	58.27	0.28	0.34
Northumbrian Water	0.53	64.81	0.19	0.25
National Grid	0.69	60.25	0.27	0.33
BA	1.26	35.88	0.81	0.84
easyjet	0.88	20.25	0.70	0.72
Ryanair	0.87	40.72	0.52	0.56
Pennon Group	0.53	56.47	0.23	0.29

Source: Europe Economics calculation using Bloomberg data

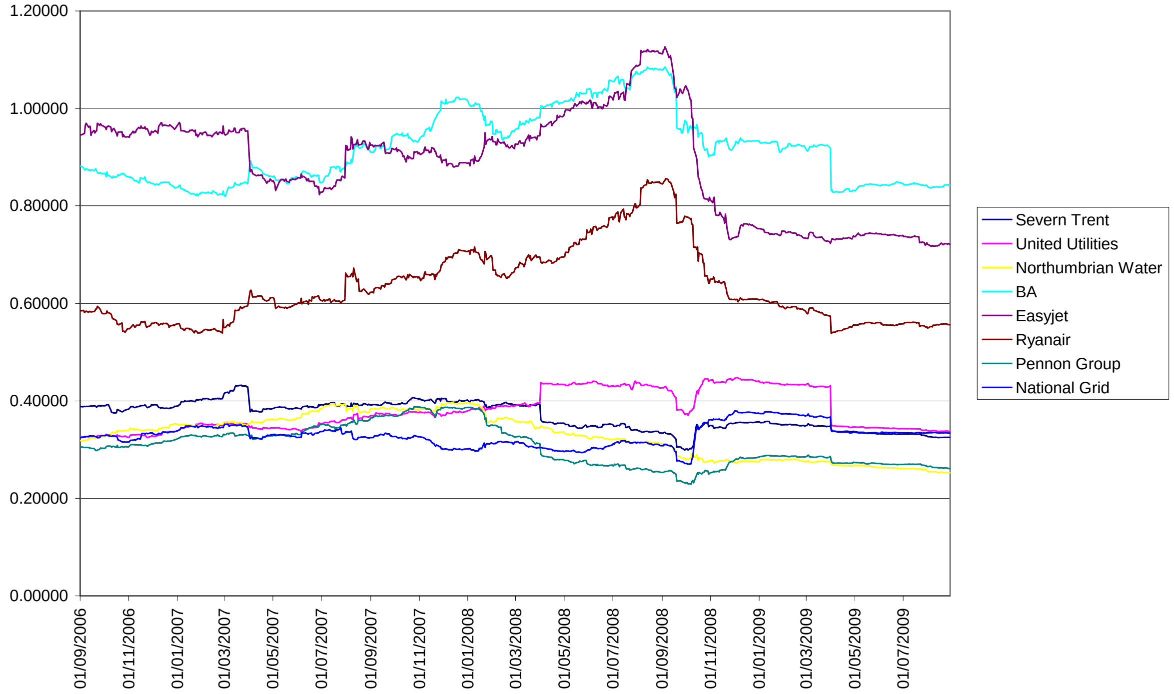
4.40 Figure 4.2 shows the asset betas for the UK comparator utilities and airlines over the period September 2006 to September 2009. The asset betas in Figure 4.2 have been calculated using Bloomberg data on companies' gearing, and assume a debt beta of 0.1. The following observations can be made:

(a) The airlines have consistently higher asset betas than those of the utilities.

(b) Asset betas for each company have been relatively stable (within around 10bps) apart from a period of high instability from mid 2008 to early 2009.

4.41 All the latest point estimates are in the range 0.25 to 0.84. As with the raw equity betas, the asset betas of the airlines are substantially higher than those for the utilities.

Figure 4.2: Asset betas of UK utilities and airlines



Source: EE calculations using Bloomberg data

Asset beta estimates used in recent regulatory reviews

4.42 Table 4.4 below shows asset betas used in recent regulatory reviews.[40]

Table 4.4: Asset beta estimates used in recent periodic reviews

	Regulator's estimate of asset beta
Electricity DNOs	0.48
Network Rail	0.46
BT (regulated businesses)	0.56
Gatwick	0.52
Heathrow	0.47
Stansted	0.61

References: First Economics, originally from ORR (2008), Periodic Review 2008: draft determinations; Ofcom (2008), A new pricing framework for Openreach – second consultation; CC (2007), BAA Ltd: a report on the economic regulation of the London airport companies (Heathrow Airport Ltd and Gatwick Airport Ltd); CC (2008), Stansted Airport Ltd: Q5 price control review.

[40] As there have been no more recent determinations, these are the same as reported in the First Economics paper.

4.43 These asset beta estimates are in the range 0.46 to 0.61. The asset betas used for the London airports are all quite similar, in the range 0.47 to 0.61.

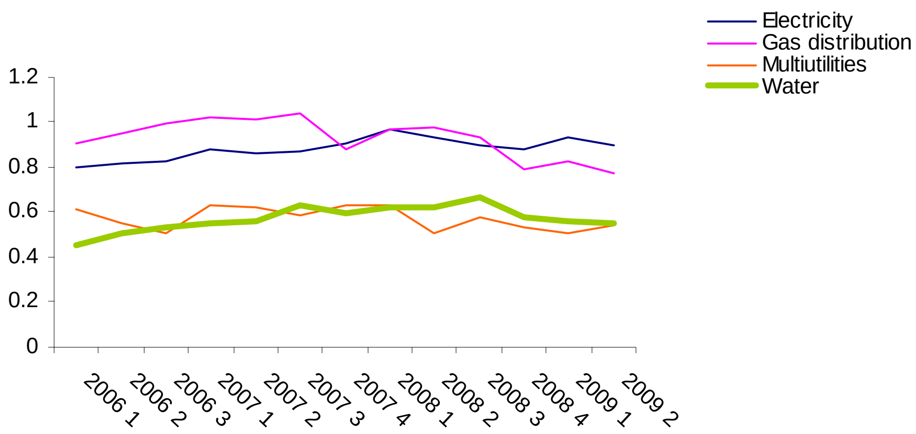
Comparator asset betas

4.44 As a cross-check, we report in Figure 4.3 and Figure 4.4 below the equity and asset betas of comparator sectors such as UK energy networks and utilities[41] together with the estimate for the water sector. These comparator betas have been sourced directly from London Business School (LBS), and hence would need to be interpreted with caution due to differences in the methodology used to estimate them. LBS betas are based on monthly data and are adjusted for thin trading and corrected through the Vasicek methodology.

4.45 The most recent equity beta estimates are in the range 0.50 to 0.90 for all the relevant comparators.

4.46 Looking at the asset betas we note that comparator sectors' asset beta are in the range 0.2 to 0.45.

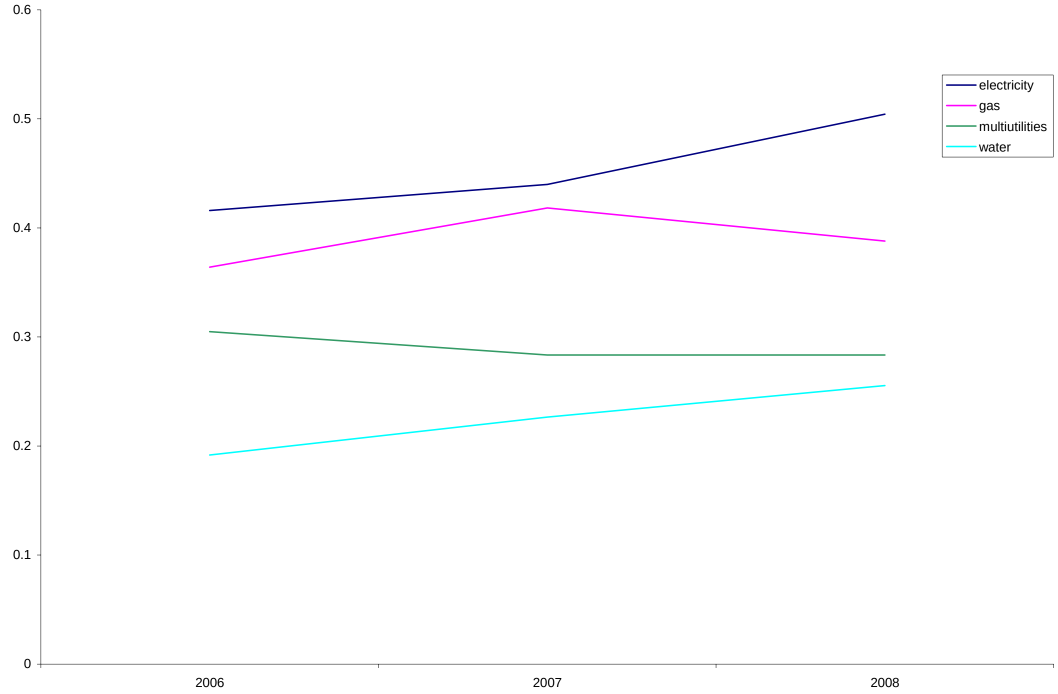
Figure 4.3: Comparator equity betas



Source: LBS

41 The portfolios are weighted by the market capitalization of the different companies in the sector.

Figure 4.4: Comparator asset betas



Source: EE calculations using LBS and Bloomberg data

Conclusion on Equity Beta

4.47 We reviewed the work carried out by First Economics. We updated the work previously carried out by First Economics to obtain the latest calculations of the asset beta for the UK comparators. We analyzed the asset betas of comparable sectors and the main regulatory precedents.

4.48 Our analysis found that asset betas range from 0.56 to 0.84 for airlines[42], 0.47 to 0.61 for UK airports[43], and 0.29 to 0.48 for utilities[44].

4.49 The asset betas for airlines and airports are shown in the following table:

42 Range based on EE calculations, debt beta of 0.1 assumed.
43 Range based on recent regulatory precedents, debt beta of 0.1 assumed.
44 Range based on EE calculations and recent regulatory precedents, debt beta of 0.1 assumed for EE calculations.

Table 4.5: Airlines and Airports Asset Betas

	Asset beta
BA	0.84[45]
Easyjet	0.72[46]
Ryanair	0.56[47]
Gatwick	0.52[48]
Heathrow	0.47[49]
Stansted	0.61[50]

Source: EE calculations using Bloomberg data; BAA Ltd: a report on the economic regulation of the London airport companies (Heathrow Airport Ltd and Gatwick Airport Ltd); CC (2008), Stansted Airport Ltd: Q5 price control review.

4.50 We have shown in our analysis that asset betas tend to be relatively stable throughout time. This suggests that without any significant changes to its cost structure or regulation the asset beta of NATS is unlikely to have changed significantly since the last review.

4.51 At CP2 the CAA set NATS' asset beta equal to 0.6, which sat at the top of the 0.5 to 0.6 range identified by the CAA's advisors PwC.

4.52 First Economics suggested that Gatwick should be used as a comparator with a range of 0.5 to 0.6 as a starting point for the calculation of NATS' asset beta.

4.53 We consider that a weighted combination of Gatwick and a low cost airline (Ryanair or easyjet) could also be considered as a comparator. It is unclear what the correct weighting for this would be. Taking the average of easyjet and Ryanair's asset betas as the upper limit, this would lead to a range of 0.52 to 0.64, with a central estimate of 0.58.

4.54 We note that without an underlying equity beta to appeal to and thus using comparators the intrinsic uncertainty in this type of beta estimation is quite high. We therefore consider the degree of appropriate aiming up to be a little higher in these circumstances than if we had equity betas to appeal to.[51]

4.55 We therefore consider that 0.5 to 0.64 is likely to be the most appropriate range for CAA to consider for NATS' asset beta, with a suggested point estimate of 0.6. The corresponding re-leveraged equity beta range at 60 per cent level of gearing with debt beta of 0.1 is 1.10 to 1.45, with a suggested point estimate of 1.35.

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45 Debt beta of 0.1 assumed
46 Debt beta of 0.1 assumed
47 Debt beta of 0.1 assumed
48 From regulatory determination, debt beta of 0.1 assumed
49 From regulatory determination, debt beta of 0.1 assumed
50 From regulatory determination, debt beta of 0.1 assumed
51 We note, for example, that we have previously disputed the CC's contention that it is appropriate to aim up by two standard deviations, preferring the position that one standard deviation is adequate because the appropriate ambition is not to eliminate all statistically significant risk that the cost of capital determination is too low (which would be the implication of the CC's approach).

4.56 As stated above, this estimate assumes a non-zero debt beta of 0.1. If a zero debt beta had been assumed the suggested range would have been 0.46[52] to 0.61[53]. The corresponding re-leveraged equity beta range at 60 per cent level of gearing with debt beta of 0 would be 1.15 to 1.53.

4.57 This estimation involves an element of aiming up to take into account the uncertainty inherent in this type of comparator analysis. This aiming up is also intended to reflect the uncertainty in the estimation of the RFR and cost of debt, we therefore do not aim up when estimating those parameters, beyond the extent to which our broader methodology has done so automatically — e.g. our risk-free rate estimate aims up on the data, favouring 1.75 over what we contend is the natural data-only conclusion of 1.5; and our estimate of 5 to 6 for the ERP which (as we shall now see) aims up on what we consider to be the correct conclusion of the data alone, at 5.

52 This is Gatwick's asset beta when debt beta=0 is assumed.
53 This is the average of the easyjet and Ryanair asset betas when debt beta=0 is assumed.

5 EQUITY RISK PREMIUM

The Equity Risk Premium

5.1 The CAPM equation[54] states that the expected return on a capital asset is equal to the return required on a risk-free asset plus a degree of non-diversifiable risk that is inherent to the market. The right hand side of the CAPM equation therefore includes a term defined as the Market Risk Premium (MRP) ($E(R_m)$-R_f). Strictly speaking, a fully diversified portfolio might include assets such as land or gold, and no usable all-assets index exists. The normal proxy employed is the Equity Risk Premium (ERP) — the implicit assumption being that stock markets are, by themselves, sufficiently diverse to span all risks and allow of perfect diversification with a stocks-only portfolio. The ERP is the difference in the rate of return expected by shareholders for holding risky equities rather than risk-free securities.

5.2 We note that it is sometimes asserted that stock markets do not have this property and that therefore the CAPM is not strictly correct. This does not follow — CAPM requires only that a fully diversified portfolio could, in principle, be constructed from all available assets (not merely shares). But it might follow that the ERP is an imperfect proxy, so that measured estimates of the CAPM did not perfectly capture the cost of capital. Specifically, it would mean that the risk on a maximally-diversified pure equity portfolio included risk that was specific to equities but could, in principle, be offset (diversified) in a wider asset portfolio. Hence the ERP would be greater than the MRP. Thus, the risk that stock markets do not permit full diversification is the risk that using the ERP results in an over-estimation of the cost of capital. Similarly, if periods of high stock market volatility are also periods in which stock markets temporarily lose function with the consequence that they lose some of their ability perfectly to diversify, a consequence will be that ERP estimates for those periods will over-estimate MRPs.

5.3 Standard practice of most financial economists estimating ERP is to measure the historical equity premium over fairly long periods and make extrapolations based on this about the expected ERP. Prior to the end of the technology bubble (2000), the most widely cited US source was Ibbotson Associates' figures, whose equity premium history starts in 1926. Before research by Dimson, Marsh and Staunton (2002) raised the bar for both data and methods used to estimate the ERP, the most widely cited sources for the UK were the studies published by Barclays Capital and CSFB, with both of their equity histories starting in 1919.[55]

5.4 An often cited survey conducted by Welch in 1998 of the opinions of 226 financial economists who were asked to forecast the thirty-year arithmetic mean equity risk

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54 CAPM states that $E(R_i) = R_f + \beta_i(E(R_m) - R_f)$.

55 Dimson, Elroy, Marsh, Paul and Staunton, Mike (2002) "Global evidence on the equity risk premium" London: London Business School.

premium, showed that a large number of correspondents were calibrating their forecasts relative to the longest-run historical benchmark available from Ibbotson, and then altering the historical number downward based on subjective factors.

5.5 To find the expected future risk premium, extrapolation from the past is not sufficient; consideration has to be given to the question whether the future is likely to reveal a difference in the market preferences or institutional factors that have determined the historic risk premia. There are particular problems if extrapolation is based on a short time period.

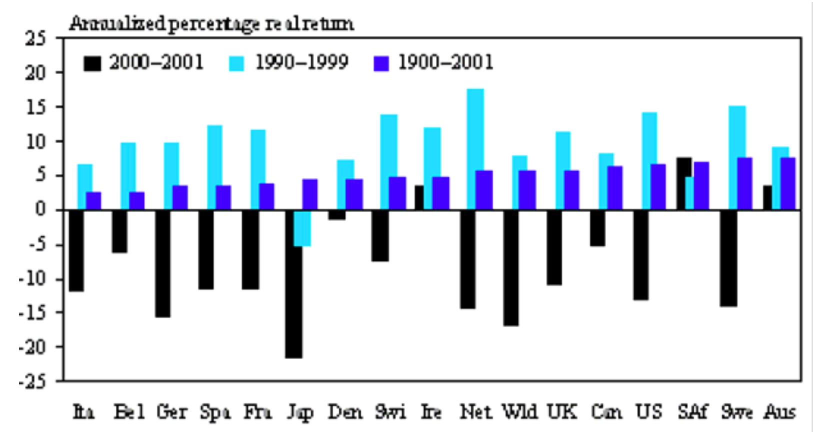
Methodological Issues

Limitations of Estimates of the Risk Premium based on short time periods

5.6 Short term time frames clearly do not provide a solid basis for generalising about future returns — stock markets are far too volatile on a year to year basis for good predictions to be made. A common choice of timeframe has been ten years, but even looking over a decade will not produce robust results since it is not long enough to cancel out "good and bad luck" (or negative risk premia and excess risk premia). The high corporate growth rates during the late 1990s and the subsequent 'burst' of the technology bubble, is an example of extremes which cannot be relied upon for future predictions. For such reasons, Dimson et al. argue that judgements should be informed by the full extent of financial history.

5.7 Using achieved risk premia to forecast required risk premia depends on having a long enough period. Even with 102 years of data, market fluctuations have ome impact. In addition, the underlying MRP could vary over time (e.g. as tastes for risk evolve). It is moreover important to take into account the fact that stock market outcomes are influenced by many factors. For example, non-repeatable events (such as the removal of trade barriers) would feasibly mean projected premia should differ from past premia. The figure below shows how the difference in time frame used can impact the estimated returns, and therefore the ERP.

Figure 5.1: Short-term and Long-term Real Returns on Equities from Around the World



Note: the country names listed in abbreviated form along the horizontal axis are (from left to right) Italy, Belgium, Germany, Spain, France, Japan, Denmark, Switzerland, Ireland, the Netherlands, the world (weighted average of the sixteen individual countries), the United Kingdom, Canada, the United States, South Africa, Sweden and Australia.

Source: Dimson, Marsh and Staunton, 2001

5.8 This problem can be illustrated by comparing the first and second halves of the twentieth century. Several factors may have contributed to the large risk premia achieved during the second half of the twentieth century. These include:

(a) Unprecedented growth in productivity and efficiency and great technological change have led the market outcome to exceed investor expectations. (But higher growth in corporate cash flows then became known to the market and presumably built into higher stock prices.)

(b) Stock prices rose relative to dividends because of a fall in the required rate of return due to diminished business and investment risk. Factors reducing business risk included increased international trade flows and the end of the Cold War. Investment risk may also have diminished through diversification.

(c) Transaction and monitoring costs fell materially over the century.

5.9 A major shortcoming of the Ibbotson Associates, Barclays Capital and CSFB reported premia is the historical success of the US equity market and survivorship bias, alongside bias in the index construction due to narrow coverage.[56,57] Dimson et al. point out that even when indices are constructed to account for survivor bias within countries, the very fact that certain markets did not survive through the very long run (a century) means that

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56 Survivorship bias refers to the tendency for markets (and therefore estimates of returns) to include equity from only companies that have been successful but not account for those which have folded, thereby overestimating returns. Dimson et al point out that even when indices are constructed to account for survivor bias within countries, the very fact that certain markets did not survive through the very long run (a century) means that certain countries had to be omitted such as Poland, Russia and China. These markets are likely to have had smaller ERPs than those in the sample.

certain countries had to be omitted such as Poland, Russia and China. These markets would have been likely to have had smaller measured ERPs than those in the sample.

Arithmetic or Geometric Mean?

5.10 Discussions of the ERP explore the implications of using the arithmetic or the geometric mean of historical equity premia.[58] There are reasons for using each. In theory, the arithmetic mean treats each estimate as independent of the others (consequently it is considered to be "forward looking"), and therefore corresponds to the "true" expectation. The geometric mean necessarily tracks past estimates, and will therefore always be smaller than the arithmetic mean in the presence of market volatility. Its stickiness renders it a superior indicator of the magnitude of past returns.[59]

5.11 The two means are linked by volatility when returns are distributed along a lognormal distribution, which is commonly assumed in long term equity markets.[60] Lognormality can often characterise observed returns which exhibit a skewed distribution, allowing returns to be unbounded above zero, but to not drop below -100 per cent (i.e. the distribution is one-tailed).

5.12 The relationship between the arithmetic and geometric mean is perhaps more easily understood through a mathematical explanation, proof and example. Jensen's inequality implies that, under lognormal distribution, the arithmetic average risk premium is approximately equal to the geometric average risk premium plus half the variance.[61] To be clear, if (in the impossible scenario that) there were no volatility in annual returns, the arithmetic mean risk premium would equal the geometric mean one. While the difference between (arithmetic) mean log returns and the geometric mean is typically very small, this relationship gives rise to the counter-intuitive result that an asset may have negative geometric mean returns but positive arithmetic mean returns (i.e. if an investor loses money over a long period of time).

5.13 Formally, the arithmetic mean log return may be expressed as a linear approximation as

$$E(r_{jt}) + \frac{\sigma^2(r_{jt})}{2},$$

where

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57 Dimson, Elroy, Marsh, Paul and Staunton, Mike (2002) "Global evidence on the equity risk premium" London: London Business School.

58 What is conventionally referred to as the "geometric mean" is technically the compound average return — or the geometric average of 1 + R_{jt}, minus one.

59 Abrams, Dr. Jay (1996) "Arithmetic vs. geometric means: empirical evidence and theoretical issues." www.abramsvaluation.com/pdf/Arith_geom.pdf.

60 Wright, Stephen, Mason, Robert, and Miles, David (2003) "A study into certain aspects of the cost of capital for regulated utilities in the UK" London: Smithers & Co Ltd.

61 Gregory, Alan (2007) "How low is the UK equity risk premium?" XFi Centre for Finance and Investment paper number 07/09, University of Exeter.

– $E(r_{jt})$, the expected log return on some financial asset — directly related to the expected mean value;[62] and

– $\sigma^2(r_{jt})$ is the variance (volatility) of the returns.

5.14 Wright et al show that the above expression is closely related to the geometric mean return, whose linear approximation is $E(r_{jt})$, or the log arithmetic mean return minus its variance. The geometric mean return, $G(R_{jt})$, can be expressed as:

$$1 + G(R_{jt}) = \exp(E(r_{jt})) .$$

5.15 To a linear approximation,

$$G(R_{jt}) \approx \log(1 + G(R_{jt})) = E(r_{jt}) .$$

5.16 As an example, Dimson, Marsh and Staunton (2001) suppose that a general estimate for the standard deviation[63] of equity market log returns (over a 102 year period) is 0.2. Let us assume that the true distribution of returns is normal. Then the difference between the arithmetic and geometric mean is approximately $(0.2)^2/2=0.02$. A two percentage point difference between the two mean returns is non-trivial. Moreover, as volatility increases, the difference grows more rapidly; for volatility levels of 0.3, the gap becomes 4.5 per cent.

Now let us assume that the true distribution of returns is lognormal: if $E(r)=0.04$, the geometric mean return is $\exp(0.04)-1$, or 4.08 per cent — a very small difference.

5.17 Experts that assume lognormality of returns (Campbell, Dimson et al) opt for using geometric means for part or the entirety of calculating the expected premium. Others such as Fama and French believe that the arithmetic mean is stable and should therefore be used because changes in returns are serially uncorrelated. A sound approach may be found in the report written by Wright et al for Smithers & Co (2003):[64]

> Given the absence of a clear consensus on the best way to model the underlying properties of returns, the only clear-cut recommendation must be to deal consistently with the difference between the two averaging methods, to be precise in noting which estimate is being used in any context, and to be aware of the potentially significant differences between the two.

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62 The relationship between the arithmetic mean and log arithmetic mean is: $E(R_{jt}) \approx \log(1 + E(R_{jt})) = E(r_{jt}) + \frac{\sigma^2(r_{jt})}{2}$.

63 Standard deviation is the square root of the variance ($\sigma = (\sigma^2)^{1/2}$).

64 p. 27: Wright, Stephen, Mason, Robert, and Miles, David (2003) "A study into certain aspects of the cost of capital for regulated utilities in the UK" London: Smithers & Co Ltd.

Historical Estimates

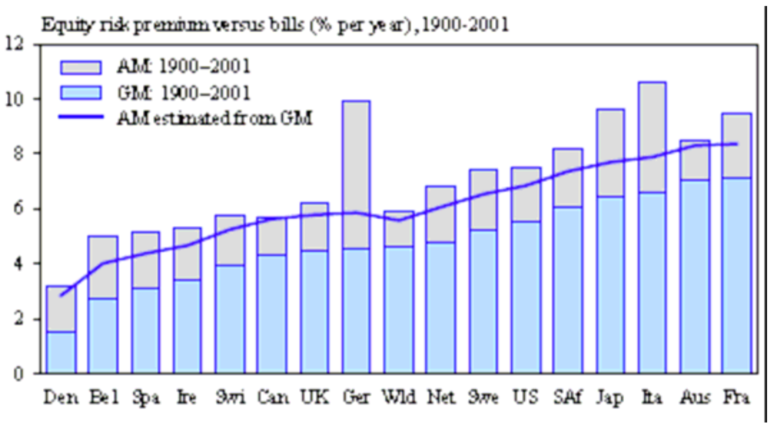
Dimson, Marsh and Staunton

5.18 Dimson et al. (2002) created a database of long-run international returns comprising annual returns for sixteen countries from 1900-2001. This overcomes some problems in the previous indices (specifically, concerns about biases), through extending the time frame back to 1900, when returns were lower (partly due to events in the lead up to, and including, WWI), and by including premia from countries other than the US (from their data, in fact, the premia for two-thirds of other countries in this sample were lower than for the US).

5.19 Before the pivotal Dimson et al. dataset was developed long-run studies took US or UK premia. The twentieth century was a period of remarkable growth in the US and UK economies, which probably exceeded the expectations held by investors in the early twentieth century.

5.20 To extrapolate the prospective risk premium from historic ones, Dimson et al. deduct the impact of the growth in cash flows and the gain from falls in the required risk premium. This means that this estimate is lower than the raw historical risk premium, and the estimates given by finance academics in surveys. To reconcile the difference between arithmetic and geometric means, the authors replace the historical difference between the two with a difference based on contemporary risk estimates.[65] The following figure illustrates the effect of this method, which the authors describe in their 2001 estimation.

Figure 5.2: Arithmetic Mean Equity Risk Premia Relative to Bills (1900-2001)



Source: Dimson, Marsh and Staunton, 2001

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65 Dimson et al assume a single volatility level for all sixteen national markets used (for simplicity) of 16 per cent, and for the world I ndex of 14 per cent.

5.21 Their prospective arithmetic risk premia for the US was 5.3 per cent, for the UK 3.6 per cent and for the world index is 3.9 per cent. They also argue, given the increasingly international nature of capital markets, it may be more appropriate to take a global rather than a country by country approach to determine the prospective equity risk premium. This is also a consequence of between-country differences being attributable to individual country shocks that are not likely to repeat themselves. Dimson et al suggest, that due to the inherent difficulty of using historical data to predict future premia, that it may be better to use a "normal" equity premium most of the time, and to deviate from this when there are compelling economic reasons to suppose expected premia are unusually high or low.

Smithers & Co

5.22 In the seminal 2003 "Smithers Report", Wright et al derive a (global) geometric ERP of 3 per cent and an arithmetic ERP of 4-5 per cent. In the context of cost of capital estimation, the authors argue the importance of starting with average cost of equity returns and working backwards (i.e. subtracting the safe rate), due to greater historic uncertainty levels over the ERP than over costs of equity.

5.23 Wright et al claim that the safe rate is hard to explain, and appears to be unstable in the data. To some degree this is a consequence of the many problems of assuming a constant riskless rate when estimating the ERP over long time spans. Siegel (1998) showed that in the period between 1830-1998, while thirty-year stock returns appear to move within a relatively narrow range, those returns for bonds and bills were much less stable. This concern may be exacerbated by the so-called "risk-free rate puzzle", which is unable to reconcile historically low average risk-free rates with consumer preferences modelled to prefer consumption today over consumption tomorrow.

Other estimates

5.24 Alan Gregory (University of Exeter) argued in 2007 that previous estimates of the UK arithmetic risk premium exhibit an upward bias, resulting from three components: [66]

(a) It is inconsistent to use two differing proxies for risk free assets for the two right hand side components of the CAPM equation, which is what has been done conventionally (the historical and the current risk free rates).[67]

(b) A further disparity between the risk free rates arises because *ex post* realised returns are not completely insulated from inflation risk.

[66] Gregory, Alan (2007) "How low is the UK equity risk premium?" XFi Centre for Finance and Investment paper number 07/09, University of Exeter.

[67] This point is also emphasised in the Smithers Report.

(c) In the context of a state of "excess volatility" in the market, when adjusting from geometric to arithmetic averages of historical ERP in order to estimate future ones, the arithmetic premium estimates are likely to be over-estimates.

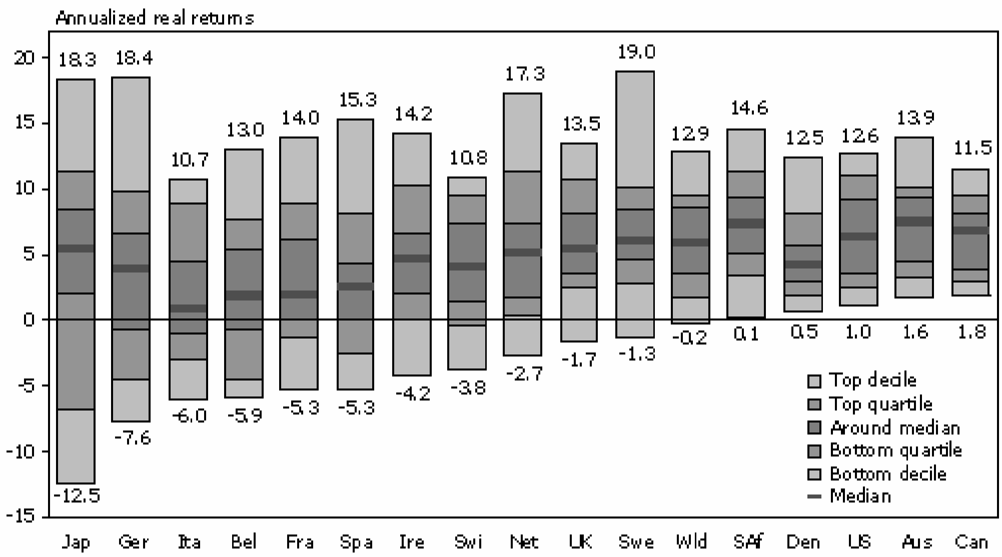
5.25 As such the author re-estimates the ERP and concludes that the arithmetic premium ranges between 2 and 4.3 per cent, and the geometric equivalent ranges between 1.5 and 3.3 per cent.

5.26 Other recent estimates include a range of 2.5-6.5 per cent from Schaefer (2007) and 4-6 per cent from Myers (2008).

Extrapolation of Future ERP from Historical Estimates

5.27 Dimson et al (2003) exposed what they believed at the time to be the predominant trend of "irrational optimism" of investors regarding the expected performance of world stock markets. According to the authors rewards were being overestimated and risk underestimated. Granted, based on historical experience in the US markets, forecasts were pointing to favourable years to come. However, during the 20th Century the US stock market had both higher real returns and lower volatility (as discussed above in paragraph 5.8) than many other countries which should not be overlooked, especially in an increasingly global financial system: looking at long run (20 year) return horizons, just two markets outperformed the US between 1900 and 2002 (see figure below). Thus when historic returns were calculated based on world markets, the ERP became much lower than had been previously estimated. The authors concluded that a plausible, forward-looking ERP for the world's major markets would be **3 per cent**.

Figure 5.3: Percentiles of the Distribution of 20 Year Returns (1900-2002)

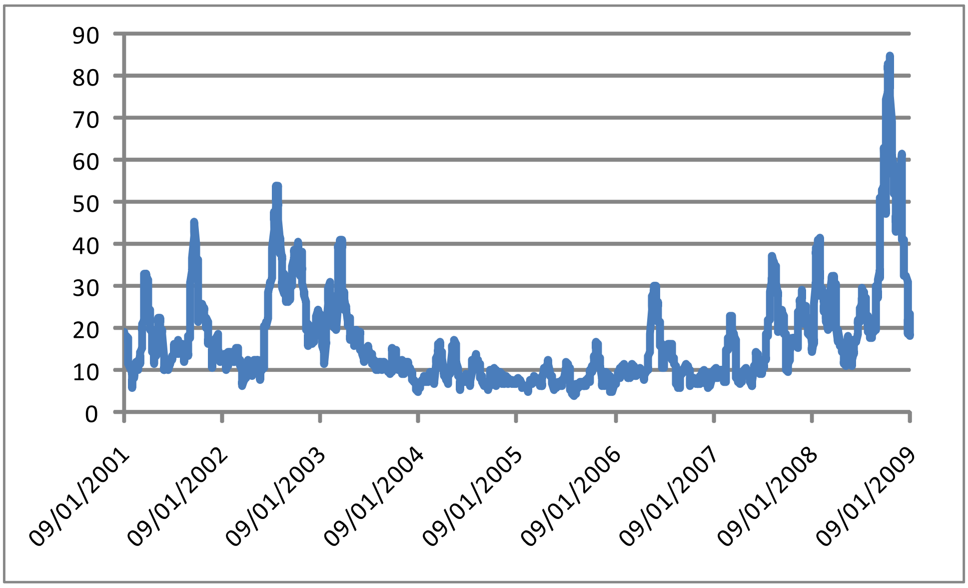


Source: Dimson, Marsh and Staunton, 2003.

5.28 Dimson et al expect riskiness of markets to continue, not just in terms of business risk, but also in counterparts of the 20th Century World Wars and Cold War: wars on terror, drugs, or climate change. The current financial crisis may potentially involve, *inter alia*, some change to the forward-looking ERP. However, the effects of this would not appear in the measured data for many years. In the short term, as volatility in markets is high we should expect to see increases in the ERP as measured over the short period. But, as discussed above, this might well be a poor indicator of the true risk premium on equities over a longer timescale. However, in 2007 Dimson et al revised their estimate back up to a geometric world average of 4.1 per cent and arithmetic average of 5.2 per cent, and UK values of 4.2 and 5.4, respectively.

5.29 Figure 5.4 below gives an idea of the recent volatility experienced by equity markets.

Figure 5.4: FTSE All Share Historic Volatility



Source: Bloomberg, 2009

5.30 The following table displays Dimson, Marsh and Staunton's 2007 ERP estimates and volatility levels for a number of countries.

Table 5.1: DMS 2007 ERP estimates and volatility levels

	Arithmetic mean	Geometric mean	Standard error
Belgium	4.6	2.8	1.9
France	6.2	4.0	2.2
Germany	8.5	5.5	2.7
Ireland	5.4	3.9	1.8
Italy	7.8	4.5	2.9
Netherlands	6.1	4.0	2.1
Spain	4.6	2.6	2.0
USA	6.6	4.6	1.9
UK	**5.4**	**4.2**	**1.6**
World	**5.2**	**4.1**	**1.4**

Source: Dimson, Marsh and Staunton, 2007

Regulatory Precedents

5.31 Table 5.2 presents some recent regulatory ERP estimations.

Table 5.2: Regulatory Precedents of ERP Estimates

Regulator	Year	Sector/company	ERP
Ofwat	2004	Water (WaSCs and WoCs)	higher end of 3.5% - 5.0%
Ofgem	2004	Electricity DNOs	higher end of 2.5% - 4.5%
Ofcom	2005	BT	4.0% - 5.0%
Smithers & Co for Ofgem	2006	Four electricity and gas licensees	higher end of 2.5% - 4.5%
Ofgem	2007	GDNs	2.5% - 4.5%
Competition Commission	2007	Heathrow and Gatwick (BAA)	2.5% - 4.5%
Civil Aviation Authority	2008	Heathrow and Gatwick (BAA)	4.5%
CEPA for Office of Rail Regulation	2008	Network Rail	3% - 5% but may be as high as 7%

Sources: Regulator respective reports

Limitation of the Historical Approach

5.32 The use of the DMS methodology, which we still consider to be the most robust approach to use to infer the ERP, presents some problems in the current financial and economic context, in which consistent variations in risk premia are likely to be observed.

5.33 For example evidence reported in De Paoli and Zabczyk (2009) suggests that the size of this risk premium depends on whether the economy is in a period of stagnation or prosperity. In particular, investors seem to require higher premia during economic slowdowns than during booms. This empirical regularity has been termed “premium counter-cyclicality”.[68]

Variation in the ERP in Periods of Recession

5.34 Extensive empirical evidence supports the view that risk premia tend to be higher in recession and stagnation periods.[69] Cochrane and Piazzesi (2005) argue that the ERP increases by almost 20 per cent in periods of crisis, coming back to its previous “normal level” three years after the end of the recession, on average.

Europe Economics ERP Choice

5.35 Drawing particularly on the DMS 2007 estimates of the UK ERP (between 4.2 and 5.4 per cent) and on recent regulatory precedent (above), Europe Economics’ view is that the appropriate ERP for a non-crisis period would be 5.0. We believe that the DMS range of 4.2 to 5.4 is the appropriate range from which plausible regulatory judgements might be formed.

5.36 Cochrane and Piazzesi (2009) and other authoritative literature argue that in periods of crisis ERPs increase by 20 per cent, that implies that the ERP might be 6 at present.[70] We note the implication of the earlier discussion that if the financial crisis impairs financial market function, and implication might be that ERPs overstate MRPs, and thus we regard this 20 per cent markup as conservative. We thus consider that the range for ERP increase in crisis is 0 to 20 per cent.

5.37 Hence bearing in mind the uncertainties associated with recent financial market events, and the arguments about the counter-cyclicality of the ERP we would recommend an ERP range of 5 to 6 per cent in the current crisis and 5 per cent after the end of the turmoil. Our current working point estimate is 5.2 per cent.

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68 See B. De Paoli and P. Zabczyk (2009) “Why do risk premia vary over time? A theoretical investigation under habit formation. Harvey (1989) showed that US equity risk premia are higher at business cycle troughs than they are at peaks. Subsequent results of Bekaert and Harvey (1995), He, Kan, Ng and Zhang (1996) and Li (2001) con_rmed these _ndings. Cochrane and Piazessi (2005) finnd that the term premium is countercyclical in the United States while Lustig and Verdelhan (2007) document strong countercyclicality in the exchange rate risk premium. The two most popular asset pricing models attribute this variation either to countercyclical changes in risk aversion (Campbell and Cochrane (1999)) or to changes in the volatility of the consumption process (Bansal and Yaron (2004))

69 See footnote to paragraph 5.33.

70 5 x 1.2 = 6

6 CAPITAL STRUCTURE

6.1 In calculating a WACC estimate, it is necessary to make an assumption about the gearing level of the company so as to know the weight which should be placed respectively on the cost of equity and the cost of debt. However, as discussed below, the choice of gearing does not necessarily affect the vanilla WACC since both the cost of equity and the cost of debt change with gearing. The choice of gearing does, however, affect the tax liabilities which NERL has to allow for within price limits.

6.2 The notional level of gearing on which the WACC calculation is based is not intended to represent second-guessing of companies' decisions about their optimal financing structure or to provide any guidance on the gearing level that firms should adopt.

6.3 However, the CAA is currently considering options in respect of alternative approaches to regulating finance, in particular the potential for introducing mechanisms to prevent/discourage NERL from over-gearing in order to exploit market perceptions that special financial support might be offered if the company became distressed.[71]

6.4 So as not to prejudge the outcome of this work on regulating finance, this paper is based on existing assumptions concerning a notional gearing structure for NATS, as used at CP2 and described in the CAA February 2009 policy update.[72]

Capital Structure and CAPM: MM Proposition I

6.5 The starting point in thinking about the effect of gearing is the Modigliani-Miller insight (MMI) that the riskiness of a company depends on the riskiness of its real cash-flows — volatility in the costs and in the demand for its products. The implication is that where there are no taxes, incentive or information problems, the way a project or firm is financed does not affect its value or its cost of capital — the market value of any firm is independent of its capital structure. This is because the overall risk on the company's asset base), the asset beta, does not change with the capital structure of the firm (i.e. the chosen combination of equity and debt).

6.6 This section first explains the MMI more fully, and then investigates situations where the proposition may not apply.

Understanding MMI

6.7 A company can be thought of as a bundle of investment projects (installation of different physical assets, different marketing schemes, etc). MMI is easiest to explain in terms of raising finance to undertake a project. A project can be represented by a stream of uncertain, future cash flows or (net) revenues. Each set of future revenue is equivalent to

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71 See: Report for the CAA by Europe Economics, Regulating Finance for NATS CP3, January 2010

72 CAA policy update: NATS (En Route) plc price control review for Control Period 3 2011-2015, February 2009

some amount of cash today; the exact amount is obtained by discounting by the cost of capital. Adding all the cash equivalents together gives the total value of the project, V, say.

6.8 Suppose the project costs an initial amount *C*. Then the project is worth undertaking if and only if $V > C$, that is, if and only if it contributes positive net value. This brings us back to MM proposition I, as follows. The financiers of the project — who put up the *C* — have to get their *C* back. They can get it back in a variety of ways: they could be given a share *s* of future revenues, where $sV = C$, or they could get some debt (risk-less or risky) that has a present value equal to *C*. Regardless of the method, they must get *C*, and simple arithmetic tells us that the entrepreneur that sets up the project will get the remainder $V - C$. That is, from the entrepreneur's point of view (and from the financiers') the method of financing doesn't matter. (It does not matter how the C is sliced up.[73])

6.9 Since the riskiness of the asset is determined by its real features, not its method of financing, causality runs from the asset cost of capital to the costs of debt and equity, via the capital structure, rather than the other way around. Many people, first encountering corporate finance, have a thought along the following lines — if the cost of equity is 11 per cent, the cost of debt is 1 per cent, and the gearing level is 50 per cent, then the cost of capital will be 6 per cent (0.5 x 11 + 0.5 x 1). But (they think) if gearing rises to 75 per cent, then the cost of capital must fall to something like 3.5 percent (0.25 x 11 + 0.75 x 1). If that were so then causality would run from the costs of debt and equity to the overall asset cost of capital, via the capital structure (the cost of capital would depend on the costs of debt and equity and the gearing). The Modigliani-Miller theorem reverses this, saying that the asset cost of capital is fixed by the real nature of the asset, so, in fact, it is the costs of debt and equity that depend on the level of gearing, not the asset cost of capital.

6.10 The proposition is illustrated in Figure 6.1 below. At zero level of gearing the weighted average cost of capital is equal to the cost of equity. As gearing increases, the weight on the (lower) cost of debt increases. However, cost of equity and debt both adjust such that the combined WACC remains unaltered, until at 100 per cent gearing WACC simply equals the cost of debt.

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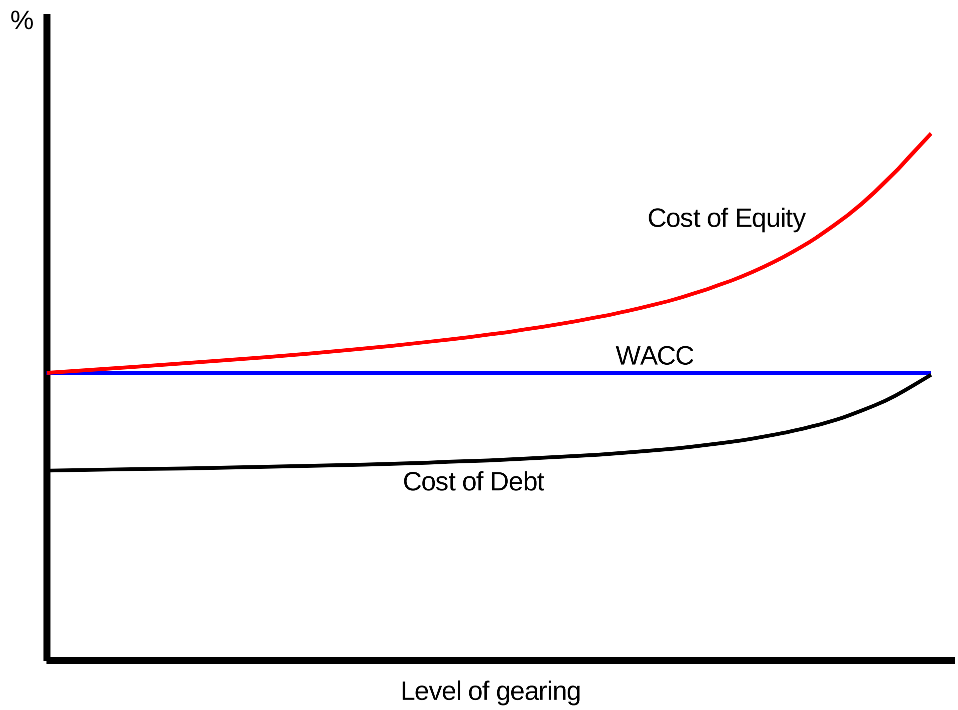
[73] Miller used to illustrate MM proposition I with one of baseball legend Yogi Berra's famous (mis-)sayings: "You better cut the pizza in four pieces because I'm not hungry enough to eat six."

Figure 6.1: Modigliani-Miller proposition I



6.11 Since capital structure is irrelevant according to MMI, if that were all there were to it, we might expect to see completely random capital structures of companies. But we do not. MMI then points us to the reasons why capital structures might matter for a company, particularly through noting for us the matters from which MMI abstracts.[74] These are the things the proposition abstracts from: [75]

(a) Taxes — differential tax treatment of equity and debt finance may imply that increasing gearing will save tax and in this way increase company value;

(b) Costs of financial distress — in the absence of other distortions, the expected costs of financial distress will rise with the level of gearing, at least partially offsetting the potential benefit from tax effects;

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[74] Note that it is sometimes naively asserted that the MMI result "does not hold" — i.e. that it is not true that the cost of capital is invariant to the level of gearing — if the assumptions the MMI theorem's proof requires do not hold. That is fallacious. For example, if we take as an assumption given, that my sister is currently in my house, it follows that my house has not fallen down (there is a quasi-logical proof). But just because my sister is not, in fact, currently in my house (just because our assumption does not hold) it does not follow that my house has, in fact, fallen down. Likewise, we are not entitled to assume, upon observing a world of information asymmetry or costs of bankruptcy, that *therefore* the cost of capital will vary with the capital structure. That remains to be proven one way or another. Many claims concerning conditions that, if they held, the MMI result would not hold, have turned out upon subsequent analysis not to be convincing. The MMI result, once one understands the intuition, is amongst the most compelling, elegant, and universal in all corporate finance theory, and has been recognised as such ever since its publication.

[75] MM proposition I also assumes efficient well functioning capital markets, but that is an assumption we will keep throughout this paper.

(c) Incentive problems — financial structure may affect incentives that for example the managers have to maximise the net present value of the company;

(d) Information problems — the information that different market participants have access to at different times might vary; and

(e) Transaction costs — for example in changing the level of gearing.

6.12 The figure below illustrates possible effects these factors might have on the market value of the company. The horizontal line represents the situation under the MMI – the level of gearing has no effect on company value. Once we move to a situation with taxes, however, gearing may have an effect due to the tax advantage of interest payments, as illustrated by the rising straight line. Considering only the effects of taxation would imply that the best possible capital structure involved holding no equity.[76] However, as gearing rises, so do the risks and expected costs of financial distress. Therefore there is some optimal level of gearing as illustrated by the higher of the curved lines in Figure 6.2. If in addition there are some incentive problems associated with high levels of gearing, the optimal level of gearing might be lower still, as represented by the lower of the curved lines in Figure 6.2.[77]

6.13 The same can be shown with the rate of return on the vertical axis rather than the market value of the company. Figure 6.2 shows the effects of the value of the tax shield in pre- and post-tax WACC settings. A pre-tax approach allows the company to earn a return out of which to settle tax expenses. In a post-tax approach on the other hand, taxes are modelled separately from the return (WACC) as a cost item. Therefore as gearing increases, pre-tax WACC falls due to the value of the tax shield, until the expected costs of financial distress begin outweighing the benefit from the tax shield.

6.14 In a post-tax setting the WACC allows only for returns to investors, after taxes have been paid. Therefore only the costs of financial distress show on the WACC diagram (we are here ignoring the other possible distortions), and it would seem there is no obvious optimal level of gearing. This is, however, more apparent than real — taxes have merely been moved out of this equation. Their effect, including the tax shield value that varies with the level of gearing, still exists in the separate modelling, and the company will take their value into account when selecting its financial structure.

6.15 We will turn to the effects outside of MMI after considering the basic proposition in the CAPM framework in slightly more detail.

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76 Taxation however introduces a distortion, such that the value in a world with taxation will never actually reach the value of the company in a world without any taxation, as in the MMI. Hence the MMI line lies above the "world with distortions" lines.

77 The drawing of the "incentive problem line" in Figure 6.2 is not intended to imply that incentive problems arise before significant effects on cost of financial distress. This does not have to be the case, and the titling of the curved lines could as easily be reversed.

Figure 6.2: Illustration gearing and market value of company

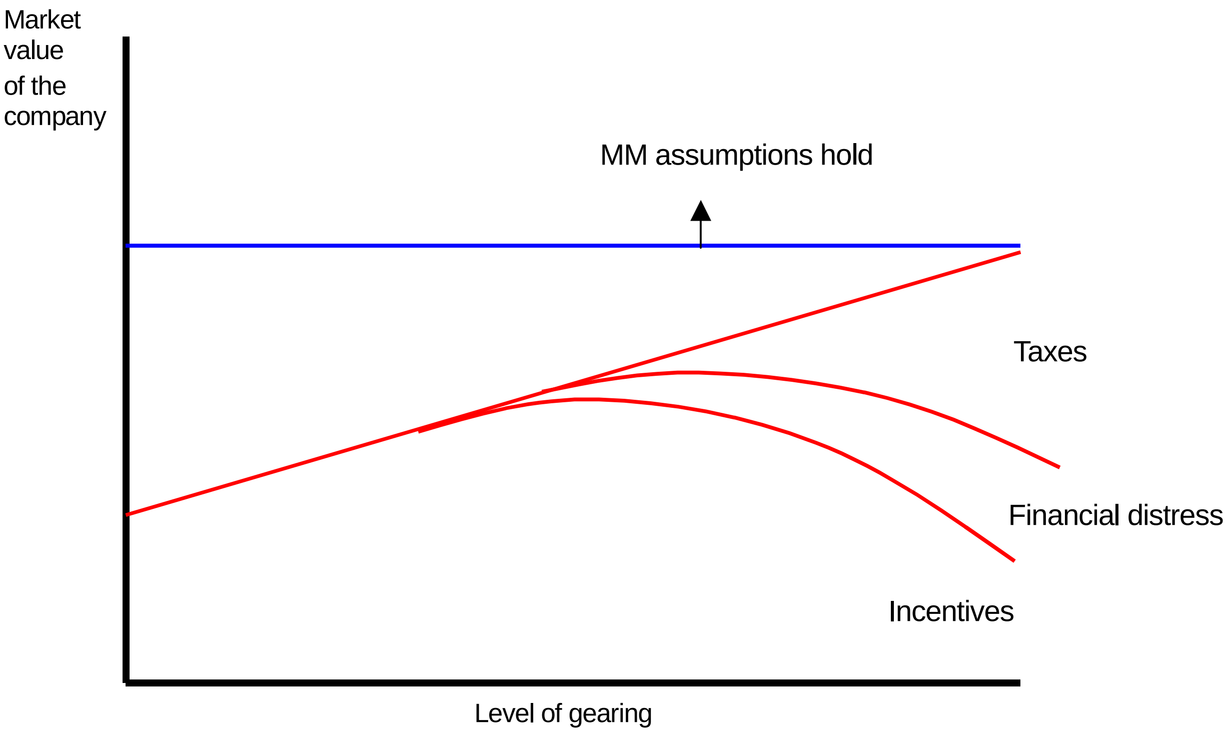
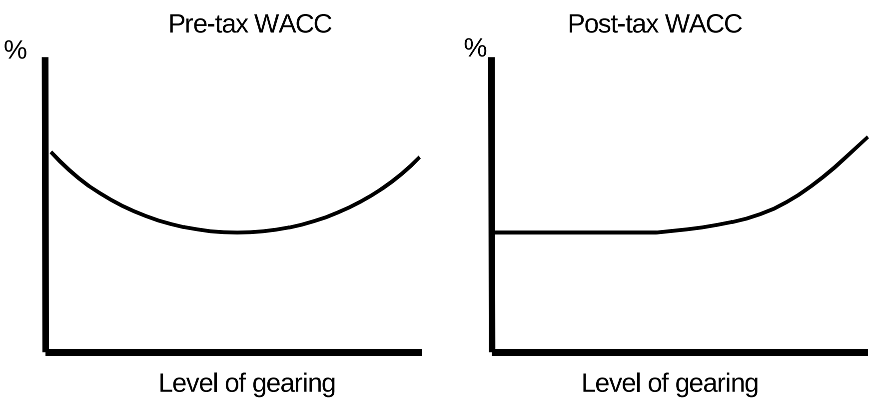


Figure 6.3: Gearing effects with pre-tax and post-tax cost of capital



Implications within the WACC Framework

6.16 In order for the financiers of the above project to be willing to put up the cost of the project, they must determine what level of risk they are taking on, and therefore, what level of return they require for their investment. To do this in a CAPM framework, they have to estimate the risk on all of the company's stock, the asset beta. As discussed in previous sections, the asset beta is a measure of how the net returns on the asset as a whole (the relevant "asset" in this context being the whole energy transmission and distribution sectors) is correlated with changes in returns across the wider economy.

6.17 The asset beta is relevant to the total WACC of the company, as opposed to just the cost of equity:

$$WACC = r_E \cdot \frac{E}{D+E} + r_D \frac{D}{D+E} \; ; \; \beta_A = \beta_E \cdot \frac{E}{D+E} + \beta_D \frac{D}{D+E}$$

6.18 If the firm uses no leverage, then the shareholders get all the project revenues, and $\beta_A = \beta_E$. However, when the firm uses debt as well as equity, β_E overstates the risk of the company, and the equity beta must be "un-levered" to get the asset beta. This is straightforward in the well functioning capital markets we are still assuming — we can utilise the above formula.

6.19 Recalling MM proposition I, the value of the company is determined by its future revenues, and how those revenues are split between different types of financiers does not matter. This means that the asset beta is constant — as the company gears up (D increases), the weight on the equity beta decreases relative to the weight of debt beta, and therefore something has to adjust to compensate (as typically $\beta_D < \beta_E$). Assuming that the risk on the debt providers does not change, the risk on equity holders must increase. This in fact is the case; the risk on the firm's equity is affected by its capital structure as well as the riskiness of the underlying business.[78]

6.20 We have now illustrated MMI in the CAPM framework. In perfect capital markets, the fact that a company gears up does not matter because the risk on equity rises in proportion to exactly compensate, leaving the asset beta, and therefore the company WACC, unaffected. In fact, it is the asset beta that drives the level of equity and debt betas — the overall risk on the asset base is what matters, the cost of equity and debt only adjust to reflect this depending on their relative amounts.

6.21 However, things are not as clear as we relax the assumptions behind MMI. The most clear-cut effects are those associated with taxation, which can be directly analysed in the CAPM framework, and to which we now turn.

Value of Tax shield in CAPM

6.22 Bringing taxation into the picture, it is now possible that a company's value is affected by its capital structure due to the tax advantage enjoyed by debt finance — interest

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[78] Occasionally, studies are produced in which the cost of equity appears to be invariant to issuance of new debt, with the argument offered that this is incompatible with MMI. But that is not correct — for example, something happening to reduce the company's cost of capital (e.g. greater certainty ov er its future revenue stream) might naturally be associated with a decision to issue additional ("securitizing" those future revenue streams). It might well be natural for the amount of debt issued in such a circumstance to be that amount that leaves the cost equity as it was before the cost of capital fell. (This is particularly likely if the determinant of the capital structure operates through or has the effect of placing a cap on the cost of equity — debt issuance would continue until that cap was reached.)

payments are tax deductible, whereas dividends and capital gains are not.

6.23 Roughly speaking, the impact of a change in the level of gearing on the WACC due to the change in the tax shield value could therefore be calculated as follows. First, estimate the values of the debt and the equity beta for the previous level of gearing, and using them construct the asset beta. Also remember that as gearing increases, the company value might be affected by the factors described in paragraph 6.11, such that the trade-offs imply that an increase in gearing would not be desirable above a certain point.

6.24 Second, remember that the asset beta will change only as a result of the change in the present value of the tax shield due to gearing up, which would have to be projected throughout the regulatory price review period. If there is no additional value from the tax shield compared to current gearing (i.e. current gearing is optimal), the asset beta can either only stay the same or *increase*, leading to a fall in the company valuation (as, other things being the same, the discount rate on the future income is now higher).

6.25 Aiming for an "optimal capital structure" implies equating the marginal benefit of debt financing with its marginal cost. Optimal gearing ratios are likely to vary by sector and even, in principle, by company within each sector.

Determining Notional Gearing Levels

Notional gearing and financeability

6.26 A regulator's duties may include a requirement to ensure companies are able to finance their activities. Where this requirement has been included it has typically meant ensuring that projected financial ratios (calculated using a notional gearing assumption) will allow companies to maintain an appropriate credit rating.

6.27 NATS is currently rated by both Moody's and Standard & Poor's. We note that NERL's rating has been recently upgraded to A2 by Moody's and A+ by S&P, from the previous A3/ A- split. Latest credit rating agency reports (Moody's December 2008, S&P June 2009) have confirmed a rating of A+/A2 for NATS. NERL's current gearing of 62.5 per cent (defined as net debt / RAB) is consistent with its underlying (BCA) rating of A3. In its report on NATS' cost of capital for CP3 (December 2008) NERA[79] concluded on an optimal capital structure of 60 per cent gearing, compatible with the target credit rating.

Actual gearing

6.28 Figure 6.1 shows gearing figures for NATS for the period 2005 to 2008.

[79] See NERA (2008) "NATS' Cost of Capital at CP3: Final Report".

Table 6.1: NATS' gearing

	Mar- 2008	Mar-2007	Mar-2006	Mar-2005
Net debt/ RAB %	62.4	58.7	65.5	72.9

Source: Moody's Investor Services: Credit opinion: NATS (En Route) PLC, global credit research – 02 Dec 2008

Suggested notional gearing figure

6.29 At the CP2 price review, the CAA's gearing assumption was 64 per cent. This was based on forecast actual gearing for CP2, but averaged over the five years in a NPV neutral way. In its February 2009 policy document[80] the CAA stated that applying the same principles to NERL's current forecast of debt levels for CP3 produces an average in the region of 60 per cent. The CAA stated that for the purpose of arriving at an indicative WACC for Customer Consultation, the working assumption was that gearing is 60 per cent.

6.30 We see no reason to disagree with this assumption by the CAA of a notional gearing figure for NERL of 60 per cent.

80 CAA policy update: NATS (En Route) plc price control review for Control Period 3 2011-2015, February 2009

7 SUMMARY OF RECOMMENDATIONS

7.1 This section draws together the material from preceding sections to set out our estimated WACC range for NERL using the CAPM-WACC framework.

7.2 We base our CAPM range on the following assumptions:

Gearing

7.3 Gearing affects directly the weighting of the cost of debt and cost of equity components of the WACC. It is also an important input into the calculation of the cost of debt itself and to the cost of equity, other things being equal.

7.4 We assess NERL's cost of capital based on a notional gearing ratio of 60 per cent. This is consistent with a credit rating of A+/A3, which NERL has stated that it targets. It is also consistent with NERL's current gearing and its target gearing over CP3, and with a theoretical optimal level of gearing (as demonstrated by analysis by NERA).[81]

Tax

7.5 We estimate the WACC on the basis of NERL's estimated effective tax rate over CP3 (which we understand to be approximately 35 per cent), consistent with the approach taken by the CAA at CP2 and proposed by the CAA for CP3.

7.6 At the time this work was commissioned it was envisaged that CP3 would be 5 years. It is now understood that CP3 may be 4 years. The effective tax rate may be lower if CP3 is 4 years. If necessary further work will be undertaken on tax as part of the updated May report.[82]

Cost of equity

7.7 Drawing on our estimates of the risk-free rate in Section 2, of the equity beta in Section 3, of the equity risk premium in Section 4, using the CAPM framework our suggested range for the real, post tax cost of equity for NATS with an assumed gearing of 60 cent is 7 to 10.95 per cent with a suggested point estimate of 8.77 per cent. The inputs to this calculation are set out in the following table:

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81 See NERA (2008) "NATS' Cost of Capital at CP3: Final Report".

82 There may also be effects on other CAPM parameters if CP3 is 4 rather than 5 years. If necessary these would be considered in the May update.

Table 7.1: Cost of equity range

	Low %	High %	working point estimate
Real risk-free rate	1.5	2.25	1.75
Equity risk premium	5	6	5.2
Gearing	60	60	60
Equity beta (re-levered)	1.10	1.45	1.35
Cost of equity[83] (real, post-tax)	7	10.95	8.77

Source: EE calculations

Cost of debt

7.8 Our analysis on the cost of debt is set out in Section 3. Our calculated range for the pre-tax cost of debt is 3.35 to 4.1 per cent with a current recommended point estimate of 3.6 per cent.

7.9 The cost of debt estimate is obtained by adding a debt premium of 1.85 per cent to our estimated range for the risk free rate.

Overall WACC range

7.10 Our estimate of the cost of capital for NERL for CP3 is presented in Table 7.2. Our recommended range for the pre-tax real cost of capital is **6.3 to 9.2 per cent with a working point estimate of 7.6 per cent**.[84] [85]

83 Uses re-levered equity beta with debt beta=0.1.

84 We also carried out sensitivity analysis using a debt beta of 0. As discussed in section 4, with debt beta=0, the asset beta range falls to 0.46 to 0.61 and the re-levered equity beta range rises to 1.15 to 1.53. This would result in a pre-tax WACC range of 6.5 to 9.5 per cent.

85 In section 2 we explained the Smithers & Co view that the sum of the risk free rate and ERP is more stable than the individual components. This view suggests that the cost of capital for NERL is very unlikely to be at either the very top or very bottom of the estimated range.

Table 7.2: Recommendations on the WACC

	Low	High	working point estimate
risk-free rate	1.5	2.25	1.75
debt premium	1.85	1.85	1.85
pre-tax cost of debt	3.35	4.1	3.6
post-tax cost of debt	2.18	2.67	2.34
equity risk premium	5	6	5.2
asset beta	0.50	0.64	0.6
re-levered equity beta	1.10	1.45	1.35
notional gearing	60%	60%	60%
debt beta	0.1	0.1	0.1
post-tax cost of equity	7.00	10.95	8.77
pre-tax cost of equity	10.77	16.85	13.49
effective tax rate	35%	35%	35%
pre-tax WACC	**6.3**	**9.2**	**7.6**
post-tax WACC	4.1	6.0	4.9
"vanilla" WACC	4.8	6.8	5.7

Source: EE calculations