

Recent market evidence on the common WACC/CAPM parameters

Note prepared for gas DNs

August 31st 2007

1 Introduction

This note provides estimates of the common WACC/CAPM parameters. Specifically, it gives Oxera's latest estimates of the risk-free rate, equity risk premium (ERP), and debt premium for the UK based on market evidence. This note does not report estimates of beta, gearing, or the impact of alternative tax adjustments.

2 Risk-free rate

2.1 Market evidence

There are various proxies for the risk-free rate that could serve as the basis for an estimate for the time value of money. For example, the selection of the appropriate risk-free rate measure would need to consider the relative merits of:

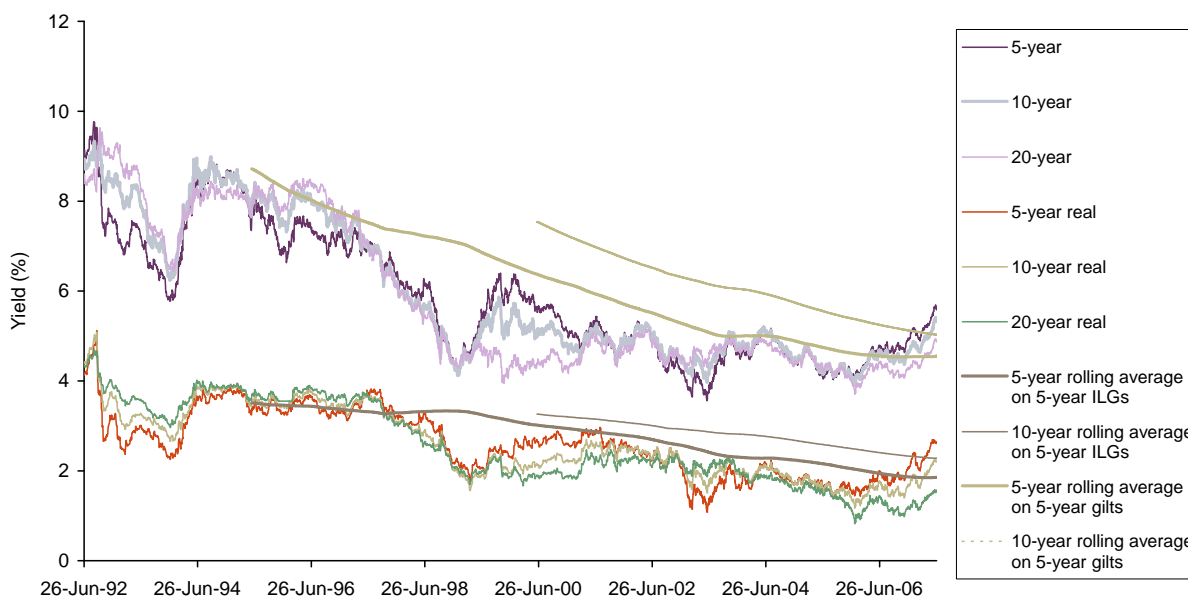
- both current spot rates and moving averages of rates over various historical periods;
- index-linked gilts (ILGs), conventional gilts and swaps, each of which can have a range of maturities; and
- different rates of expected inflation which can be used to derive implied real yields from nominal interest rate instruments.

However, Oxera considers some proxies as unlikely to be appropriate for calculating the WACC for the gas DNs for the coming control period due to the current inversion of the yield curve and the regulators' statutory duties to ensure that licensees are able to finance their regulated activities.

2.1.1 Historical gilt yields

Figure 2.1 shows the daily yields on nominal and index-linked government gilts for a 15-year period. The light and dark brown smoothed lines are the five- and ten-year rolling averages on the five-year nominal and index-linked bonds respectively. In both cases, the ten-year rolling average is the higher line.

Figure 2.1 Yields on nominal and index-linked UK government gilts, and 5- and 10-year rolling averages (1992–2007)



Source: Bank of England.

The figure highlights the following features of the behaviour of conventional gilts (top of figure):

- spot rates exhibit significant variation in the short term;
- the five-year yields followed a roughly constant downward trend from 1992 to 2003 (evidenced by the uniform gradient of the five-year rolling average). Since 2003, the five-year rolling average has levelled off and begun to rise;
- five-year gilts have recently risen above their ten-year rolling average for the first time this decade;
- ten- and 20-year gilts have also risen.

The figure highlights the following features of the behaviour of ILGs (bottom of figure):

- five-year ILG yields have followed a smoother downward trend than nominal gilts over the period, but since 2005 they have followed an upward trend, rising above their ten-year rolling average for the first time this decade;
- yields on ten- and 20-year ILGs have also risen, but the rise has been less pronounced at the long end.

Table 2.1 gives nominal and index-linked gilt yields for a range of maturities and rolling averages.

Table 2.1 Nominal and index-linked gilt yields different maturities

		Years to maturity			
		5-year	10-year	20-year	Average
Nominal	Average value over last 10 years	5.03	4.92	4.71	4.89
	Average value over last 5 years	4.55	4.59	4.48	4.54
	Spot	5.60	5.33	4.87	5.27
Index-linked	Average value over last 10 years	2.28	2.15	1.99	2.14
	Average value over last 5 years	1.86	1.84	1.67	1.79
	Spot	2.62	2.20	1.55	2.12

Source: Bank of England and Oxera calculations.

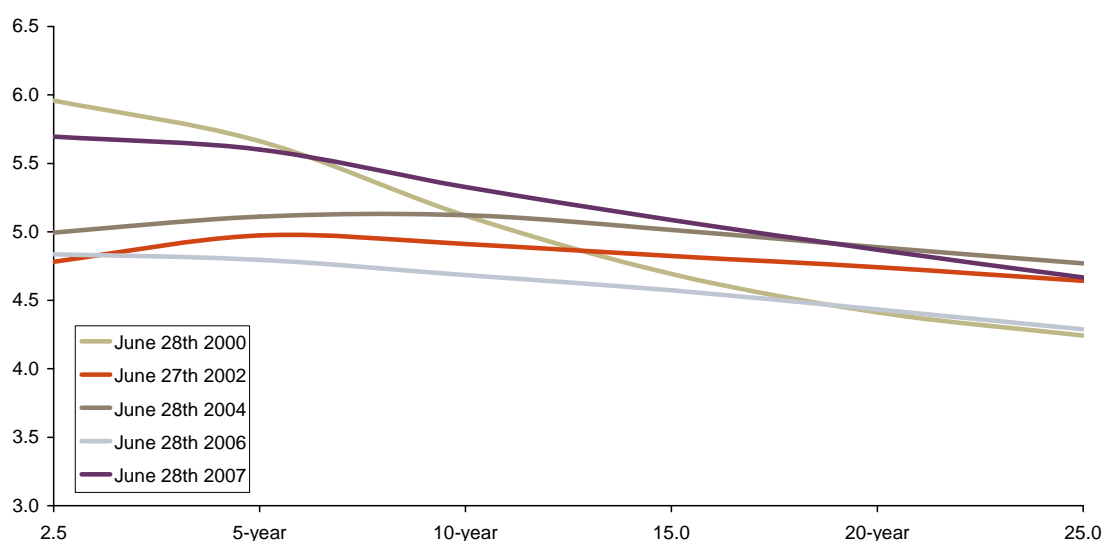
Table 2.1 displays three features of particular relevance:

- compared with average values, the spot yields on nominal bonds have risen more than those on ILGs;
- this rise has been less pronounced for those with longer-term maturities;
- the 20-year ILG is the only bond that remains below its 5- and 10-year average, suggesting that there might be a distortion in this particular market.

2.1.2 Yield curve inversion

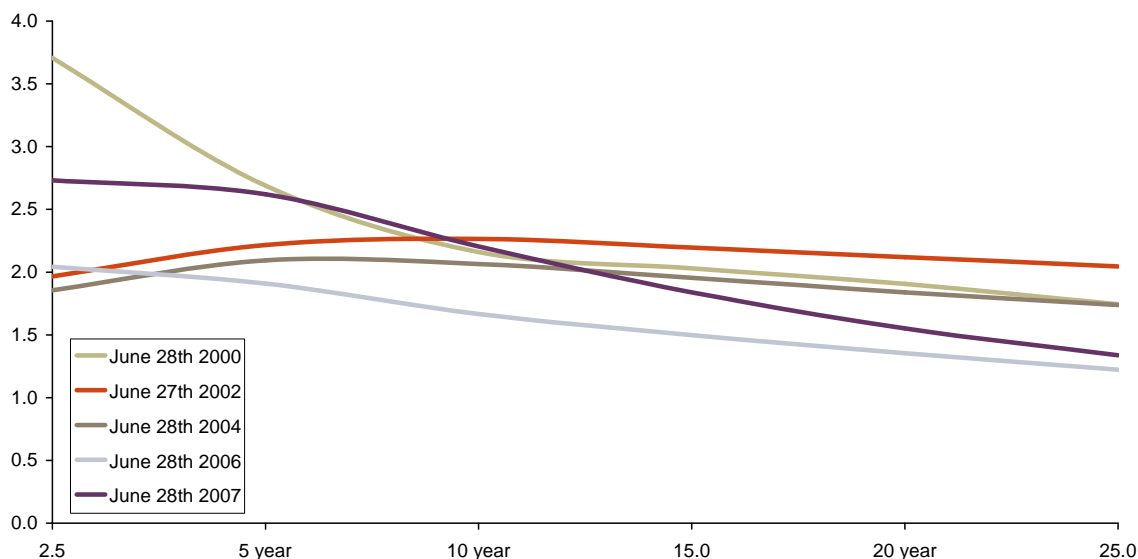
It is possible to evaluate further the existence of market distortions by analysing the evolution of yield curves on government bonds. Figure 2.2 displays yield curves derived from ILGs taken on June 28th for the years 2000, 2002, 2004, 2006 and 2007. Figure 2.3 displays the same yield curves derived from nominal gilts.

Figure 2.2 Yield curves based on nominal gilts (nominal interest rate, %)



Note: The curve is not directly comparable to a Bank of England term structure of interest rates, as it has been constructed by taking the spot yield for a cross-section of maturities on June 28th for the years 2000–07.
Source: Bank of England and Oxera calculations.

Figure 2.3 Yield curves based on ILGs (real interest rate, %)



Note: The curve is not directly comparable to a Bank of England term structure of interest rates, as it has been constructed by taking the spot yield for a cross-section of maturities on June 28th for the years 2000–07.

Source: Bank of England and Oxera calculations.

From the perspective of informing the assumption of interest rates over the next regulatory period, the following points are important to note.

- The curves for both ILGs and nominal gilts (the most recent being the purple line in both graphs) continue to show pronounced yield inversion, suggesting potential distortion at the long end, with the implied scope for unwinding of that distortion.
- The shape of the yield curve has not changed significantly in either market over the past year (compare the purple line with the light blue line), although, in line with the evidence on the evolution of yields, it has moved upwards. This roughly parallel shift in the yield curve has been more pronounced in the nominal market.

2.1.3 Comparison of risk-free rate proxies

Table 2.2 compares a range of measure for the risk-free rate that can be derived from market evidence. In addition to showing the yields on index-linked government bonds, this table shows the implied real yields from conventional gilts for maturities of five, ten and 20 years,¹ and the implied real yield on swap rates for five- and ten-year maturities.² (The five- and ten-year rolling averages on ILGs of five-, ten- and 20-year maturities are included for reference.)

¹ It is possible to derive a number of measures of implied real gilts using different measures of inflation to deflate nominal yields. One method is to deflate nominal yields using implied inflation, derived from the differential between nominal and index-linked gilts. This method, however, assumes away the problems posed by the differential between the yields on ILGs and conventional debt instruments arising from factors other than the expected rate of inflation. Another method is to assume that the Bank of England will meet its CPI inflation target (2%) in the long term and that the historical differential between CPI and RPI inflation (0.8 percentage points) will persist. This method implies an expected level of RPI inflation of 2.8%. As this method is independent of market distortions, it is the method of choice in this note.

² Implied real swap rates are calculated by removing the credit risk from the nominal five-year swap rate by subtracting the credit default swap rate (CDS), derived from the iTraxx index and deflating by 2.8%, see footnote 1 above, to imply a real value.

Table 2.2 Comparison of risk-free rate proxies

Maturity	5-year	10-year	20-year	Average of the three
ILGs	2.62	2.20	1.55	2.12
Implied real yield from nominal gilts	2.73	2.46	2.01	2.40
Implied real swap rates	3.20	2.85	n/a	3.03
5-year rolling average on ILGs	1.86	1.84	1.67	1.79
10-year rolling average on ILGs	2.28	2.15	1.99	2.14

Note: All figures as at June 28th 2007. Implied real gilts and implied real swap rates are the spot yields on nominal gilts and nominal swap rates, having removed expected RPI inflation (2.8%; see Appendix 1) using the Fisher relationship $(1+\text{real}) = (1+\text{nominal})/(1+\text{inflation})$.

Source: Bank of England, ONS, iTraxx CDS database, Oxera calculations.

The following aspects of the proxies given in the table are worth noting.

- The evidence on the risk-free rate derived from spot rates presents a large range: from as low as 1.55% on 20-year ILGs to as high as 3.2% on five-year risk-free swaps.
- The relationship between, on the one hand, the spot rates on ILGs and the implied real rates on nominal bonds and, on the other hand, historical averages for ILGs reflects how far spot rates have moved over the recent past, and specifically since the conclusion of the most recent major UK utility price review—ie, TPCR.
- The real yields implied by the yields on nominal gilts and swaps are significantly above those on ILGs. The Bank of England has suggested that the swaps market is less distorted than the ILG market and is therefore a better proxy for the risk-free rate.³ In addition, there is the question of the choice of inflation rate to infer the real yield on nominal instruments. Oxera has used an expected inflation rate of 2.8%. As discussed in Appendix 1, Oxera has assumed that investors expect the Bank of England to achieve its target CPI inflation rate (2%) over the life of the relevant credit instruments and that the differential between CPI inflation and RPI inflation is in line with its historical average value (80 basis points).

There are a number of reasons why regulators should not rely exclusively on spot rates to determine an appropriate risk-free rate, including the following.

- Spot rates exhibit high volatility, implying significant uncertainty as to future short-term movements.
- While the level of, and differences between, spot rates might reflect market distortions, they cannot by themselves provide a basis for predicting the extent to which these market distortions may or may not persist into the future.

At the same time, current spot rates cannot be ignored for the purposes of setting the risk-free rate; this is not least because spot rates reflect the most recent market evidence which

The iTraxx Europe index comprises 125 investment-grade-rated European entities with the highest CDS trading volumes as measured over the previous six months.

³ Cooper, N. and Scholtes, C. (2002) 'Government Bond Market Valuations in an Era of Dwindling Supply' Bank of England publications.

is of relevance in a forward-looking price control. In addition, as regulators have traditionally set the risk-free rate above contemporaneous market rates (to ensure that regulated companies can meet their financing requirements over the period of the price control), the volatility of spot rates provides some basis for the size of this precautionary margin.

2.2 Regulatory precedent

The sections above suggest that regulators need to take a prudent view on how debt costs may evolve through the relevant regulatory period. They therefore need to allow an appropriate degree of headroom over their best estimate of future debt costs. Figure 2.3 shows that, even where spot rates were below trend rates, regulators have typically set values above that trend.

To the extent that Ofgem's statutory duties require it to ensure that licensees are able to finance their regulated activities, Oxera considers that a margin above current spot rates should be incorporated into forward-looking estimates of the appropriate risk-free rate for the GDPCR.

Figure 2.3 Determinations of the risk-free rate



Note: The figure displays the three-year rolling average of the ten-year ILG and the average daily yield on five, ten and 20-year ILGs. The regulatory assumptions represent the chosen value as well as the range considered for the risk free rate for the following regulatory determinations:

1. Ofgem (PESs, Aug 1994). 2. Ofwat (WASCs, July 1994). 3. CC (SHETL, June 1995). 4. Ofwat (WASCs, Nov 1999). 5. Ofgem (PESs, Dec 1999). 6. CC (Mid Kent Water and Sutton & South East Water, Sept 2000). 7. Ofgem (NGC, Sept 2000). 8. ORR (Railtrack, Oct 2000). 9. Oftel (BT Retail, Feb 2001). 10. Ofgem (Transco, Sept 2001). 11. Ofreg (NIE, June 2002). 12. CC (BAA, Nov 2002). 13. CC (Store Cards, March 2004). 14. CC (Domestic Bulk LPG, July 2004). 15. Ofgem (DNOs, Nov 2004). 16. Ofwat (WASCs, Dec 2004). 17. CC (Home Credit, Dec 2004). 18. Ofgem (Scottish TOs, Feb 2005). 19. CC (Direct Advertising, Apr 2005). 20. Ofcom (BT, Aug 2005). 21. Ofgem (NGET, Nov 2005). 22. CC (Store Credit Cards Services, Mar 2007). 23. CC (Home Credit Inquiry, Nov 2006). 24. Ofgem (TPCR, Dec 2006). 25. Ofgem (GDPCR, one-year extension, Dec 2006). 26. CC (Classified Directory Advertising Services, Dec 2006).

Source: Bank of England and ONS.

2.3 Summary

The above analysis of the risk-free rates suggests the following.

- In setting a risk-free rate for the purposes of determining a price review cost of capital, regulators have to take a prudent view of how interest rates will move over the next regulatory period.
- Over the past few years, when spot gilt yields have been below trend, regulators have placed more emphasis on trend values, albeit typically adding a margin to these values.
- Currently, with spot yields having risen substantially over the past few months and now at around the trend level, regulators need to give due weight to those spot values, albeit allowing for further rises. This is not least because the statutory obligations on regulators, in the context of assuming a fixed cost of capital for the duration of the regulatory period, imply the effective need for regulators to place more emphasis on the higher of spot and trend values.
- In disentangling the various measures of the risk-free rate (short and long maturities, nominal gilts versus ILGs versus swaps), yield inversion suggests that yields on longer-term bonds are more distorted by factors that may unwind before or within the next regulatory period. The higher implied real yields on nominal instruments (when compared with yields on ILGs) suggest that even relatively undistorted shorter maturity ILG yields are something of a minimum measure of the current risk-free rate.
- Setting a risk-free rate which would allow for significant headroom over spot and trend ILG yields would be consistent with regulatory precedent, as set by both the CC/MMC itself and by the sector regulators. It would also be consistent with allowing for observed historical volatility of bond yields, even with no allowance for the unwinding of structural distortions.

Taken together, the available market evidence and regulatory precedent suggests a range estimate for the risk-free rate of 2.6–3%.

- The **low-end estimate** of 2.6% is based on the spot yield on ILGs with a maturity of five years.
- A **high-end estimate** of 3% allows for both future volatility in risk-free yields and for the fact that instruments other than ILGs (ie, nominal gilts and swaps) both imply higher current yields.

3 Equity risk premium

3.1 Market evidence

The ERP cannot be directly observed, but may be estimated on the basis of ex post evidence—that is, through observation of past returns on equity. Arguably, the most recent and most comprehensive ex post assessment of the ERP is that of Dimson, Marsh and

Staunton in their *Global Investment Returns Yearbook*,⁴ and it concludes that the UK ERP lies in the range 4.1–6.1%.⁵ Table 3.1 provides estimates of the ERP presented by Dimson, Marsh and Staunton (2006) on a number of measures and in a number of regions.

Table 3.1 ERP around the world, 1900–2005 (%)

	Relative to bills			Relative to bonds		
	Geometric mean	Arithmetic mean	Standard deviation	Geometric mean	Arithmetic mean	Standard deviation
UK	4.4	6.1	19.8	4.1	5.3	16.6
USA	5.5	7.4	19.6	4.5	6.5	20.2
World	4.7	6.1	16.6	4.0	5.1	15.0

Source: Dimson, E., Marsh, P. and Staunton, M. (2006), *Global investment returns yearbook*, February.

It is important to note that the upper end of this range estimate is based on ‘excess’ market returns relative to bills (ie, short-term money market instruments with a maturity less than one year). Given that UK regulators typically base their RFR estimates on gilts with maturities between 5 and 20 years, then arguably it is the excess market returns relative to bonds that are of interest. On this basis, the UK ERP evidence presented by Dimson, Marsh and Staunton (2006) is in the range 4.1–5.3%.

3.2 Academic evidence

Considerable attention has been devoted by academics to the question of the appropriate value for the ERP. In particular, three separate strands can be identified that are relevant to this note:

- whether historical excess equity returns over the returns on government bonds/bills are necessarily a reliable estimate of the forward-looking ERP, or if some forward-looking adjustments should be applied to historical returns;
- linked to this, research based on approaches to estimating the ‘implied ERP’ using market-based models;
- surveys of academics (as opposed to practitioners), as to what the appropriate ERP might be.

Each of these strands of research are considered below in turn.

3.2.1 Forward-looking adjustments

On the first of these, Dimson, Marsh and Staunton⁶ have argued that there are two grounds for considering that historical returns may not necessarily provide a reasonable forward-looking estimate of the ERP:

⁴ Dimson, E., Marsh, P. and Staunton, M. (2006), *Global Investment Returns Yearbook*, February.

⁵ It is important to note that a geometric average of the ERP of 4.1–4.4% (see Table 3.1) is consistent with an arithmetic average ERP of 5.5–6.4%, assuming that equity returns are log-normally distributed. Moreover, it is arguably the arithmetic average ERP that should be used in the calculation of the WACC since this is consistent with the theoretical underpinnings of the consumption CAPM.

- increased investor confidence—since the early part of the period from which their historical averages had been calculated, it was observed that there had been a significant increase in the P/E ratio, suggestive of a long-term decline in the ERP;
- outperformance of expectations—it was argued that, historically, equities had outperformed expectations more often than they had fallen short of them, and hence that historical equity returns were likely to overstate the required forward-looking ERP.

On this basis, in subsequent publications,⁷ the authors suggested that the following adjustments should be made.

Table 3.6 Forward looking adjustments to the ERP suggested by Dimson, Marsh and Staunton (%)

	UK	USA	World
2002 paper			
Adjustment for increased investor confidence	0.6	1.2	1.4
Adjustment for outperforming expectations	1.7	0.6	0.2
2003 paper			
Adjustment for increased investor confidence	0.3	0.8	1.0
Adjustment for outperforming expectations	Not provided	Not provided	Not provided

Source: Dimson, Marsh and Staunton (2002) and (2003).

Applying the adjustments for increased investor confidence from the 2003 paper and the adjustment for outperforming expectations from the 2002 paper results in the following ERP estimates.

Table 3.7 ERP adjusted for Dimson, Marsh and Staunton adjustments (%)

	UK	USA	World
Geometric average	2.0	3.2	2.8
Arithmetic average	3.2	5.2	3.9

Source: Dimson, Marsh and Staunton (2002) and (2003).

However, despite these relatively low estimates, it is interesting to note the recommendations made by Dimson, Marsh and Staunton in their latest update to this series of publications, where they state explicitly their recommendations for practical application:

Our estimate of a plausible, forward-looking risk premium for the world's major markets would be on the order of 3% relative to bills on a geometric mean basis, while the corresponding arithmetic mean would be around 5%. These are lower than the historical premia quoted in most textbooks or cited in surveys of finance academics. They

⁶ Dimson, E., Marsh, P. and Staunton, M. (2002), 'Triumph of the Optimists: 101 Years of Investment Returns', ABN AMRO and London Business School.

⁷ Dimson, E., Marsh, P. and Staunton, M. (2003), 'Global Evidence on the Equity Risk Premium', *Journal of Applied Corporate Finance*, 15:4, 27–38.

nevertheless represent our best estimate of the equity risk premium for investment, asset allocation, valuation, and corporate budgeting applications.⁸

In interpreting this quote, and as is discussed further below, it is important to note that regulatory precedent supports the use of comparing the ERP to bonds rather than bills (as it is the bond rate used in the risk-free rate estimation), which might suggest a lower number than those identified; but also the use of arithmetic rather than geometric averages, supporting the higher end of the range identified.

3.2.2 Academic assessments of 'implied ERP'

Given the possibility that 'the future is not like the past', a number of academics have applied a range of market-based approaches to assessing the ERP. The key numerical estimates coming from a sample of the most recent applications of this suite of approaches are as follows.

- Fama and French found that, in the period 1951 to 2000, there was a difference between historical average equity returns and estimates from dividend and earnings growth models.⁹ Attributing this difference to 'unexpected capital gains', they conclude that the unconditional expected ERP is between 3.83% and 4.78% (based on the dividend growth model (DGM) and earnings growth model, respectively).
- Using a similar approach, Lamdin found the ERP estimates based on data from 1981 to 2000 to be in the range 3.3–4.7%.¹⁰
- Schroder, using both the dividend discount model and the residual income model to estimate the forward-looking cost of capital, finds a range for the ERP of between 5.21% and 6.46%, based on data for the FTSE 100 companies.¹¹
- In the USA, the Office of the Chief Actuary of the Social Security Administration engaged three academics to address the question of the appropriate ERP estimate. All three used variants of this approach. Campbell suggested an ERP of between 1.5% and 2.5%, while the other two suggested a range of 3–3.5%.¹²
- Claus and Thomas, using an abnormal earnings model to estimate the cost of equity, estimate an ERP of 3.39%.¹³
- Harris and Martson, using the DGM on US data between 1982 and 1998, estimate an ERP of 7.14%.¹⁴

It can be seen that this approach has led to a wide range of estimates of the ERP, depending on the precise approach to estimating the cost of equity (and the assumptions within this), as

⁸ Source: Dimson, E., Marsh, P. and Staunton, M. (2006), 'Global Investment Returns Yearbook 2006', *ABN Amro/London Business School*, February, p. 43.

⁹ Fama and French (2002), 'The Equity Premium', *Journal of Finance*, **57**, 636–59.

¹⁰ Lamdin (2002), 'New Estimates of the Equity Risk Premium and Why We Need Them', *Business Economics*, October.

¹¹ Schroder, D. (2005), 'The Implied Equity Risk Premium: An Evaluation of Empirical Methods', Bonn Econ Discussion Papers 13/2005, May.

¹² As reported in Derrig, R. and Orr, E. (2003), 'The Equity Risk Premium: Expectations Great and Small', <http://irm.wharton.upenn.edu/F03-Derrig.pdf>

¹³ Claus, J. and Thomas, T. (2001), 'Equity Premia as Low as Three Percent?' *Journal of Finance*, **56**, 1,629–66.

¹⁴ Harris, R. and Marston, F. (2001), 'The Market Risk Premium: Expectational Estimates using Analysts' Forecasts', *Journal of Applied Finance*, **11**, 6–16.

well as the dataset used. However, while there are some extreme estimates within these studies, they generally support an ERP in the range of 3.0–5.0%.

3.2.3 Academic surveys

A final source of information provided by academics are in the form of response they provide to surveys on this topic. One of the most important of these is the survey undertaken by Welch (2000 and 2001) of nearly 500 financial economists.¹⁵ The average of these results was a one-year arithmetic estimate of the ERP of 3.4% and a 30-year ERP of 5.5%.

3.3 Regulatory precedent on the ERP

Table 3.2 summarises several regulatory precedents on the ERP. The evidence presented in this table demonstrates that regulators have typically adopted ERP estimates over the range of 3.5–5%.

Table 3.2 The ERP at recent regulatory determinations (%)

Regulator	Year	Subject	ERP range	ERP used in determination or implied by final decision
Ofwat	2004	WASCs (PR04)	4–5	n/a
Ofgem	2004	DNOs (DPCR4)	n/a	4.75
CAA	2005	NATS	3.5–5.0	4.4
Ofcom	2005	BT copper access	4.0–5.0	4.5
Postcomm	2006	Royal Mail	3.5–5.0	4.4
CC	2006	Storecards	3.0–5.0	4.0
CC	2006	Bulk LPG	3.0–5.0	4.0
Ofgem	2006	TPCR	4.0–5.0	4.5

Sources: Regulatory documents.

Furthermore, it is useful to examine in more detail the discussion on the ERP conducted by Ofcom in 2005.¹⁶ Here, Ofcom considered issues such as the different sources of information for data on this parameter, the relative weight that should be attributed to different types of data, and how the point estimate should be chosen for a given range. Alternative approaches considered by Ofcom included historical average returns on equity, adjusted historical risk premia, survey evidence from academics and practitioners, regulatory precedents set elsewhere, and measures derived from using alternative measures of the cost of equity to ‘back out’ (ie, infer) an ERP.

A number of important methodological issues were addressed as part of this review including:

¹⁵ Welch, I. (2000), ‘Views of Financial Economists on the Equity Premium and on Professional Controversies.’ *The Journal of Business* 73–4, 501–537, October; Welch, I. (2001), ‘The Equity Premium Consensus Forecast Revisited’, Cowles Foundation Discussion Paper No. 1325, September.

¹⁶ Ofcom (2005), ‘Ofcom’s approach to risk in the assessment of the cost of capital’, January.

- *the use of country benchmarks*—Ofcom commented that too many studies focus on US data. In its analysis, the regulator used only historical risk premia on world and UK indices. Individual countries were not considered because, it was argued, the information should already be included in the world index.
- *the use of geometric and arithmetic means*—both were seen as relevant. Ofcom considered that geometric means reflected the returns actually earned by investors, while arithmetic means reflected the historically experienced volatility of returns. However, more weight was placed on arithmetic being the basis for most investment decisions.
- *the risk-free rate over which the premium is calculated*—Ofcom assessed that the historical ERP should be calculated relative to bonds, rather than short-term bills.

In terms of actual evidence, on the basis of its review of the work by Dimson, Marsh and Staunton, Ofcom considered that there was a case for historical ERP estimates to be revised (downwards) to reflect the fact that the future was unlikely to be like the past. However, it noted that more weight should be placed on unadjusted historical premia since these were more objective and more widely recognised. In light of all these, Ofcom concluded that the appropriate range for the ERP was between 3.0% and 5.0%, which, it contended, ‘reflected a balanced view of the currently available evidence’.

A further aspect of Ofcom’s assessment is the regulator’s deliberation on the approach to determining the point estimate within the range:

The principal issue for Ofcom in choosing an appropriate ERP within the plausible range of estimates is to balance the relative risks of setting a cost of capital that is too high with one that is too low. Ofcom must take into account both the short and long term impacts on consumers and firms ... Excessive rewards may lead to:

- consumers paying prices that are above the competitive level, leading to an overall welfare loss; and
- investments that are not fully justified by consumer demand being made (and, possibly, investments in other areas that are justified by consumer demand not being made as a result)

However, while setting rewards too low will lead to consumers benefiting from lower prices in the short run; it may also lead to discretionary investment being discouraged, meaning that the levels of infrastructure-based competition and innovation are at sub-optimal level ... **Ofcom believes that the costs associated with setting too low a cost of capital are greater than those associated with setting it too high.** [emphasis added]¹⁷

In light of this argument, Ofcom concluded that an appropriate point estimate for the ERP was towards the top end of the range identified, and a value of 4.5% was chosen.

Having reviewed its approach in this area and on review of the available evidence and responses on this issue Ofcom believes that values in the range 4.0% to 5.0% are reasonable. Within this range Ofcom takes the view that 4.5% is the appropriate value for it to use in estimating a company’s cost of capital.¹⁸

¹⁷ Ofcom (2005), ‘Ofcom’s Approach to Risk in the Assessment of the Cost of Capital’, August, pp. 2–3.

¹⁸ Ofcom (2005), *ibid.*, pp. 2–3.

More recently, Ofgem's initial proposals for the 2007 TPCR advocated a range of 6.5–7.5% for the cost of equity. Its central estimate for the cost of equity implied an ERP of 4.5%, which is aligned with other recent determinations.

3.4 Summary

The debate over the appropriate value of the ERP needs to take account of the wide range of evidence available on this issue, while also recognising that, as it is an unobservable parameter, an element of judgement will be required in reaching a final decision. The key pieces of evidence that would appear relevant to determining the appropriate value of the ERP are that:

- unadjusted historical average returns for equities suggest an ERP both for the UK and on a global basis of between 4.1% and 5.3%;
- there are some arguments to suggest that there is a need for a downward adjustment to these numbers to reflect the fact that 'the future is not like the past', although regulatory precedent (Ofcom) suggests that these adjustments should be applied cautiously;
- surveys of academics suggest a range of between 3.5% and 5.0%; and
- regulatory precedent supports a range of between 4% and 4.75%, based on the outcomes to past determinations.

Taken together, the above evidence suggests a range estimate for the ERP of 3.5–5%, although the regulatory precedent strongly suggests that the appropriate central estimate for ERP is above the middle of this range.

4 Debt premium

4.1 Market evidence

This section presents the latest data on debt premia for UK corporate bonds over gilts, showing the spreads for debt of various credit ratings and maturities. It summarises the available data on credit spreads on a spot basis, as well as showing the evolution of average spreads over the last few months and years. These spreads are presented in Table 4.1.

The methodology to derive these estimates is based on publicly available bond indices. The credit spread for corporate debt with a given rating (eg, 'A' rated) and maturity (eg, ten years) is the average of the observed series of daily redemption yields over the relevant time horizon (eg, the past six months), less the redemption yield on government gilts of a similar maturity.

Table 4.1 Credit spreads relative to UK gilts (bps)

	AA			A			BBB		
	5	10	20	5	10	20	5	10	20
Spot (August 2nd)	73.7	107.4	81.6	95.6	132.6	104.4	118.2	153.7	122.4
1 month	64.5	86.8	67.0	82.1	113.1	90.1	107.5	126.5	109.3
6 months	49.4	65.1	56.6	63.8	90.8	82.4	91.0	103.4	102.4
1 year	45.9	62.4	58.6	60.0	89.9	85.1	89.6	105.5	110.4
2 years	45.9	64.0	63.5	59.9	87.8	88.3	96.0	115.0	122.5
3 years	46.8	65.6	67.1	60.8	85.3	90.4	104.8	120.1	129.1
5 years	57.5	74.5	76.7	82.3	97.9	103.4	147.7	153.9	150.9

Source: Datastream, Oxera analysis.

For AA, A and BBB bonds at the maturities shown, the spreads have come down in recent years and reached historically low levels in Q1 2007. However, in the last three months this trend has reversed, and corporate yields and spreads have increased somewhat. There remains considerable uncertainty over future developments in the credit markets.

The broader trend of falling yields and spreads reflects the lower number of speculative-grade (BBB and below) and investment-grade defaults (A and above) that have occurred since 2002.¹⁹

4.2 Regulatory precedent

In TPCR (2006), Ofgem used the observable premium on A- and BBB-rated utility debt to inform its choice of the high- and low-end estimates for the debt premium. It noted at the time that corporate debt premia were at historically low levels, and since it was unclear that these levels would persist for the duration of the price control, Ofgem used a higher top-end estimate of 150bps.²⁰ With a bottom-end assumption of 100bps, this gave a midpoint estimate on the debt premium of 125bps (which was eventually used in the WACC calculation).²¹

4.3 Summary

Taken together, the above market evidence suggests a range estimate for the debt premium of 1.1–1.4%.

- The **low-end estimate** of 1.1% is based on the spot credit spread on A-rate corporate bonds with a range of maturities.
- The **high-end estimate** of 1.4% is based on BBB-rate corporate debt. Specifically, this estimate is based on the midpoint of spot and five-year average spreads across a range

¹⁹ Standard & Poor's, 'Annual 2006 Global Corporate Default Study and Rating Transitions'.

²⁰ Ofgem (2006), 'Transmission Price Control Review: Final Proposals', Decision Document 206/06, December.

²¹ Ofgem (2006), *ibid.*

of maturities. This high-end estimate allows for future volatility in corporate debt spreads.

These estimates are consistent with the recent precedent set by Ofgem at TPCR, given that A- and BBB-rated corporate debt spreads were used.

5 Conclusion

This note has presented the market evidence on the common parameters of the WACC/CAPM to update Oxera's prior estimates (as at September 19th 2006) of the cost of capital for the gas DNs. The key findings from this analysis are as follows.

- A range estimate for the **risk-free rate** of 2.6–3% has been adopted based on the current yields on ILGs with five-year maturity.
- A range estimate for the **ERP** of 3.5–5% has been adopted, based on market evidence, academic research, and regulatory precedents established by Ofgem and other UK regulatory authorities.
- A range estimate for the **debt premium** of 1.1–1.4% has been adopted, based on credit spreads on A- and BBB-rated debt with a range of maturities.

Oxera has adopted an equity beta of 1 for illustrative purposes, which is consistent with Ofgem's precedents at DPCR4 (2004) and TPCR (2006). However, this equity beta assumption does not consider the evidence on risk differentials between energy networks, which suggests that gas distribution equity betas may be up to 0.5 higher than for transmission firms (assuming gearing of 60%).²²

It is important to note that the above WACC parameter estimates are also contingent on the notional gearing level used. Oxera believes that the above parameter estimates are broadly consistent with a notional gearing estimate of 60%. If the notional gearing level were adjusted upwards, then this would also require upward adjustments to the equity beta and debt premium in order to be consistent with fundamental corporate finance principles.²³

Table 5.1 summarises Oxera's parameter estimates and the associated WACC calculations.

²² Oxera (2007), 'Is there a risk differential between energy networks? Results from 'pure-play' comparator analysis', report prepared for the gas distribution networks, July 20th, p9.

²³ See Modigliani, F. and Miller, M., H. (1958), 'The Cost of Capital, Corporation Finance and The Theory of Investment', *The American Economic Review*, 3, June, pp. 261–97; and Modigliani, F. and Miller, M., H. (1963), 'Corporate Income Taxes and the Cost of Capital: A Correction', *American Economic Review*, 53, June, pp. 433–43.

Table 5.1 Cost of capital range estimates

Parameters	Low	High
Risk-free rate (%)	2.6	3.0
ERP (%)	3.5	5
Equity beta	1	1
Debt premium (%)	1.1	1.4
Gearing (%)	60	60
Corporation tax rate (%)	28	28
Post-tax cost of equity (%)	6.1	8
Pre-tax cost of debt (%)	3.7	4.4
Pre-tax WACC (%)	5.6	7.1
Post-tax WACC (%)	4	5.1
Pre-tax debt; post-tax equity WACC (vanilla WACC) (%)	4.7	5.8

Source: Oxera.

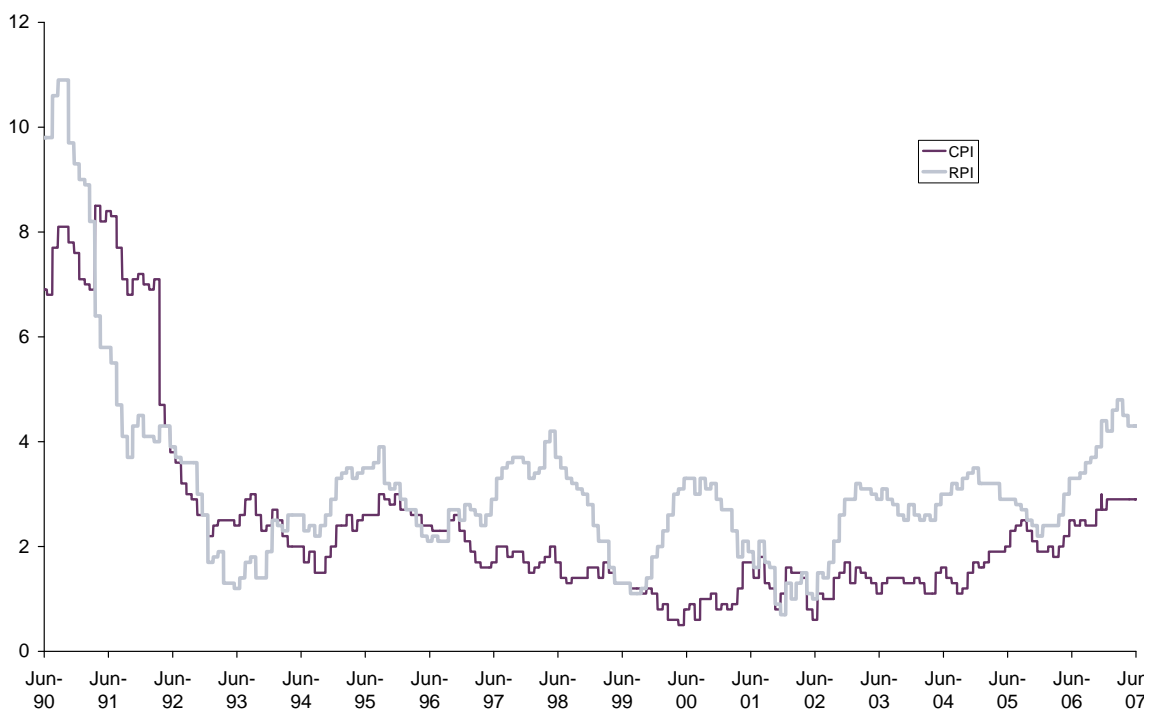
Appendix 1 RPI and CPI inflation

This appendix briefly sets out the basis for the expected inflation estimate used by Oxaera in estimating the risk-free rate implied from nominal gilt yields. As explained in section 2.1.3, expected inflation is based on the CPI inflation target plus the expected divergence between CPI and RPI.

This methodology is motivated by the fact that, in 2003, the Chancellor decided to adopt the European standard inflation measure for the purpose of inflation targeting, while the RPI inflation measure continues to be used in a range of commercial contexts, including in the adjustment of utilities' real rates of return for inflation.

Figure A1.1 and Table A1.1 present some summary statistics on RPI and CPI.

Figure A1.1 RPI and CPI (% per annum)



Source: ONS.

Table A1.1 RPI and CPI descriptive statistics

Statistics for period June 1990-June 2007	CPI	RPI	(RPI-CPI)
Arithmetic average	2.71	3.53	0.82
Geometric average	2.69	3.51	0.82
Max	8.50	10.90	3.10
Min	0.50	0.70	-3.10
Median	2.00	3.00	0.90
Variance	3.92	4.63	1.69
Confidence interval (90%)	-0.55, 5.97	-0.01, 7.07	-1.32, 2.96

Note: Based on monthly data.
Source: ONS, Oxera calculations.

It is important to note that the current inflation target is symmetric around a CPI of 2%, whereas the target for RPI was symmetric around 2.5% (prior to the introduction of CPI in 2003).

Figure A1.1 and Table A1.1 show RPI and CPI for the entire period for which both series are available from the ONS. The data also suggests that:

- the ‘average’ level of RPI is higher than the CPI;
- the volatility of RPI is greater than CPI; and
- the ‘average’ level of the difference between RPI and CPI is around 80 bps.

It is also important to note that the above analysis is subject to a number of caveats. In particular, the ONS has in the past noted that, due to the relatively recent introduction of the CPI (relative to the RPI), it is unlikely that there is sufficient data to show statistically if there is any long-run deviation between the CPI and the RPI (or its magnitude).²⁴ However, it remains possible that:

- the independence of the Bank of England in 1997 could have fundamentally impacted on inflation expectations, probably by making it more credible that inflation would be lower and/or less volatile—this makes it difficult to analyse ‘average’ deviations of RPI and CPI over the entire sample period given above;
- the above analysis of volatility may be affected by the presence of a trend, thereby making the statistical interpretation of variances, standard deviation, and confidence intervals more difficult; and
- the above analysis has not adjusted for the presence of business cycles, thereby making it more difficult to compare inflation measures over time.

Notwithstanding these caveats, the above findings imply that the long-run differential between RPI and CPI has been around 80 bps. The significance of this is that it would be reasonable to expect the rate of RPI increase, consistent with a CPI inflation target of 2%, to be around 2.8%.

²⁴ ONS (2004), ‘The New Inflation Target: The Statistical Perspective’, London, January.