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Cost of Capital for PR09
Final Report for Water UK

NERA
Economic Consulting

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Executive Summary

NERA has been commissioned by Water UK to estimate the cost of capital for the water industry, as an input into the 2009 price review (PR09). For this assignment we have worked closely with Professor Paul Grout (University of Bristol) and Professor Ania Zalewska (University of Bath). Professor Grout and Professor Zalewska are leading finance academics with a renowned track record of publications in the area of regulatory finance.

This report reflects our best estimates of the cost of capital as of March 2008. As such, with many details of PR09 still to be fleshed out, and especially due to the current volatile conditions in the financial markets, it will be necessary to update our assessment of the cost of capital closer to the time when Ofwat will be making its estimates of the cost of capital and decision on the allowed rate of return. In this study we have also not explicitly considered the impact of increased competition and/or structural reform on the cost of capital of the E&W water sector.

Cost of Equity

We have relied primarily on evidence from the CAPM, taking into account that this is the model that Ofwat will likely rely on most heavily in its assessment of the cost of capital at PR09. We note that the Competition Commission has also recently concluded in the BAA airports quinquennial review that the CAPM remains the preferred tool for estimating the cost of equity.[1]

In applying the CAPM, we adopt the following principles:

- estimates of a "forward-looking" cost of equity are based on the use of averages of long-term time-series data in order to achieve internally consistent and stable results;
- use of objective methods for calculating each parameter;
- parameter estimates are cross-checked with regulatory precedents in the UK and for other similar regulatory regimes.

The second criterion is especially important in deriving an estimate of the real risk free rate. Our analysis has shown that yields on UK government index-linked gilts (ILGs) remain downwardly biased as a measure of the real risk-free rate as a result of distortions in the financial markets. Applying an arbitrary or unsubstantiated adjustment to the UK ILG yield would be inconsistent with the aim of using objective and transparent methods. We show that use of time series data on swap rates adjusted for credit risk provides a more robust basis for estimating the risk free rate.

It is important to challenge the results from the CAPM using other market evidence. We have used the DGM to cross check the results from the CAPM and we find that results from the two models are broadly supportive.

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[1] Competition Commission report: BAA Ltd - A report on the economic regulation of the London airports companies (Heathrow Airport Ltd and Gatwick Airport Ltd) - presented to the CAA 28 September 2007, p53.

Taking into account all the available evidence, our analysis shows that the real post tax cost of equity for the UK water sector is in a range of 6.7-7.9% using the CAPM based on a 60% gearing assumption. The range is 7.4-8.5% using the DGM. The results are shown in Table 1 below.

Table 1
Cost of Equity for PR09 (%)

	CAPM	DGM
Real Risk-free Rate	2.6	
Equity Risk Premium (ERP)	4.2 - 5.4	
Gearing	60	60
Asset Beta	0.39	
Equity Beta	0.98	
Cost of Equity (real, post-tax)	**6.7 - 7.9**	**7.4 - 8.5**
Overlap Range	***7.4 - 7.9***	

Source: NERA anlysis

The CAPM parameters shown in Table 1 above are derived as follows:

- The risk free rate of 2.6% is based on a ten year trailing average of UK swap rates adjusted for credit default risk. Our results are broadly consistent with recent UK and European regulatory precedent on the real risk free rate, and substantially higher than current or historic averages of UK government ILG rates which mostly lie in the range of 0.5-2%.
- The ERP is based on the results of long run time series evidence on historical equity returns. The ERP is presented as a range of 4.2-5.4% due to uncertainty over the correct method for *averaging* historic returns. The lower end of this range represents the results of geometric averages whereas the upper end of this range represents the result of the arithmetic average of historic returns. Our review of the latest academic evidence on the ERP suggests that the majority of academic opinion supports the use of arithmetic averages of historic returns as the basis for estimating the equity risk premium.
- We show that long run asset betas for listed UK water companies lie in a range of 0.33 to 0.44. This is a similar range to the very recent asset betas for UK water companies calculated over six months or one year of data. However, we show that short run asset betas are highly volatile over time and conclude that it is inappropriate to rely only on very recent data. Our central asset beta estimate of 0.39 is consistent with an equity beta estimate just below 1.0 at 60% gearing.

The DGM-based cost of equity range is 7.4-8.5% based on share price data and dividend and earnings forecasts for the listed WaSCs over 2006 and 2007. Our long run dividend growth forecasts take account of consensus analysts' dividend forecasts taken from Bloomberg, and sustainable dividend growth rates based on projected RCV growth. Estimates of the DGM can be updated closer to PR09 as RCV-growth projections over AMP5 are published. The conclusions from the DGM are broadly supportive of the CAPM results overlapping at the upper end, and so suggesting a cost of equity at the upper end of the CAPM results.

Overall, we conclude on a range for the cost of equity of 7.4-7.9% for UK water at 60% gearing which represents the overlapping of the CAPM and DGM ranges. This range also implicitly places a higher weight on the upper end of the plausible ERP range, which is consistent with the use of arithmetic averages of historic returns as the basis for estimating the equity risk premium

Cost of Debt and Gearing

There are different regulatory approaches to determine the cost of debt in setting the allowed cost of capital. Ofwat's approach at PR04 was to base the cost of debt estimate on time series averages of debt costs. This approach has been followed by Ofgem at the Transmission and Gas Distribution price reviews in 2006 and 2007. However, the Competition Commission more recently estimated the cost of debt for BAA based on "current" market data.

Our analysis presents data on both historic time series data on debt costs and current debt costs for different ratings. Time series evidence shows that average real debt costs for BBB+/A- rated debt have been in the range of 2.6-3.6% across a range of debt instruments over a ten year historic period. However, recent evidence on A- debt costs over January-March 2008 shows average real costs of new debt issues are in the range of 3.6-4.0%. Our analysis of transaction and pre-funding costs shows that these costs are in the range of 0.18-0.28%.

Overall, based on evidence up to March 2008, after allowing for transaction and pre-funding costs, we recommend that the allowed real cost of debt at PR09 should be in the range of 3.4-4.0% for A- rated debt. The lower end of this range is more appropriate if Ofwat decides to rely only upon time series evidence on debt costs. The upper end of the range can be supported if Ofwat decides to follow the recent Competition Commission precedent and rely only upon current market data in estimating the cost of debt, and forward-looking debt costs remain at current levels. However, this would require a change in Ofwat's cost of capital methodology from PR04 when it relied upon long run time series data on debt costs.

Our recommendation is that Ofwat should weight the time series and current market debt costs to reflect assumed average proportions of new or refinanced debt over AMP5 by comparison to existing debt. This takes account of the fact that the industry may have raised finance efficiently at different parts of the interest rate cycle, but that the forward-looking cost of debt may be very different. Using this approach, our recommended real cost of debt for PR09 based on the latest available data is 3.7%. This reflects a weight of 60:40 attached to "current: time series" debt data.

Cost of Capital Conclusions

Taking into account all the available evidence, our best estimate of the real post tax (net of debt tax shield) cost of capital for the UK water sector at the current time is a range of 4.4-4.9%.

Table 2
NERA Estimates of Real Cost of Capital for UK Water Sector for PR09 (%)

	Estimate
Gearing	60
Real Cost of Debt	3.4 - 4.0
Real Post Tax Cost of Equity	7.4 - 7.9
Post-tax WACC (Net of tax shield)	**4.4 - 4.9**
Vanilla WACC (Gross of tax shield)	*5.0 - 5.5*

Source: NERA anlysis

We also note that the Competition Commission recently decided to recommend a WACC towards the top of the CAPM-based range after concluding that the negative consequences of setting a WACC too low were greater than the costs of setting a WACC too high. Our calculated WACC based on a cost of equity range of 7.4-7.9%, towards the top end of the plausible CAPM range, is consistent with this logic.

Comparison to PR04

Our cost of capital range of 4.4-4.9% compares with Ofwat's allowed cost of capital at PR04 of 5.1% before small company premium and financeability adjustments. Our range is lower than the allowed rate of return at PR04 mainly due to a lower cost of debt reflecting updated time series evidence on debt costs at strong investment grade credit ratings. However, we note that the cost of new debt achievable by water companies has been increasing in recent months and the debt markets will need to be monitored closely in the lead-up to PR09 in order to ensure that the allowed cost of capital does provide the right investment incentives at the margin.

Our cost of equity range of 7.4-7.9% is broadly similar to Ofwat's estimate of the cost of equity at PR04 of 7.7%, although we assume a slightly higher gearing of 60% (compared to 55% at PR04). We note that there is some evidence from the recent Water UK Investor Survey that certain risks (political, regulatory, force majeure and management) are perceived to have increased since PR04, and some elements of methodology are not yet detailed (e.g. Capex Incentive Scheme). Against this, there are some elements of the proposed PR09 methodology (revenue cap, symmetric treatment of capex overspends) that might be expected to reduce risk.

We also note that our WACC range of 4.4-4.9% is slightly higher than Ofgem's (2006) allowed WACC of 4.4% for UK gas and electricity transmission, which is consistent with updated evidence on debt costs, as well as evidence from the Water UK Investor Survey that water is perceived as more risky.

Overall, we believe it is important for Ofwat to justify changes in the estimated cost of capital at PR09, from the level that was assumed at PR04, based on objective evidence on changes in the risk profile of the industry and updated market evidence, rather than making subjective changes to its cost of capital methodology. Hence it will be important to reassess the appropriate cost of capital closer to PR09 when other elements of the PR09 methodology are more certain.

Financeability

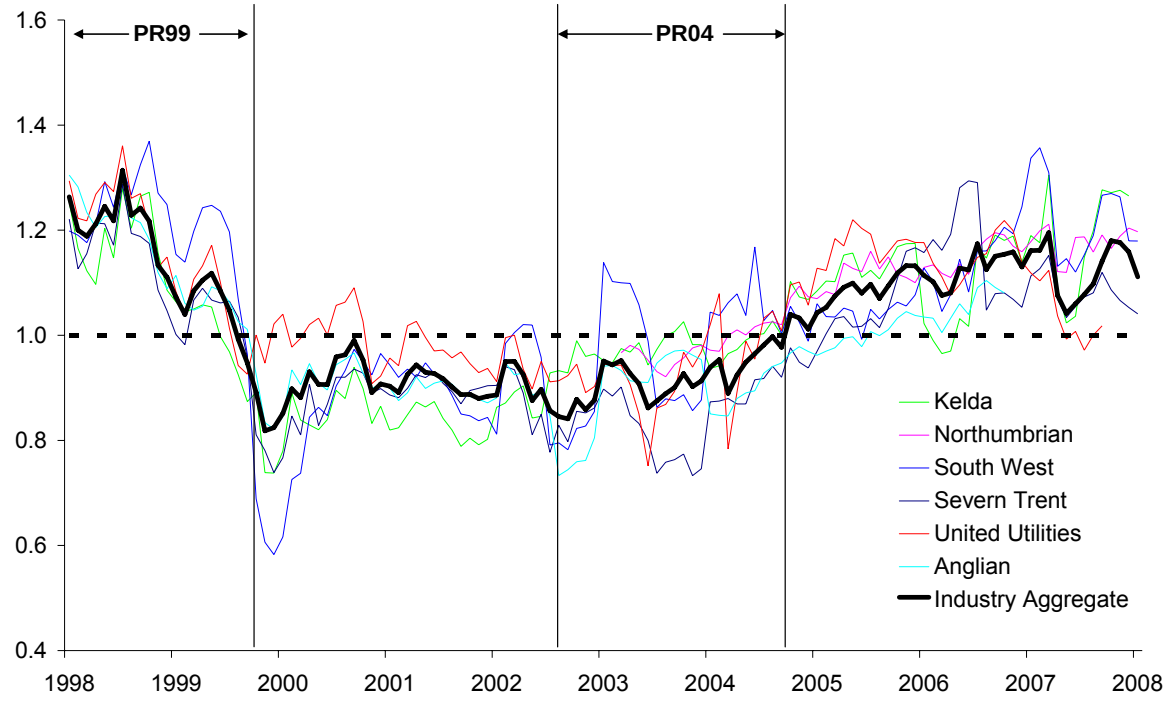
This paper also appraises different methods reportedly under consideration by Ofwat for dealing with financeability issues at PR09. Our conclusions are summarised as follows:

- The intertemporal mismatch between costs and revenues in the regulatory regime provides a theoretical reason for financeability adjustments. However, it is important not to overstate the impact of this effect since the RCV contains a portfolio of investments, some of which over-recover and some of which under-recover in any particular year.
- A more basic remedy for inadequate financial ratios is for Ofwat to consider whether its WACC estimate is adequate. It seems unlikely that the regulatory WACC estimate is correct if large adjustments for financeability are required for nearly all water companies regardless of the specific capital investment programme, age of the asset and other company specific factors.
- Issuance of IL debt (rather than nominal debt) and/or issuance of new equity provide market-based solutions to financeability issues that might arise from cash flow timing problems in the future. The regulatory methodology should therefore take account of these financing options before looking for alternative financeability solutions. However, IL debt is not currently as cost-effective as it was and recent issuances have been limited. Account needs to be taken of the forward-looking liquidity and demand for IL debt closer to PR09 to be sure the latest impacts of the credit crisis have been accounted for.
- The recent Water UK survey highlighted that financial markets regard rights issues negatively as a mechanism for dealing with financeability constraints, and Ofwat should not assume rights issues for large numbers of companies as part of their modelling on financeability over AMP5. In the event that some new equity issuance is assumed for some companies, the WACC estimate must be sufficient to attract new equity into the sector and must also include the full issuance costs of all new finance.
- Finally, individual companies may still have a problem if they face conditions that are significantly different from those facing other water companies. For example, a company may have a high "operating leverage", i.e. a larger than average commitment to fixed costs, including commitments to capex in the short-term. In this case, revenue uplifts may be necessary to achieve financeable regulatory packages. However, we are sceptical about whether a revenue uplift in the form of an NPV neutral adjustment will deal with financeability issues over the AMP5 period and more especially beyond this. Other regulators have investigated a number of ways to shift cashflow forward from the next regulatory period (e.g. Ofgem's use of accelerated depreciation allowances), but all methods effectively represent loans from future customers. These loans must be paid back in the form of lower cashflows at some future date and it is unclear whether at such times those reduced cashflows will be sufficient to satisfy investors.

Evidence on MARs for listed WaSCs

Our analysis shows that listed WaSCs have traded at average premiums to RCV of around 11% since PR04 but have been in the range of 1% to 20%. Evidence on MARs for the listed WaSCs over a ten year period from 1998 to 2008 is shown below:

Figure 1
Market to Asset Ratios for Listed UK WaSCs



Source: NERA analysis of Bloomberg data and analyst reports. Aggregate MAR constructed by summing RCV, Enterprise Value and non-regulated businesses across companies. Price review periods are between the release of the final 'Setting price limits' document and the publication of the Final Determination.

This chart illustrates that although MARs have increased significantly from the lows over AMP3, they still remain below their level prior to PR99.

However, it is important to emphasise that these estimates of MAR require an estimate to be made of the valuation of the non-regulated businesses of each WaSC, which are then subtracted from the observed enterprise value (market value of equity and net debt) to derive the MAR for the regulated business. We show a number of examples of analyst valuations of the same company's non-regulated business varying by ±20% at very similar points in time. As a result of this, MAR calculations cannot be made precisely.

Drivers of MARs over the AMP4 Period

We constructed a financial model, which we use in order to assess the impact of various value drivers on MAR. We draw on data for RCVs, opex and capex as published in the Final Determination 2004. The financial model replicates Ofwat's regulatory framework, e.g. companies are allowed to keep outperformance on a rolling five year basis and at the start of each regulatory review opex/capex are reset to reflect efficient costs. Further, we assumed real growth in RCV of 2.2%, which is equal to projected RCV growth over AMP4 for the aggregated RCV of the currently listed WaSCs (including Kelda).

Table 3 below shows the NPV of the additional allowed revenues of different value drivers as a percentage of the RCV. Our best "guess" is that expected outperformance could explain a MAR in the range of 1.06 – 1.14, but we note that there is a large confidence interval around this range.

Table 3
MAR Explained by Key Value Drivers

	Outperformance Assumption		Impact on Market Value
	AMP4	**post-AMP4**	**% of RCV**
Opex Outperformance (% p.a.)	1.0 - 3.0	1.0 - 3.0	4.8 - 11.8
Capex Outperformance (% p.a.)	2.5 - 5.0	2.5 - 5.0	0.2 - 0.3
Tax Outperformance	5% higher gearing	*no outperf.*	0.3
OPA (% every 5 years)	-1.0 - 0.5	-1.0 - 0.5	-0.8 - 0.4
Financeability (% p.a.)	0.3	0.0	1.4
Other factors	?	?	?
MAR explained by 'Additional Revenue'			**5.8 - 14.2**

Source: NERA analysis

Implications for the Cost of Capital of at PR09

Figure 1 shows that the aggregate MARs for the listed WaSCs lie in a range of 1.01 to 1.20 over the AMP4 period, and on average have traded at around 1.11.

Table 3 shows that a premium of 0.06-0.14 can be explained by factors such as expected outperformance that are not related to the cost of capital.

Adjusting the observed MAR range of 1.01-1.20 by the range of 0.06-0.14 that *might* be explained by other factors leaves an unexplained MAR of 0.87-1.14 that could be due to the difference between the regulated allowed rate of return and the cost of capital. This range for the adjusted MAR is almost symmetric around 1 which suggests that the market cost of capital is not inconsistent with the rate of return that Ofwat allowed at PR04 of 5.1%.

However, we believe that we cannot attach significant weight to the informational value of MARs for the true cost of capital for the following reasons:

- First, the observed MAR range of 1.01-1.20 is imprecise and requires an estimate to be made of the valuation of the non-regulated business which has a significant confidence interval;
- Second, the portion of the MAR that is explained by other factors, such as expected outperformance is also imprecise. We have made estimates about what investors assume over AMP4 and beyond, but there is no objective data available to support this;
- Third, in trying to back out what a particular value of MAR means for the market cost of capital, a further assumption needs to be made about what cost of capital investors assume Ofwat will set at future price reviews. We believe the most plausible assumption

that investors make is that a "wedge" between the market cost of capital and allowed rate of returns will only be temporary and that Ofwat will correct for any difference at future price reviews. If this is the case, a MAR range of 0.87-1.14 could imply a market cost of capital (real post-tax WACC) in the range of 2.1-7.9%.

In summary, the MAR evidence over AMP4 implies a very wide range for the cost of capital. After adjusting for outperformance, our estimated range for the (adjusted) MAR is almost symmetric around 1 which shows that Ofwat's allowed rate of return at PR04 at 5.1% is within the plausible range for the cost of capital. However, the range is too wide to make a judgement with sufficient confidence on the implied cost of capital required by investors.

Infrastructure Bubble

This paper also presents data on recent transactions and on trends in company valuations to demonstrate the presence and impact of an "infrastructure bubble". We present the following evidence:

- a significant increase in valuations of infrastructure (including utilities) assets over the past few years – not only in the UK but also more widely;
- transaction premiums for all infrastructure assets have increased over the past several years; and
- companies with very similar business profiles, but without infrastructure assets, have not had growth in valuations of a similar magnitude.

This evidence is consistent with a substantial increase in demand for infrastructure type assets from infrastructure and pension funds searching for low risk investments offering attractive yields (relative to government securities). More specifically, the increase in the transaction prices paid for UK water stocks has been mirrored by the increase in transaction prices paid for other types of similar infrastructure-type assets. We do not find any evidence to suggest that the prices paid for infrastructure assets are related to the regulated allowed rates of return.

Though we cannot entirely discount the possibility of widespread regulatory generosity, there seems little doubt that an infrastructure bubble has been a significant driver of the recent increase in UK water company MARs.

The presence of the infrastructure bubble over AMP4 further undermines the use of MARs as an input to the cost of capital determination at PR09.

1. Introduction

In November 2009 Ofwat will set limits on the prices that water and sewerage companies in England and Wales can charge their customers during the five year period 2010-15. An important component of this review is the cost of capital. At PR04 Ofwat's approach to estimating the cost of capital relied on a range of evidence including the traditional CAPM, supplemented by dividend growth models, market to asset ratios and evidence from transactions involving water companies. In March 2008 Ofwat released "Setting Price Limits for 2010-15: Framework and Approach" ("SPL"), which indicated that its methodology for PR09 was likely to be quite similar to the approach at PR04.

The key changes to the cost of capital and financeability adjustment methodology, so far signalled by Ofwat, compared to PR04 include:[2]

- Changes to financeability adjustments – Ofwat has signalled that the revenue uplift approach it adopted at PR04 to ensure companies meet financial ratios is unlikely to be needed over PR09. Instead, Ofwat has indicated that market mechanisms such as index-linked debt and new equity issues or retained earnings may ease the financing constraint. Further, in the event that a revenue uplift is required, Ofwat has indicated it will be applied in a NPV neutral manner.

- A proposal to place more weight on short term market evidence - Ofwat has stated that it "will set the cost of capital reflecting the up-to-date market data", but will continue to take account of existing debt costs as well.[3] This compares to the approach at PR04 which focused mainly on long-term time-series evidence.

- Possible removal of small company premium – Ofwat has stated that it doubts the need for a small company premium, particularly on the basis of market illiquidity or equity issuance costs.

In addition to these changes, Ofwat has also made some early comments on its views on other cost of capital parameters, which we have summarised in Table 1.1. Ofwat's initial assessment is that *"(T)he evidence suggests a lower cost of capital than our 2004 assumptions*".

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[2] Other key changes to the price review methodology flagged by Ofwat include revenue smoothing, menu regulation for capex, removal of the current notified items and accounting separation. Since these issues are less directly relevant to the cost of capital, they have been not been dealt with extensively in this report.

[3] See Ofwat (2008) Setting Price Limits for 2010-15, p46.

Table 1.1
Cost of Capital at PR04 in Light of Ofwat's Comments at SPL (March 2008)

CAPM Parameter	Value	Comment in SPL (March 2008)
Gearing	55%	"The industry average gearing is likely to be above the 55-65% range assumed in 2004" (p49).
Real risk-free rate	3.0%	"The risk free rates for short-, medium- and long-term debt are much lower than when we set prices in 2004" (p47).
Equity beta	1.0	Ofwat expect an equity beta of less than one.
Equity risk premium	4.0% - 5.0%	No explicit comment on ERP
Real cost of equity (post-tax)	7.7%	
Debt premium (incl. transaction costs)	1.3%	"Debt premiums remain below our PR04 assumptions" (p47).
Real cost of Debt (pre-tax)	4.3%	
Real post-tax WACC	5.1%	"The evidence suggests a lower cost of capital than our 2004 assumptions" (p45).

Source: Ofwat "Future water and sewerage charges 2005-10: Final determinations", Chapter 15 and Ofwat (2008) Setting Price Limits for 2010-15, March 2008.

As part of our work on the cost of capital for the water sector we have been asked to assess the relative risk profile of water against other regulated utilities. In Appendix A, we give a short summary on the results of this analysis. Broadly, we conclude that the water sector faces a lower risk than BAA designated airports and NATS, but is riskier than electricity and gas transmission and distribution activities. However, we strongly recommend that Ofwat undertake their own analysis of the cost of capital and do not rely on the analysis undertaken by other regulators.

The remainder of this report is structured as follows:

- Section 2 presents our analysis of the risk-free rate;
- Section 3 presents our analysis of beta;
- Section 4 presents our analysis of the ERP;
- Section 5 summarises our analysis of the CAPM cost of equity;
- Section 6 presents results on the cost of equity using the DGM;
- Section 7 presents evidence on the cost of debt;
- Section 8 presents our estimates of the WACC;
- Section 9 discusses optimal capital structure;
- Section 10 considers financeability adjustments and their relationship to the cost of capital;
- Section 11 considers market to asset ratios and transaction premiums and discusses their implications for the cost of capital, and;
- Section 12 reports results from our consultations with companies on WACC, the impact of the credit crisis, optimal capital structure, financeability issues and asset valuations.

The Appendices provide various supporting information.

2. The Risk-free Rate

The real risk-free rate is the price that investors demand to exchange certain current consumption for certain future consumption. In part it is determined by investors' subjective preferences and in part by the nature and availability of investment opportunities in the economy.

UK regulators have traditionally based risk-free rate estimates on yields of UK government bonds and in particular on IL Gilts (ILG). However, recent regulatory decisions have shown ILG yields especially may not provide reliable evidence as the basis for a risk free rate due to the impact of regulations and accounting requirements such as the Minimum Funding Requirement (MFR), FRS 17 and IAS19.[4] Some other method of identifying the risk-free rate is therefore required.

In this section we argue that swap rates should be used to estimate the real risk-free rate in preference to government bonds and in particular ILGs.

This section is structured as follows: Section 2.1 discusses recent regulatory precedent regarding the real risk-free rate; Section 2.2 presents recent evidence on UK ILG yields and discusses reasons for the recent fall in UK yields; Section 2.3 presents evidence on recent international IL government bond yields; Section 2.4 considers evidence on the real risk-free rate based on swap rates; and Section 2.5 concludes.

2.1. Regulatory Approaches

At PR04, Ofwat used a range for the real risk-free rate of 2.5-3.0%. This was based on a historic period average level of yields on medium-term ILGs. Ofwat noted that the current market spot rates at the time of the price determination "*would not lead to a sustainable WACC over the medium term*".[5]

The most recent regulatory decision on the risk-free rate relevant to UK water is the CAA's decision on BAA. The UK Competition Commission (CC) presents evidence on yields to maturity for five- and ten year UK ILGs (including forwards) over different historic periods from 1-day to 10-years. The CC concludes that the risk-free rate is 2.5%. This recommendation was subsequently adopted by the CAA in setting BAA's price controls in March 2008.

We have reviewed recent regulatory decisions on the real risk-free rate in Western European countries. The number of decisions and average rates are shown in the Figure below. Appendix A reports all individual decisions on the risk-free rate (real and nominal).

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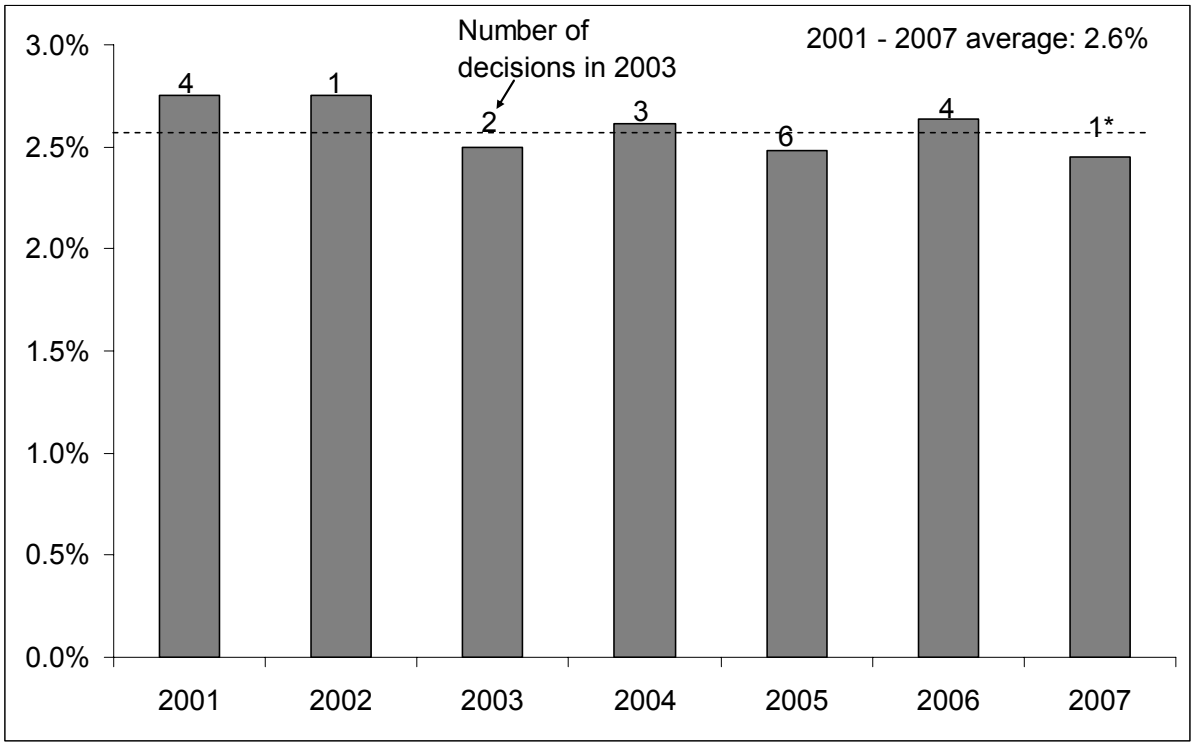
4 See for example Competition Commission: (2000b), p117 and Competition Commission (2003), p188.

5 Ofwat (2004), FD, p.222

Figure 2.1
Real Risk-free Rate - Regulatory Precedents (2001 – 2007)



*Source: European regulatory decisions. *based on NERA analysis of Ofgem's cost of capital determination of the 2007 gas distribution price control review. Note: Details on regulatory decisions can be found Appendix A.*

The average real risk-free rate used by regulators over the period from 2001 to 2007 is 2.6%. Table 2.1 presents the most recent regulatory decisions on the real risk-free rate made in 2006 to 2008.

Table 2.1
2006 - 2008 European Regulatory Decisions on the Real Risk-free Rate

Regulator	Country	Date	Activity	Real RFR
CRE	France	2006	Gas transmission	2.4%
Ofreg	N.Ireland	2006	Electricity transmission	2.8%
Ofreg	N.Ireland	2006	Electricity distribution	2.8%
Ofgem	Britain	2006	Electricity and gas transmission	2.5%
DTe	Netherlands	2006	Electricity transmission	2.7%
DTe	Netherlands	2006	Electricity distribution	2.7%
CER	Ireland	2007	Gas transmission and distribution	1.8%-2.3%[1]
Ofgem	Britain	2007	Gas distribution	2.5%[2]
CAA/CC	Britain	2008	BAA	2.5%

Source: European regulatory decisions. (1) CER (Ireland) only state range of risk-free rate however concluded on upper-end of overall allowed cost of capital estimate. (2) Ofgem (2007)'s decision on gas distribution implied a real risk-free rate of 2.45%.

This evidence shows that there appears to be a reasonable consensus amongst regulators that the real risk-free rate has been around 2.5%.

However, the decision cannot always be easily reconciled with the evidence presented based on objective and transparent methods. The recent recommendation by the CC on the real risk-free rate for BAA of 2.5% was essentially a subjective one, since it only matched the average yields on short term (5 year) ILGs over an arbitrary historical period of 3 months.[6] The yields on ILGs for all other maturities were all lower than 2.5% over different historical periods. The average yields on 5-year ILG maturities were also lower than 2.5% over different historical periods from 1-day to 10-years. The CC offered no specific reason to rely on the use of a 3-month data period or 5-year maturity as the right way to estimate the real risk-free rate.

This outcome conveys the impression that the CC wanted to conclude on a real risk free rate of 2.5% but found it difficult to present a transparent and objective methodology to justify this conclusion.

In the next section we present the most recent data on yields for UK ILGs and present reasons for the very low levels of yields recently observed in this market.

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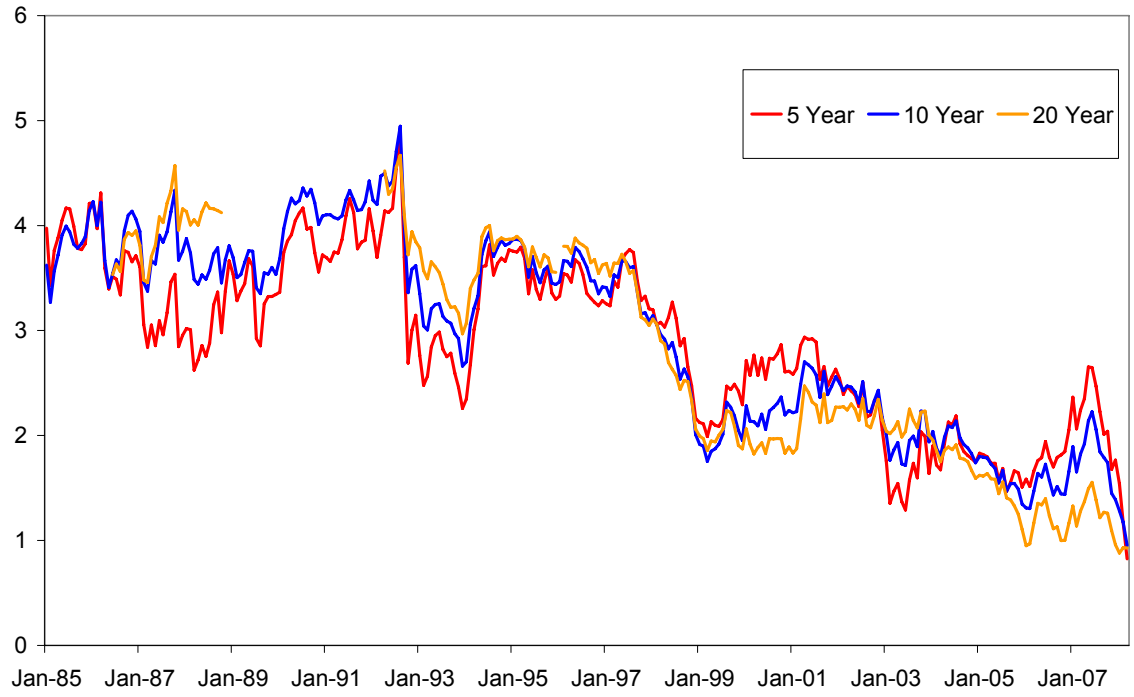
[6] This data showed average yields between 1.70% (10-year UK ILG, 3-year average) and 2.52% (5-year UK ILG, 3 month average). The CC does not take account of evidence on longer maturity yields in deriving its risk-free rate estimate noting (based on evidence presented by NERA amongst others) that longer dated ILG yields appear to be depressed by pension fund demand: "*in the presence of such distortions, the relatively low yields on long dated IL gilts may not be an accurate estimator of the RFR.*"[6] The CC (para.47) also refers to NERA evidence on international yields to support this view.

2.2. UK ILG Yields

Figure 2.2 shows yields on 5, 10 and 20 year maturity UK ILGs since 1985.[7]

Figure 2.2
Month–End Yields on ILGs for Maturities of 5, 10 and 20 Years
(1985-2008)



Source: Bank of England yield curves - real spot rate.

The Figure shows that ILG yields ranged from 3.0-4.0% over the period 1985 to 1997 (notwithstanding short periods above or below this range in the early 1990s), but were less than 2.0% (20 year maturity) by the end of 1999. From 2003 yields fell steadily hitting below 1.0% (20 year) in early 2006. During the recent period of market volatility yields have plunged even further, with yields on all maturities (5, 10 and 20 years) below 1% at the end of March 2008.

As the Table below shows, at March 2008, the 3 month average yield to maturity for a 5-year maturity UK ILG is 1.3% by comparison to the 2.5% observed by the CC in October 2007.[8]

[7] Figure 2.2 is an updated version of CC (2007) Appendix F, Figure 3, pF13.

[8] Table 2.2 is an updated version of CC (2007), Appendix F, Table 2, pF14.

Table 2.2
Update of CC's Analysis of the Risk-Free Rate

	5 Year	10 Year	Forward rate for September 2010
Spot rate 31-3-2008	0.82	0.95	0.95
March 2008	0.93	1.02	1.18
Last 3 months	1.33	1.23	1.47
Last 6 months	1.60	1.41	1.75
Last year	2.01	1.71	2.07
Last 3 years	1.85	1.62	--
Last 5 years	1.81	1.73	--

Source: NERA's analysis of BoE data up to and including 31 March 2008.

At March 2008, average yields on ILGs for <u>all</u> maturities are significantly below the CC's (2007) estimate of the real risk-free rate of 2.5% no matter what period of historical data is considered.

The steep decline in real yields from 1997 onwards is widely recognised by commentators such as the Bank of England to be mainly associated with the introduction of the pension fund regulations such as the Minimum Funding Requirement (MFR) and subsequent further pensions' regulations such as FRS17 and IAS19.[9] Other reasons for the fall in yields that have been suggested include the volatility of equity markets seen after the collapse of the Dotcom "bubble" in 2000/01 which drove investors into safe assets – the "flight to safety".

Increasing levels of inelastic demand related to institutional factors (such as pension fund regulations or government issuance) and levels of supply that have failed to keep pace have caused yields to be distorted from the true risk-free rate. This is because these factors are not related to fundamental changes in investors' preferences over risk.

In the BAA case, the CC focused on the 5 and 10 year maturity ILG benchmarks and forward rates as the "best available indicators of the risk-free rate" after concluding that long dated yields were distorted and were not an accurate measure of the risk-free rate. However, it is implausible that ILGs with shorter term maturity are not also affected by these distortions caused by regulatory requirements and inelastic demand by institutional investors such as pension funds. For example, an investor wishing to purchase a 15 year ILG would instead buy a 10 year ILG if the price (yield) was sufficiently lower (higher). Mechanically, via the same process, these distortions – albeit of decreasing magnitude - must spill-over to the short-end of the curve. Since there is no widely accepted correction for this distortion, no market for gilts provides any guidance as to the true risk-free rate.

[9] See for example the Bank of England: "*The Minimum Funding Requirement led to strong institutional demand for ILGs. The combination of strong and rather price-insensitive demand (largely from pension funds) with limited supply, has pushed real yields down, perhaps more than in the conventional gilt market. Consequently, real yields in the ILG market may not be a good guide to the real yields prevailing in the economy at large*" (Bank of England (1999) *Quarterly Bulletin*, May).

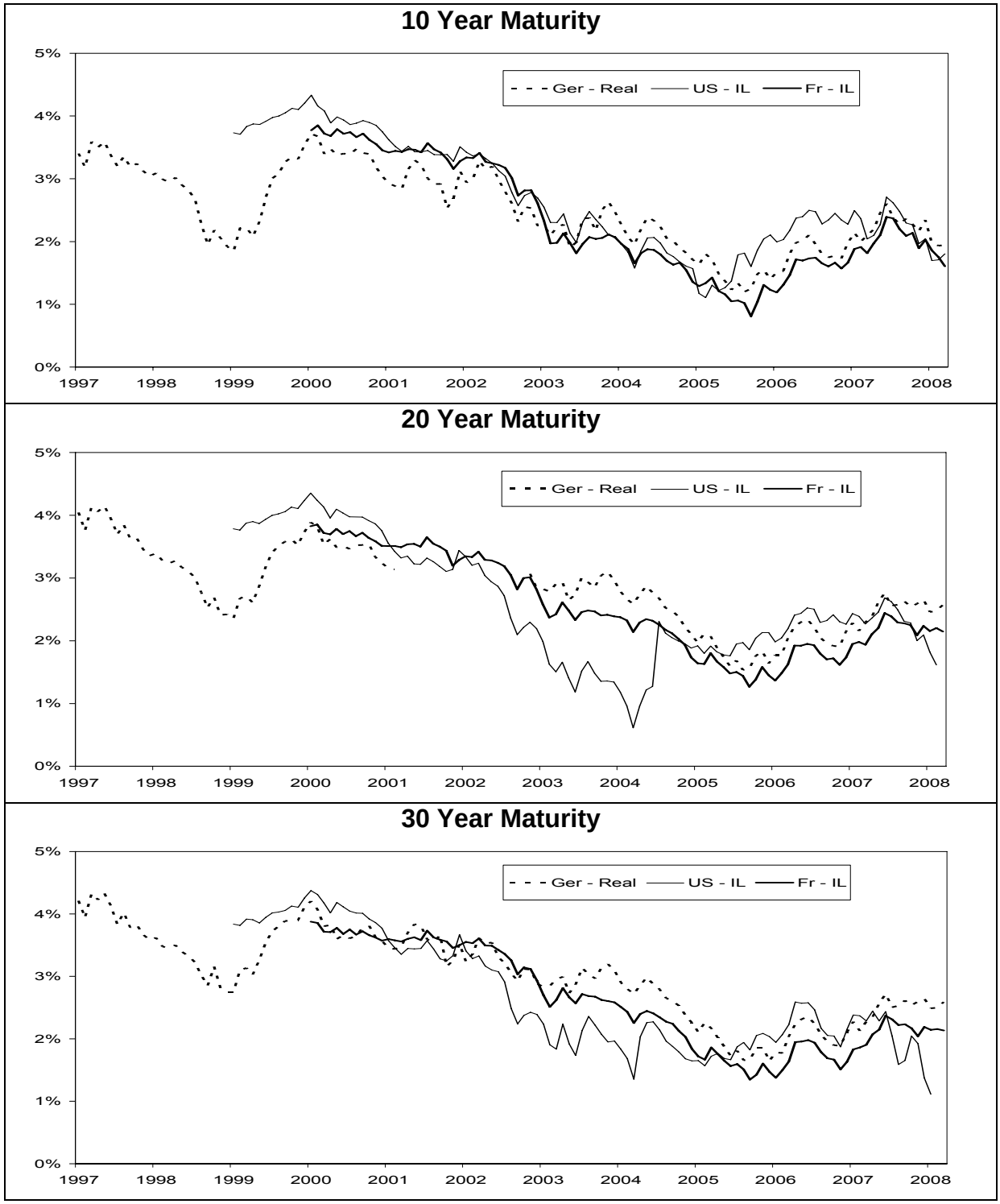
This spill-over effect is borne out by the latest data. The 3-month average yield on an ILG with 5 years maturity is 1.2% whereas it was 2.5% at the time of the CC report on BAA in October 2007.

In summary, UK gilt yields have been distorted for many years by the effects of pension fund regulations (such as the Minimum Funding Requirement, FRS17, IAS19 and the Pension Protection Fund) that have led to highly inelastic demand for UK government bonds. The effect of these distortions is to depress observed yields on the affected range of bonds below the true risk-free rate by the amount that pension funds are willing to pay to meet their legal obligations. For this reason, UK ILGs do not provide an accurate measure of the real risk-free rate for estimating the cost of capital.

2.3. International Government Bond Yields

This Section presents historical evidence on international government bond yields and examines whether they might provide better evidence on the risk-free rate than UK gilts.

Figure 2.3
Yields on Constructed French & US IL, Real German Government Bonds



Source: NERA analysis of Bloomberg data. In order to construct indexes we interpolated linearly between yields for maturities falling between 10 and 30 years. For some months we extrapolated (by no more than two years) out (in) from maximum (minimum) maturity in order to derive 10 and 30 year maturity yields. German real yield is nominal government bond yield deflated by Consensus Economics' forecast Eurozone inflation. German real bond yields for 2008 have been derived assuming inflation expectations of 2.0% (i.e. the ECB's target inflation rate) per annum for 10, 20 and 30 year maturities.

France and the UK are by far the largest issuers in the European IL government bond market. In terms of the number of bonds in issue and maturity depth, these markets along with the US are also the most developed. In addition to international IL evidence, we also consider implied real yields on German government bonds (bunds) as Germany is a major government bond issuer within the Eurozone. Figure 2.3 shows yields on constructed French and US IL and real yields implied by German bund indices for 10, 20 and 30 year maturities from January 1997 onwards.

The Figure shows that yields have fallen more or less steadily from around 4% in 2000. However, there are currently some significant differences across markets and maturities:

- The 3 month average yields on French IL bonds range from 1.7% (10-year) to 2.2% (30-year);
- The 3 month average yields on US IL bonds range from 1.7% (10-year) to 1.1% (30-year);
- The 6 month average yields on German nominal bonds adjusted for inflation range from 2.1% (10-year) to 2.6% (30-year).

The data shows that there are significant differences in real government bond yields across countries. Market data for the US shows an inversion of the yield curve similar to that observed in the UK, whereas the French and German markets currently show an upward sloping yield curve.

The inversion of the yield curve in the US suggests that similar influences to those placed on UK gilts may be pushing yields below fair value. Press reports state that pension fund demand may have strengthened as international accounting standards, requiring pension funds to state deficits in their financial accounts, approach implementation stage. In the US, the Pension Protection Act was enacted in August 2006, mandating stricter funding requirements on defined benefit plans. The influence on yields of pension fund demand in the US has been noted by the Federal Reserve.[10]

Recently the French IL yield curve and German yield curve have also often been inverted. The FT, amongst others has suggested that Dutch reforms have placed particular pressure on the French IL bond market, which is the largest in the Eurozone.[11,12]

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[10] *"In the US, pension funds are required to reduce risk in portfolios by matching liabilities with less risky asset classes such as long-dated bonds. Stewart Cowley, head of fixed interest at Newton, says: "At present, there are insufficient fixed-interest securities for pension liability matching. Demand is not going to go away for long-dated bonds which should see a higher return for investors." That's a view that has received official backing also. In one of his first speeches as Federal Reserve Chairman, Ben Bernanke said the demand arising from changes in pension rules was "a third possible source of a declining term premium," the so-called yield curve conundrum.""* Investment Week (11/09/06) "Economic slowdown in US to benefit long-dated bonds"

[11] *"There aren't many players in Dutch inflation so it's expensive and there's a tendency to use the euro convergence, for example French inflation-linked bonds," says Mr James. And while he accepts that in strict LDI terms the correlation between euro CPI (or even French domestic RPI) and Dutch wage inflation is not perfect, the shorter duration of the bonds they can use compared with the pension duration liabilities, reduce risk even further. But the market feels there is also a shortage of supply of euro-denominated inflation debt, although Germany has recently entered the market."* Financial Times (01/09/06) "Financial Times Mandate: Strategy Selection: Inflation-linked Bonds - Inflation-linked bonds wait for market to go Dutch." "LDI" in this article refers to liability-driven investment.

The OECD observed in early 2006 that undersupply of the bonds demanded by pension funds was a global phenomenon:

> *"Very long-dated and IL bonds seem to be currently undersupplied relative to perceived or expected demand"* [13,14]

In summary, real yields on international government bonds have fallen fairly consistently since 2000 exhibiting similar trends to the UK gilts market. Reasons for this fall include: (i) increasing liquidity of international IL bond markets; (ii) high levels of volatility in international stock markets; and (iii) pension reforms in the Eurozone and US that may have encouraged investment in government bonds in a similar fashion to the UK. The inversions of the real yield curves that are currently seen in the US, UK and France are contrary to economic theory that predicts upward-sloping yield curves. For these reasons, we conclude that market data on international yields are also biased as a proxy for the real risk-free rate.

2.4. Real Risk-free Rates Based on Swap Rates

In this section we present an alternative method for estimating the risk-free rate. We explain the concept of swap rates and discuss the reasons why swap rates (as opposed to government bond yields) are a better benchmark for estimating the "true" risk-free rate which is most appropriate for estimating the cost of equity within a CAPM framework.

An interest rate swap involves two parties, one of which agrees to pay fixed-rate interest payments in return for receiving floating-rate interest payments. The payments are based on a notional principal, which never actually changes hands. The fixed rate is set at the inception of the contract, while the floating rate is tied to some benchmark interest rate, such as Libor. Because the floating interest rate is not entirely risk-free – Libor includes an inter-bank credit risk premium (i.e. AA risk) – neither is the swap rate. Therefore, typically, a swap rate will exceed the rate on a government Treasury even abstracting from any distortions in the Treasury market.[15] A nominal risk-free rate can be obtained from the swap rate by subtracting some measure of the AA risk premium.[16]

The concept of an interest-rate swap based approach to the risk-free rate is not new. Fleming (2000) and Choudhry (2005), among others, have proposed using swap rates as the basis for a

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[12] *"They say changes in pension regulations in Europe, under which firms are required to highlight deficits from defined-benefit schemes in balance sheets, look set to sustain demand for safe sovereign bonds to year-end and beyond, and to more deeply entrench the present German yield-curve inversion. The super-long end of the European government bond curve is in the grip of pension and insurance funds that are more interested in cash flow than the economic cycle, said Calyon's Keeble."* Dow Jones Newswires (9/11/06) "Pension Funds To Keep Long Bond Yields In Check"

[13] As reported in Dow Jones International News (30 January 2006) *"Euro Yield Curve is Unlikely to Invert"*

[14] See also *"The increased issuance of long-dated bonds by different European governments is not enough to meet investor demand for these instruments."* Financial Times (01/02/06) "Financial Times Mandate: News & Analysis: Products and Strategies - Clients call for more long-bonds."

[15] See, for example, Fleming (2000), p246, who says "swap rates exceed those on Treasuries mainly because the floating payments are based on a rate that contains a premium for credit risk (Libor is a Aa/AA rate)."

[16] An alternative approach might be to add some measure of the distortion or illiquidity in Treasury markets to the observed Treasury rate.

risk-free rate estimate. The various approaches differ in the way they adjust for the credit risk inherent in swap rates.[17]

Choudhry (2005) states:

> *"The swap spread is a measure of inter-bank risk, given that the government curve is assumed to be default free, and the swap market is used by banks and corporates to hedge their interest rate risk. Traditionally, the swap spread was taken to be the measure of corporate default risk, with a corporate bond asset-swap spread taken as an indicator of the credit risk on that reference bond. The swap market, however, is now very large and liquid, and does not suffer from illiquidity, even out to long-dated maturities. There are also no supply constraints in the swap market, unlike for (say) long-dated gilts or Treasuries, and the use of collateralisation, margining, netting and other measures has substantially reduced counterparty risk. Government bond markets, on the other hand, have experienced low liquidity and supply constraints, leading to inverted curves, causing some commentators to suggest that the government yields have traded below the true risk-free level; see Fleming (2000, 2001). In other words, the government curve may on occasion be overvalued, whereas the swap curve can be regarded as lying at fair value" (emphasis added).*[18]

In a very recent paper by Feldhutter and Lando (2007), the authors conclude:

> *"…the riskless rate is better proxied by the swap rate than the Treasury rate for all maturities".*[19]

NERA have proposed the use of swap rates previously as the basis for estimating the risk-free rate in all regulatory price reviews.[20] Our report, submitted to the CC as part of the BAA inquiry, concluded that evidence on swap rates is a preferable basis for estimating the risk-free rate within a CAPM framework.

Whilst the CC did consider the NERA evidence on swap rates it states that it was "*not persuaded*" that swap rates provided a stronger basis for determining the risk-free rate than ILGs. However, the CC does not state any reasons why they were not persuaded. The CC

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[17] For example, Choudhry (2005) characterised the fair value (as opposed to the observed) swap spread (i.e. the difference between the swap rate and the Treasury rate) in terms of the expected spread between the Libor rate and the general collateral repo rate over the life of the swap. However, this result only holds if the fair value swap spread does not also comprise some premia for the risk that the Libor-repo spread will not turn out as expected. Alternatively, Liu, Longstaff and Mandell (2006) model the term structure of swap and Treasury curves and conclude that the swap spread comprises both liquidity and risk premia. The mean risk premia in the US between 1988 and 2002 was estimated to be about 18 and 45 basis points for five and ten year maturities, respectively, though quite volatile. In an updated version of that paper, the corresponding estimates over the same period are both about 13 basis points (though with substantial uncertainty).See Liu, Longstaff and Mandell (2006).

[18] See Choudhry (2005) "An alternative bond relative value measure: determining a fair value of the swap spread using Libor and GC repo rates", Journal of Asset Management, Vol. 7(1), p18.

[19] Peter Feldhütter and David Lando (2007) Decomposing Swap Spreads, *Working paper*, May, Copenhagen Business School.

[20] NERA (April, 2007) "*A Review of the CAA's Assessment of the Risk-free Rate for the 2007 Airport Price Control Review: A Report for EdF Energy and Central Networks*".

may have been unwilling to consider the adoption of a "new" regulatory methodology for estimating the risk-free rate in the context of a regulatory review, however compelling the initial analysis.

In a recent submission to the BAA airports inquiry, Stephen Schaefer (2008) concurred with NERA's approach:

> "*If the yields on Treasury bonds are lower than swap rates primarily because Treasuries provide liquidity benefits then, on the (reasonable) assumption that equities do not themselves provide the same liquidity benefits as Treasuries, the swap rate may be a better measure of the risk-free rate than the Treasury rate when applying the CAPM to estimate the required return on equity".*

However swap rates are not entirely risk-free and reflect the default risk of the interbank sector, which is generally considered as AA credit risk. A measure of interbank - or AA credit risk - can be readily obtained from market data on Credit Default Swap (CDS) contracts or market indices thereof.

In its simplest form, a single-name CDS contract can be illustrated as follows: The first party to the contract, the protection buyer, wishes to insure against the possibility of default on a bond issued by a particular company. The company that has issued the bond is called the reference entity. The bond itself is designated the reference obligation. The second party to the contract, the protection seller, is willing to bear the risk associated with default by the reference entity. In the event of a default by the reference entity, the protection seller agrees to buy the reference issue at its face value from the protection buyer. In return, the protection seller receives a periodic fee from the protection buyer. This fee, typically quoted in basis points per £100 notional amount of the reference obligation, is called the default swap premium.[21] Similar to the way a stock index is created as a portfolio of individual stocks, a CDS index is a portfolio of single-name credit default swaps.

In deriving a swap-based risk-free rate, we base our estimate of interbank default risk on a CDS index (5 year maturity) for Senior Financials compiled by iTraxx.[22] CDS indices form a large sector of the overall credit derivative market. The iTraxx indices are constructed on a set of rules with the overriding criterion being that of liquidity of the underlying CDS. CDS indices allow an investor to transfer credit risk in a more efficient manner than using groups of single CDSs. They are standardised contracts and reference a fixed number of obligors with shared characteristics.[23] The iTraxx Senior Financials CDS index provides the best available market data for measuring interbank credit risk inherent in swap rates.

We note there is some academic support to our approach. For instance Hull, Predescu, and White (2004) estimate a risk-free rate for the US market over a period from 1998 to 2002

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[21] In the event of default, the contract is settled (exchange of the bond and the face value) and the protection buyer discontinues the periodic payment. If a default does not occur over the life of the contract, then the contract expires at its maturity date.

[22] The iTraxx suite of indices are owned, managed, compiled and published by International Index Company (IIC), that is a company owned by a group of the largest global investment banks.

[23] Investors can be long or short the index which is equivalent to being protection sellers or buyers.

using swap rates and CDS premiums. The authors conclude "*that our best estimate is therefore that the benchmark five-year risk-free rate is on average about 10 basis points less than the swap rate. […] Alternatively [the risk free rate] can be characterized as above the Treasury rate by about 83% of the spread between the five-year swap rate and the five-year Treasury rate*".[24] This means, Hull, Predescu, and White find that the five-year Treasury yield is around 60 bps below their measure of the risk-free rate.[25] We note the iTraxx CDS index data available to us in 2008 represents a substantial improvement in measuring default risk in swap rates.

Before the introduction of CDS indices[26], the academic literature discussed the spread between LIBOR and the general collateral ('GE') repo rate as a possible measure for interbank credit risk. Cooper and Scholtes (2001) and Choudry (2005) have both suggested that the *expected* difference between the general collateral repo rate and LIBOR could be used as a proxy for a measure of interbank risk.[27] However in a recent paper, Feldhutter and Lando (2007) argue that "short term liquidity effects in the [Libor-GE repo] spread imply that this spread is not suitable for catching the credit risk premium in longer term swaps".[28]

We note CDS indices are a readily available data source (other than the Libor-GE repo spread, which needs to be constructed as the difference of Libor and the GE repo rate) to measure interbank credit risk. Time series evidence (with the exclusion of the current period of credit market turbulences) also shows that CDS index premiums have been relatively stable over time.

Using swap rates and market data on CDS index premiums for Senior Financials, we estimate a *nominal* risk-free rate by deducting CDS premiums from swap rates. A swap-based *real* risk-free rate is then obtained by stripping out inflation expectations from our nominal risk-free rate. We do this by applying the Fisher formula, which in general terms can be expressed as:

$$1 + r = \frac{(1 + n)}{(1 + \pi_e)} \tag{2.1}$$

Where r is the real rate, n is the nominal rate and π_e is expected inflation.[29]

The value of expected inflation is an important component in the calculation of the real risk free rate.

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[24] See Hull, Predescu and White (2004) "The relationship between credit default swap spreads, bond yields, and credit rating announcements", Journal of Banking and Finance, Vol. 28 (11), November, p2789-2811.

[25] Calcualted as 10 bps / (1 – 0.83%) = 59 bps.

[26] iTraxx published the first CDS indices in mid-2004.

[27] Since this approach obviously assumes the GC repo rate is default free, a natural extension might be to use the repo rate itself as a measure of the risk free rate. However, repo rates usually only have very short term (i.e. up to one year) maturities, which is not generally sufficient to avoid biases introduced by the interest rate and business cycles.

[28] Peter Feldhütter and David Lando (2007) Decomposing Swap Spreads, *Working paper*, May, Copenhagen Business School, p23.

[29] Throughout this report real rates (such as for the cost of debt) are derived from nominal rates through the Fisher formula.

Since price-caps for UK water are indexed to RPI (as are ILGs), for consistency, we require forecasts of RPI. Ideally, we would require a five-year-ahead measure of RPI inflation to match the maturity of the five-year swap rate.

HM Treasury publishes RPI forecasts on a monthly basis since 1997. However forecasts are only available for one year ahead, which is insufficient for our purpose in estimating a five-year maturity real risk-free rate.[30]

Oxford Economic Forecast (OEF) publishes forecasts of RPI on a quarterly basis up to four years ahead on a continuous basis since 1997. Earlier publications (1997 – 2000) provide forecast for 3 years ahead.

On the basis that OEF produces on a continuous basis medium-term RPI forecasts, we use this data source for our measure of inflation expectations. We derive a time series of inflation expectations used to deflate our time series of nominal swap rates. Since OEF is a quarterly publication, we estimate inflation expectations for each quarter by taking an average of OEF's medium-term inflation forecast. Within each quarter we hold inflation expectation constant.[31]

Applying this approach we obtain an estimate of expected RPI inflation of 2.60% over the April 1998 to March 2008 period. For the period from January 2008 to March 2008 the estimate of inflation expectations is 2.64%.[32] Our preferred estimates are shown in Table 1.

Table 1
Expected RPI Inflation

	April 1998 – March 2008	January 2008 – March 2008
Expected RPI Inflation	2.60%	2.64%

Source: NERA calculations based on Oxford Economic Forecasting's RPI inflation forecasts. Averages are calculated as the arithmetic average over NERA-constructed quarterly forecasts within the period shown. Quarterly forecasts are constructed as the arithmetic average of all year-ended inflation forecasts published by OEF in that quarterly publication.

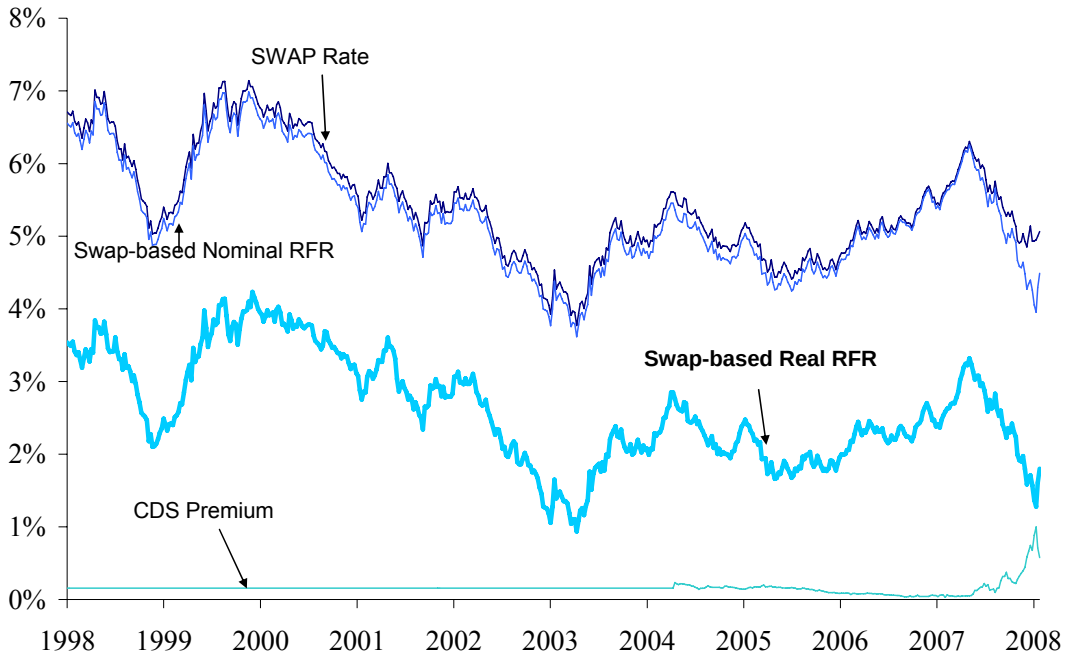
[30] We note, for the period February 2002 – May 2004 (inclusive), some editions (usually every four months) contain forecast of RPI of up to four-years ahead. From August 2004 onwards, HM Treasury replaced RPI forecast with CPI forecasts.

[31] We note that the Competition Commission in its recent BAA recommendation derived RPI inflation expectations of 2.8% per annum by adding the Bank of England's CPI target of 2.0% to the historical difference between RPI and CPI (0.8%). We do not believe that this is an appropriate measure of medium-term inflation on an ongoing basis.

[32] The use of an arithmetic average instead of a geometric average will not be materially different provided there are not significant fluctuations in the inflation forecasts. We note that the OEF forecasts do not exhibit much volatility at any point in time. Had we taken an arithmetic average of geometric averages (instead of an arithmetic average of arithmetic averages) for the April 1998 to March 2008 period we would have obtained inflation expectations of 2.56% instead of 2.60%. For the January 2008 to March 2008 period the approach based on geometric averages would deliver inflation expectations of 2.62%.

Figure 2.4 shows swap-based estimates of the real risk free rate over a ten year horizon since 1998, deflated by our index of inflation expectations. Although the data shows a fall in the real swap-based risk-free rate since the late 1990s, the decline is much less significant than the decline in ILGs shown in Figure 2.2 above.

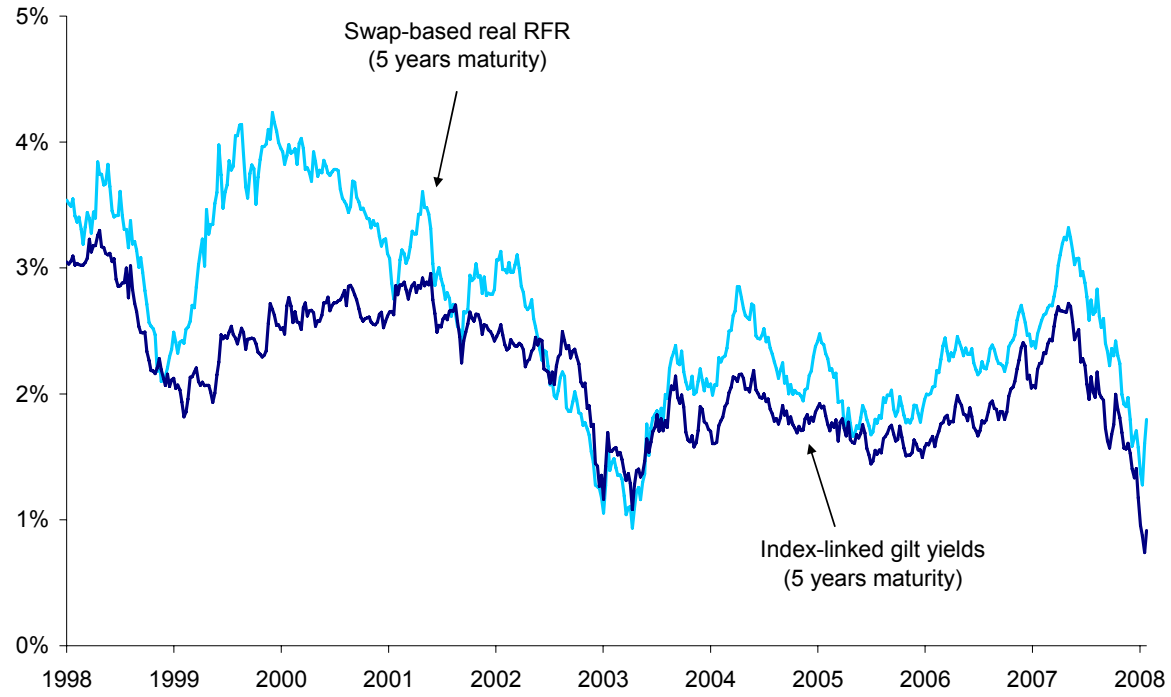
Figure 2.4
Swap-based Real Risk-free Rate
(March 1998 – March 2008)



Source: Bloomberg, Oxford Economic Forecasting (RPI Inflation forecast 1998 –2008) and ITraxx, 5Y Senior Financials, Series 1. Note: iTraxx series 1 starts in Jun-04; CDS premium for Mar-98 to Jun-04 equal to average CDS premium from Jun-04 to Mar-08 of 16 bps.

We now compare the risk-free rate derived using swap rates with the ILG yields on a 5 year maturity bond. Figure 2.5 shows the risk-free rate from swap rates is above the rate for ILG over the whole period, except in 2003. That is, the real risk-free rate derived from medium term ILG has been lower, historically, than our preferred swap-based real risk-free rate. And, importantly, ILG yields have also plunged since the onset of the credit crunch.

Figure 2.5
Swap-based Real Risk-free Rate versus IL Gilt Yields
(March 1998 – March 2008)



Source: Bloomberg, iTraxx, Bank of England yield curves - real spot rate, Oxford Economic Forecasting (RPI Inflation forecast 1998 –2008) and NERA analysis.

Table 2.3 shows our swap-based measure has historically exceeded ILG yields by around 40 basis points over a ten year period. In the current period the differential between the two approaches has widened further to about 50 basis points.

Table 2.3
Estimates of the Risk-free Rate over Different Timeframes (%)

	Swap-based RFR 5Y Maturity	ILG 5Y Maturity
Current	1.7	1.2
PR04 – June 2007	2.2	1.9
April 1998 – March 2008	2.6	2.2

Source: Bloomberg, Bank of England yield curves - real spot rate, Oxford Economic Forecasting (RPI Inflation forecast 1998 –2008) and ITraxx, 5Y Senior Financials, Series 1. Note: iTraxx series 1 starts in Jun-04; CDS premium for Mar-98 to Jun-04 equal to average CDS premium from Jun-04 to Mar-08 of 16 bps.

2.5. Conclusions on the Risk-free Rate

Our analysis in this section has shown that yields on UK ILGs remain downwardly biased as a measure of the real risk-free rate - as a result of regulatory and accounting distortions (Minimum Funding Requirement and FRS17) that have caused temporary (though not short-lived) increases in demand for government securities. Using the UK ILG rate would therefore result in the cost of capital being underestimated.

Applying an arbitrary or unsubstantiated adjustment to the UK ILG rate would be inconsistent with the aim of using objective and transparent methods. Such an adjustment is unnecessary since objective evidence on the risk-free rate is available from the swap market which is not affected by the factors distorting UK government bond yields. Although this method is new in the UK regulatory arena, it has considerable academic support.

In Table 2.4 below, we present our estimate of the real risk-free rate based on swap rates. This evidence shows a real risk-free rate of 2.60%.

Table 2.4
Swap-based Measure for the Real Risk-free Rate (%)

	Long-Term (Mar 1998 - Mar 2008)
Swap rate	5.45
CDS premium	0.16
Swap-based Nominal RFR	**5.30**
Expected Inflation (RPI)	2.60
Swap-based Real RFR	**2.6**

Source: Bloomberg, Oxford Economic Forecasting (RPI Inflation forecast 1998 – Winter 2008) and iTraxx, 5Y Senior Financials, Series 1. Note: iTraxx series 1 starts in Jun-04; CDS premium for Mar-98 to Jun-04 equal to average CDS premium from Jun-04 to Mar-08 of 16 bps, Expected inflation calculated as average (March 1998 – March 2008) of averages of quarterly inflation expectations for up to four years ahead.

3. Beta

This section discusses the estimation of the beta parameter, the measure of non-diversifiable risk. Section 3.1 discusses various issues that should be considered in estimating betas, including the periodicity, adjustments to raw betas and adjustments to capital structure. Sections 3.2 presents our estimates of beta for the UK water sector, based on six month, one year and long run data. Section 3.4 discusses recent evidence on beta for UK utilities produced by Smithers (2004) and referred to in Ofwat's SPL (March 2008). Section 3.5 concludes.

3.1. Methodological Issues

3.1.1. Formula for deriving beta

Beta is a measure of the non-diversifiable risk of an asset relative to the risk on the market portfolio. It is defined as the covariance between returns[33] on an asset and returns on the market portfolio, divided by the variance of returns on the market portfolio:

(3.1) $$\beta = \frac{\text{cov}(r_e, r_m)}{\text{var}(r_m)}$$

where:

r_e is the return on a specific stock; and

r_m is the return on the market as a whole.

In theory, since the CAPM is based on expected future returns, the appropriate measure for beta is the current *expected* beta. However, in practice, as forward-looking estimates of returns on particular stocks and on the market as a whole are not available, historic returns are generally used as a proxy for expected future returns.

We derive estimates of beta for UK water using daily, weekly and monthly data over a range of historical time periods. We agree with the conclusions of Smithers and Co (2003) that the use of daily data is preferable to the use of weekly or monthly data over short time periods on the basis that beta estimates derived using daily data are more statistically robust *provided the trading frequency of the share is sufficient*.[34] Beta estimates derived using daily data can also provide a better "forward looking" measure of the riskiness of the asset on the basis that daily betas can be estimated over a period of six months to a year whereas weekly or monthly betas

[33] Returns should strictly speaking be estimated as total realised returns, ie including dividend payments: Returns = (Price_t + Dividend_t - Price_{t-1})/ Price_{t-1}. However, as noted in Patterson (1995), using percentage price change instead of total returns is likely to an unbiased estimate of beta for most firms. Smithers and Co (2003) advocate the use of excess returns (ie returns over and above the risk-free rate). However, Patterson (1995) notes that in instances where the return on the risk-free asset is correlated with the return on the market, the bias introduced by ignoring this adjustment will be small except when interest rates are very volatile (in which instance, as shown by Roll (1969), if the correlation is positive, the bias will be positive for betas less than one, and negative for betas greater than one). We have disregarded this adjustment to returns in this report.

[34] Smithers and Co (2003) derive estimates of equity betas for BT using daily, weekly, monthly and quarterly data. The authors show that the standard errors from daily data are around 1/3 of the standard errors using monthly data. They conclude that "*there is a huge increase in accuracy with daily data*" (p80) by comparison to betas estimated using weekly or monthly data.

generally need to be estimated over a period of two to five years so that the number of data points is sufficient to ensure that estimates are robust.

3.1.2. Adjustments to Raw Equity Beta Estimates

It is standard practice to adjust the raw equity betas (or historical betas, i.e. those betas obtained from the regression of the company's stocks against the market index) according to a simple deterministic formula:

(3.2) $$\beta_{\text{Equity-adjusted}} = (0.67)*\beta_{\text{Equity-raw}} + (0.33)*1.0$$

This is referred to as the Blume adjustment and is widely used, for example by Bloomberg, Merrill Lynch and ValueLine (see Patterson, 1995). The Blume adjustment formula takes account of the tendency of estimated betas to converge towards the market value of one over time.[35]

An alternative adjustment process, the Vasicek or "Bayesian" adjustment process, adjusts betas to take account of differences in the degree of sampling error for individual firm betas rather than applying the same adjustment process to all stocks.[36]

There has not been extensive research into the comparative accuracy of the Blume versus the Vasicek adjustment technique. Klemkosky and Martin (1975) found that the Vasicek technique had a slight tendency to outperform the Blume technique.[37] However, a later study by Eubank and Zumwalt (1979) concluded that the Blume model generally outperforms the Vasicek model over shorter timeframes, with little difference over long time periods.[38] The computational simplicity of the Blume formula over the Vasicek formula may explain why the former is often preferred.

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[35] Blume (1971) tested to see if forecasting errors based on historical estimates were biased. Blume demonstrated that a tendency for estimated betas to regress towards their mean value of one. The adjustment formula above captures this tendency.

[36] The Vasicek methodology forecasts beta for security I (β_{i2}) as: $\beta_{i2} = \frac{\sigma^2_{\beta i1}}{\sigma^2_{\bar{\beta}1} + \sigma^2_{\beta i1}}\bar{\beta}_1 + \frac{\sigma^2_{\bar{\beta}1}}{\sigma^2_{\bar{\beta}1} + \sigma^2_{\beta i1}}\beta_{i1}$, where β_{i1} is the historical beta for stock I, σ^2 is the variance and $\bar{\beta}_1$ is the average beta.

[37] See Elton and Gruber (1995), page 145.

[38] See Patterson (1995), page 127.

3.1.3. Adjusting Betas for Differences in Capital Structure

The value of the equity beta (i.e. the beta obtained from OLS regression of company returns on returns on the market portfolio, and adjusted according to the Blume adjustment) does not only reflect business risk, but also financial risk.[39] Equity betas have been adjusted for financial risk ("de-levered") to derive asset (or "unlevered") betas throughout this study according to the following formula:[40]

(3.3) Miller formula**:** $\beta_{Asset} = \beta_{Equity-adj} * (1 - g)$

Where *g* is the actual gearing (D/(D+E)) of the company.[41]

In a final step, we re-lever asset betas to reflect the target capital structure. The equity beta consistent with a notional target gearing level is calculated as follows:

(3.4) $\beta_{Equity@g_T} = \beta_{Asset} / (1 - g_T)$

Where g_T is the target gearing of the company.

3.2. Six Month Rolling Asset Betas for UK Water

Our estimation of beta focuses upon the co-movement between the share prices of listed UK water companies and the relevant market index, the FTSE All-share index. At the time of writing there are only three listed WaSCs, but for most of the period under consideration there have been four companies.[42]

Our initial analysis of water companies' betas focused upon estimates over six month rolling windows. Six month windows were chosen to balance data requirements against the likelihood that short term fluctuations in beta would be observable. A longer time frame might hide these fluctuations, while an even shorter window might not produce statistically robust estimates. Our analyses of six month rolling betas indicate the following:

- Equity and asset betas experienced two major periods of decline – around the PR99 review and over the period 2000-2001 following PR99. Betas also decreased early in the PR04 period. This suggests a de-coupling of water-company and market returns during price review periods. This effect was most during the AMP3 period.
- Betas have steadily increased since PR04, falling slightly over later months of 2007. This may be a consequence of water companies' divesting their non-regulated businesses: to

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39 As a company's gearing increases, the greater the variability of equity returns, since debt represents a fixed prior claim on a company's operating cashflows. For this reason, increased gearing leads to a higher cost of equity.

40 This formula is attributed to Miller (1977).

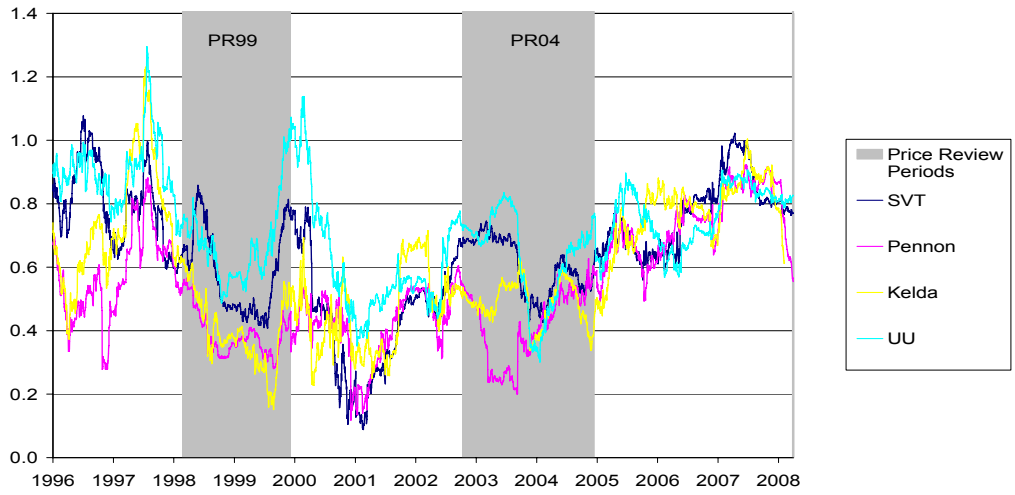
41 Net debt is defined as short-term and long-term borrowings less cash and cash equivalents. In practice, book value of debt is commonly used rather than market value. Book value has been used in this study.

42 Listed companies are Severn Trent, United Utilities, and South West Water. Kelda was listed until February 2008. Note we have not included market evidence for Northumbrian or for Dee Valley (which is the only listed WoC) in our calculations due to the relatively small size of the companies and the illiquidity of their stocks (which in the case of Northumbrian has become less of an issue in recent years), both of which may bias the resulting estimate of beta.

the extent the non-regulated business is less capital intensive than the core business, divestment leads to an increase in companies' operational leverage, and hence in an increase in beta risk.

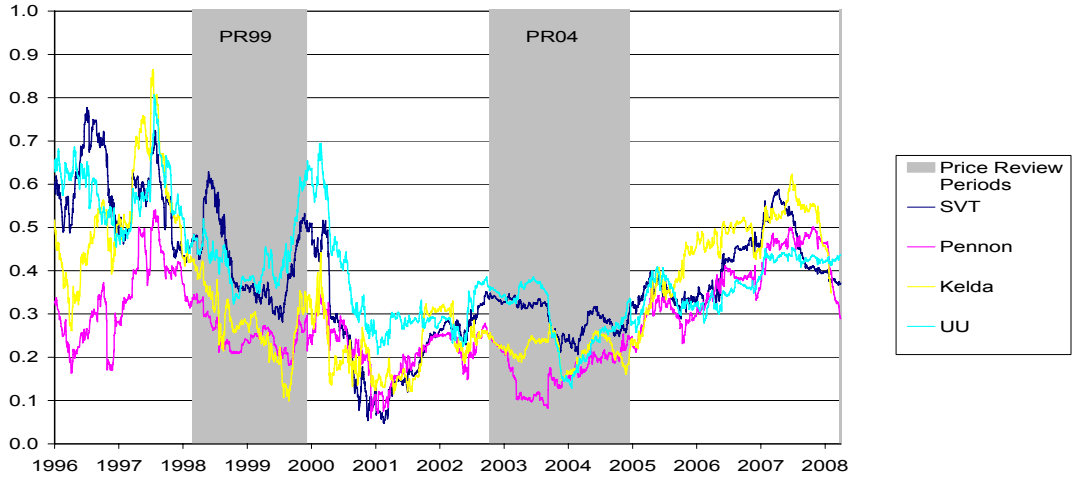
- There has been a fall in betas in recent months that appeared to start around the second half of 2007 (coinciding with the start of the credit crunch and also the start of the PR09 price review consultation process).
- The range of betas across companies has also narrowed since PR04, coinciding with the divestment of many non-regulated businesses, which has reduced the differences in the nature of businesses operated by the listed companies.

Figure 3.1
Six-Month Rolling Raw Equity Betas



Raw equity betas are adjusted using the Blume adjustment. Betas measured in sterling against FTSE All Share Index. Price Review Periods are presented for illustrative purposes and are defined as period between 'Setting price limits for water and sewerage services' document and Final Determinations.

Figure 3.2
Six-Month Rolling Asset Betas



Betas measured in sterling against FTSE All Share Index. Price Review Periods are presented for illustrative purposes and are defined as period between 'Setting price limits for water and sewerage services' document and Final Determinations. Asset betas are derived from Blume adjusted equity betas using Miller adjustment: B(asset) = B(equity)/(1+average(D/E)). Average D/E measured over period of beta estimation.

We also undertook a comparison of the asset betas using weekly or daily data. The results are shown in Table 3.1 below. The betas estimated using daily data are generally slightly lower than using weekly data but, overall, there is a strong clustering around a central range of 0.35-0.45.

Table 3.1
Asset Betas from Current Market Data

	Daily	Weekly
Six Month		
Severn Trent	0.38	0.38
Pennon	0.33	0.39
Kelda	0.32	0.34
United Utilities	0.43	0.42
Average	**0.36**	**0.38**
One Year		
Severn Trent	0.39	0.42
Pennon	0.37	0.45
Kelda	0.41	0.52
United Utilities	0.43	0.43
Average	**0.40**	**0.45**

Source: NERA analysis of Bloomberg data.

3.3. Long Run Asset Betas for UK Water

Even though the very recent betas show quite a strong clustering, it is important to understand why betas have changed over the longer term period and whether this reflects a real change in the underlying riskiness of the water sector over this period.

In our 2004 WACC report on the UK water sector[43] we highlighted two important reasons to explain the very low levels of betas following PR99, namely:

- the financial restructuring that the UK water sector experienced around this time. For example, AWG's share price was clearly affected by the long period of speculation, and subsequent implementation, of a 'thin equity' structure. By contrast, UU made clear that it was going to retain the 'traditional' financial structure and its beta estimate was considerable higher over this period.
- the impact of PR99: the covariance of the FTSE Water Index and the FTSE All Share Index dipped towards zero around late 1999, around the period of the 1999 Final Price Determination. This is likely to have been caused by 'decoupling' of the water stocks' share price from the market over that period, as investors withdrew from the water stocks in response to the perceived harsh price review.[44]

The reason why regulatory price reviews have negative impacts on beta estimates is as follows: around the period of the regulatory price review, the company's stock price primarily reacts to regulatory announcements and expectations of the outcomes of the next price control, rather than to movements in the market as a whole. This means the beta of

[43] "UK Water Cost of Capital", A Report for WUK Members, NERA 2004

[44] The perception of harsh regulatory reviews in both the electricity and water sectors was reflected in newspaper reports at the time: "Spare the rod and spoil the utility. That seems the current message from water and electricity price watchdogs. Whatever their past laxity, this year they are making up for lost time", Daily Mail, 21 November 1998. "These are worrying times for investors in utilities… The pressure from regulators and competition regimes fixed against the incumbents have taken a sickening toll on share prices", The Times, 27 November 1999.

water stocks during review period tends to decouple from market risk, i.e. the volatility is influenced by regulatory announcements, which are not correlated with movements in the market as a whole. Hence betas during this period are not representative of the fundamental business risk of water companies.[45]

We observe in the water sector that regulatory price reviews have a systematic negative impact on beta estimates. However since price reviews *per se* do not lead to a decline in the fundamental riskiness of the stock (otherwise regulators should introduce more frequent price reviews to reduce risk) the beta calculation method must control for the effect of price reviews in order to calculate an unbiased estimate of the systematic cost and business risk of the sector.

To examine the potential bias on estimates of beta for the water industry caused by the impacts of price reviews, we perform a dummy variable regression, adopted by Francis, Grout and Zalewska (2000) and Buckland and Fraser (2001). Specifically, we test the impact of price review periods upon beta by estimating the following equation which allows beta to vary during price review periods:

(3.5) $$R_{it} = \alpha + \beta R_{mt} + \alpha_1 R_{mt} PR99 + \alpha_2 R_{mt} PR04 + \varepsilon_t$$

PR99 and PR04 are dummy variables for each of the price review periods i.e. the period between the release of the final "Setting price limits for water and sewerage services" document and the publication of the Final Determination.[46] The equation is estimated using the most available data for each water company.

The OLS estimation results are presented in Appendix B. We find both price review periods have a statistically significant negative impact on beta, consistent with the de-coupling our rolling beta estimates suggested. The negative effect of price review periods on beta estimates is further confirmed by Kalman-Filter analysis.[47] In particular, we find price review periods have a significant negative effect on beta for all four companies using daily, weekly or monthly data.

This regression allows us to identify the "normal" conditions beta for these stocks, as well as estimate the impact on beta of PR99. We estimate this equation using OLS on daily returns data for Severn Trent, United Utilities, Kelda, and Pennon against the FTSE All-Share index over the period since privatisation.

The asset beta estimates are tightly clustered between 0.33 and 0.44, with Pennon the lowest and United Utilities the highest (see Table 3.2). The average asset beta across the four

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[45] In the finance literature, the impact of company specific "events" on a beta estimate is known as "decoupling". Kolbe (2000), in particular, has argued that decoupling can cause significant biases in estimates of the true beta of a stock

[46] For PR99 the review period is between 26 February 1998 and 25 November 1999. For PR04 the corresponding period is between 15 October 2002 and 2 December 2004. The period for PR94, included in Appendix B, is 4 November 1993 to 28 July 1994.

[47] An alternative more technical technique for abstracting from market volatility employs the Kalman-Filter. Appendix C presents a detailed explanation of a Kalman-Filter approach (and the Kalman-Filter technique). The key findings of that research are extremely similar to the results we present here based on simple OLS and dummy variables for each price review period.

companies is 0.39 using daily data. We note there is little variation between estimates using different periodicities, reflecting the long time series of data used.

Table 3.2
Asset Betas: Controlling for Price Review Periods

	Daily	Weekly	Monthly
Severn Trent	0.41***	0.43***	0.45***
Pennon	0.33***	0.33***	0.37***
Kelda	0.37***	0.42***	0.47***
United Utilities	0.44***	0.45***	0.47***
Average	0.39	0.41	0.44

*Source: NERA calculations using Bloomberg data. SVT data from 11/7/1991; UU data from 19/7/1990; KEL data from 11/7/1991, and; PEN data from 23/7/1990. End date is 31/12/2007. Asset betas calculated using gearing ratio averaged over sample. ***, ** and * indicate statistical significance of raw betas at 1%, 5% and 10% levels.*

3.4. Smithers (2004) on Beta for UK Utilities

Ofwat's March 2008 methodology paper on PR09 states that work by Smithers and Co (2004) "*estimates a long term beta of 0.5 for utilities (albeit with a wide confidence interval)*".[48] Ofwat refers to this evidence as relevant to the cost of equity for water companies.

Although the Smithers (2004) report was written for Ofgem, we note its conclusions were not actually used by Ofgem in setting the cost of equity at the 2004 DNO price control or the 2006 TPCR or the 2007 GDPCR. In each of these regulatory decisions, Ofgem used an equity beta of 1.0 in setting the cost of equity and did not refer to the Smithers paper in their decision.

Smithers do not set out how they derive an equity beta estimate of 0.5. Smithers' analysis sets out a range of evidence which shows equity betas varying between 0.09 and 0.90, depending on the methodology and reference market used. A beta of 0.5 is roughly the average of the betas presented. However, the average beta of 0.5 is consistent with *actual gearing* of the electricity comparators over this period, which we calculate has been significantly lower (37%) than Ofgem's assumed gearing of 60% at TPCR6 and 62.5% at the GDPCR in 2007. For comparative purposes, we derived (using data up until 2004) beta estimates for the same companies analysed by Smithers and adjusted the betas for 60% gearing using the standard formula set out in Section 3.1.3 above. Our analysis of the daily beta estimates for electricity companies National Grid, SSE and Scottish Power showed ranges from 0.8 to 1.3 at a 60% gearing level. This analysis is consistent with recent UK regulatory precedent, including Ofgem's decisions, which has typically set equity betas equal to one.

[48] Smithers (2004): Smithers & Co. "Beta Estimates for: Scottish Power, Scottish & Southern Energy, Viridian Group, Centrica, International Power, National Grid Transco, United Utilities, Kelda Group, Severn Trent, provided to Ofgem" 15 March 2004. p.5

Smithers do not fully justify their reasons for not re-levering equity betas. However (p.57), they present evidence showing that equity betas have declined for eight of the comparators over the period even though gearing has increased. Smithers appear to suggest that this evidence may undermine the standard assumptions made in finance theory that there is a positive relationship between gearing and the cost of equity.

We fundamentally disagree that the small sample of evidence presented by Smithers on betas and gearing over time is sufficient to abandon traditional and well established theories of optimal capital structure that are based on substantial empirical evidence that does show a positive relationship between gearing and the cost of equity.[49] There are only a few companies considered in the Smithers study by comparison to the large body of empirical data that has been examined to support the proposition that beta does increase with gearing. Crucially, the analysis undertaken by Smithers does not control for other factors that may also have affected the betas of the companies over this period.[50]

In conclusion, Smithers have presented little evidence to support the proposition that Modigliani-Miller's predictions of a positive relationship between equity betas and gearing levels do not hold. We therefore see no reason to depart from the standard approach of re-levering observed equity betas for consistency with the gearing assumption. The results suggest that equity betas for electricity companies at 60% gearing lie in the range of 0.8 to 1.3 not the 0.5 given by Smithers. There is no reason why Ofwat should prefer Smithers (seemingly erroneous) beta estimate of utilities to empirical evidence for UK water companies.

3.5. Conclusions on Beta Estimates

We estimate an asset beta for UK water using the following methodology:

- We estimate betas for listed UK WaSC stocks over the period of listing since privatisation;
- We base our estimates of beta using *daily* data on historic stock market returns;

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[49] There is a substantial body of academic work showing that the main prediction of Modigliani-Miller theory – that higher gearing increases the cost of equity - continues to hold. Copeland and Weston (1993) and Morin (1994) provide a summary of the empirical evidence on the effects of changes in capital structure on beta estimates. Morin concludes that: *"the evidence strongly favors a positive relationship between leverage and the cost of equity which is consistent with the Modigliani-Miller proposition. However, there is still some controversy over the acceptance of the linear formulation…(S)ome investigators believe the relationship is curvilinear, others believe it is linear but has a slope of less than R-i."*. Further studies finding evidence supporting the positive relationship between gearing and the cost of equity include Mehta, Moses, Deschamps and Walker (1980), Gapenski (1986), Brigham, Gapenski and Aberwald (1987), Copeland and Weston (1995) and Graham (2002). In summary, the bulk of empirical work done in this area supports the predicted positive relationship between gearing and the cost of equity.

[50] A close inspection of the Smithers paper shows that there are a number of reasons why – for their sample of companies and time periods – we do not observe a positive relationship between gearing and beta. Smithers themselves note one important reason, namely that betas fell during the early 2000 period during the bear market: "*Early 2000 was of course the peak in global stock markets, and was followed by a significant bear market. It is possible that a number of these companies were viewed as having a particular advantage as relatively safe investments in the bear market, and that this brought down their betas…*"

- We follow the approach adopted by Francis, Grout and Zalewska (2000) that uses dummy variables to control beta estimates for the impact of temporary shocks such as regulatory events.
- Based on this methodology, the asset betas of UK water stocks lie in a range of 0.33-0.44. The average based on daily data is 0.39. This is very similar to very recent beta estimates for UK water which lie in the range of 0.32-0.43 depending on the use of six or twelve months data using daily data.

We summarise our beta estimates in Table 3.3 below.

Table 3.3
UK Water Asset Betas

Period	Range	Point Estimate
Current (Six months/1year)	0.32 - 0.43	
Long-term (Ten years)	**0.33 - 0.44**	**0.39***

*Source: NERA analysis; * point estimate based on use of daily data.*

4. The Equity Risk Premium

The equity risk premium (ERP) is the difference between the expected return on the market portfolio and the expected return on a risk-free asset (formally stated as $E[r_m] - E[r_f]$) i.e. it is the reward investors demand for bearing the risk they expose themselves to by investing in equity markets.

In Section 4.1 we summarise recent UK and international regulatory precedent on estimates of the ERP. Section 4.2 discusses the CC's estimate of the ERP. Section 4.3 states alternative methods for estimating or calculating the ERP. Section 4.4 sets out the historical ERP based on very long-term averages of historic returns. Section 4.5 presents forward-looking ERP estimates derived from the FTSE 100 using a Dividend Growth Model. Section 4.6 concludes.

4.1. Regulatory Precedents on the ERP

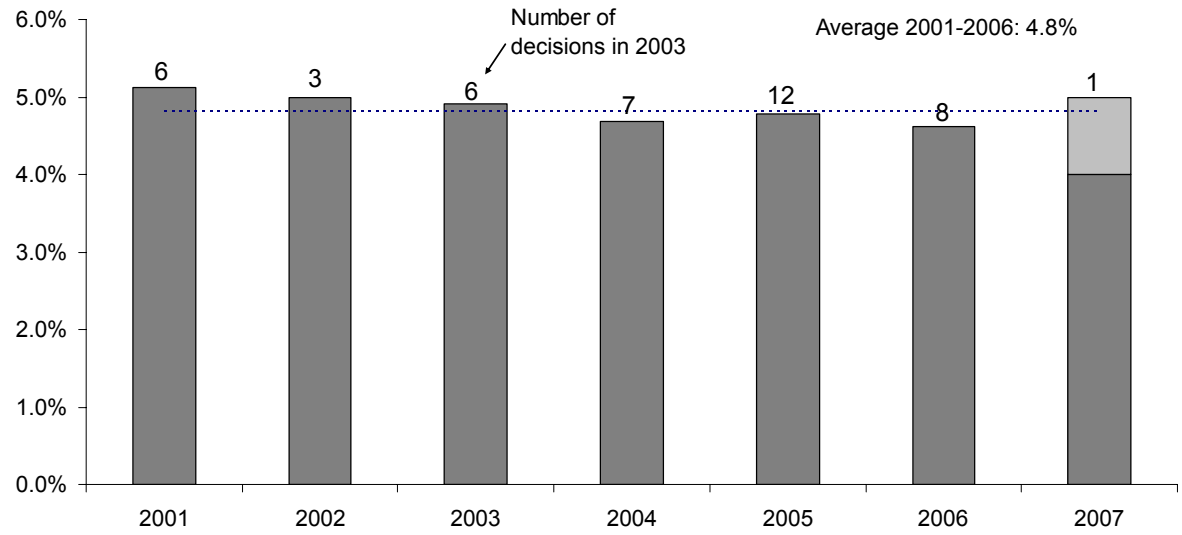
At PR04, Ofwat estimated the ERP to be in the range of 4.0-5.0% based on the advice of CEPA and EE who were reported to have advised Ofwat that the very top end of this range was most appropriate.[51] Ofwat's allowed cost of capital of 5.1% was consistent with an ERP at the top end of this range.

Ofwat's estimate of the ERP at PR04 of around 5.0% is very similar to the average estimates of other European regulators in recent years. Figure 4.1 presents average ERPs allowed by European regulators from 2001 to 2007. The average ERP over this period is 4.8%, comprising decisions ranging from 3.5-6.0%.[52] Appendix D presents the range of decisions from which we derive this average.

[51] Ofwat (2004) Final Determination, p268.

[52] The average and range only cover regulatory decisions for 2001 to 2006. The CC/CAA and CER (Ireland) decisions in 2007 only present the ERP as a range, while Ofgem's 2007 gas distribution decision did not disclose constituent cost of capital parameters.

Figure 4.1
ERP – European Regulatory Precedents (2001 – 2007)



Source: Various regulators. A full listed of the decisions considered is set out in Appendix D.
Note: 2007 figure is based on one regulatory decision from CER (Ireland), where the regulator states a range of 4.0-5.0%; CER concludes on an overall allowed cost of capital which is at the upper-end of the resulting range; CC/CAA 2007 decision for BAA not included; CC/CAA stated range of 2.5-4.5% and concluded on upper end of this range; Ofgem's 2007 gas distribution decision did not disclose constituent cost of capital parameters.

The Figure above shows that the average ERP used by regulators is broadly stable across the whole period. Examining trends over time for individual regulators shows that most regulators have either maintained a constant ERP or have increased the ERP in more recent decisions (see Appendix D). In particular, Ofgem (UK) has increased allowed ERPs relative to previous decisions. In late 2006 Ofgem used an ERP of 5.2% at the TPCR, versus 4.8% at the DNO review in 2004.

There is a notable outlier in recent UK regulatory estimates of the ERP, namely the CC's (2007) estimate of the ERP for the BAA price control (not included in Figure 4.1). In its recommendations to the CAA, the CC concluded that the appropriate range for the ERP is 2.5-4.5%. However, whilst the CC stopped short of recommending a specific point estimate for the ERP, its choice of point estimate for the cost of capital implies an ERP approaching 4.5% which is closer, but still below other UK regulatory decisions. The CC's methodology in arriving at a ERP range of 2.5-4.5% has received some notable criticism from the academic community, which we review in Section 4.2 below.

In the US and Australia, the ERP has generally been set at a higher level than in Europe. Recent regulatory decisions on the ERP are all at around 6%.[53] In the US, however, the CAPM is generally not used as the primary method for estimating the cost of equity, which

[53] For two Australian decisions which concluded on an ERP of 6% see (i) Essential Services Commission of Victoria (2008) Gas Access Arrangement Review 2008-12, March, and (ii) Essential Services Commission of Victoria (2005) Electricity Distribution Price Review 2006-10, October.

makes an estimate of the ERP unnecessary. The CAPM is however used as a check on DGM results and the most widely quoted source used in US hearings to assess the level of the ERP is the Ibbotson data.[54] The method recommended by Ibbotson is to compute the arithmetic average of stock market returns against long-term Treasury bond yields. This is consistent with the methodology applied by Dimson, Marsh and Staunton, our preferred source for the ERP discussed in Section 4.4 below.

4.2. The CC's Estimate of the ERP

The CC concluded on an ERP range of 2.5-4.5% at its recent review of BAA airports. The CC states that the lower end of the range is consistent with *ex ante* estimates by Dimson et al (2002, 2007) and Gregory (2007), and that the upper end of this range is consistent with *ex post* estimates by Dimson et al (2007)[55]. In reaching its conclusion on the WACC, the CC used an ERP of close to 4.5%. Because the CC's range of the ERP is a significant outlier compared to other UK regulatory decisions we include a more detailed analysis of the decision in this report.[56]

Our analysis shows that the CC's conclusions on the ERP range are flawed because they are inconsistent with the conclusions from the academic papers that they have cited. In particular, the CC cite Dimson et al's (2002, 2007) evidence on *geometric* ex ante returns but a close inspection of Dimson et al's papers show that they recommend the use of *arithmetic* means to estimate the prospective ERP since the arithmetic mean represents the mean of all possible outcomes. Dimson et al's ex ante 'world' ERP on an arithmetic basis is around 5% not the 3.0-3.5% geometric average reported by the CC.

There are also examples of selectivity in the choice of academic studies that the CC refers to on the ERP. For example, there is a large body of academic literature in favour of arithmetic averages, which the CC appears to overlook in its final conclusion on the ERP. Further, the CC seems to place significant weight upon an unrefereed (and therefore untested) working paper by Gregory (2007).

Further, according to recent academic opinion the CC's ERP range is too low. In particular, Myers (2008) argues that: "*(f)orecasted ERPs below 3.5% or 4% should attract extreme scepticism"*. Instead Myers argues for a range of 4-6%. Schaefer (2007) of the LBS estimates an ERP range of 2.5-6.5% while arguing that the CC's central estimate of 3.5% and its range for the ERP are very low.

Finally we note that the latest consensus view from around 400 finance professors that the equity premium is in a range of 4-7% with a central estimate of 6% as of year-end 2007 is also inconsistent with the CC's estimates of the ERP:

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[54] Ibbotson Associates publish data on the ERP every year in a handbook, "Stocks, Bonds, Bills & Inflation".

[55] Gregory, A, (2007) How Low is the UK Equity Risk Premium? XFi Centre for Finance and Investment, University of Exeter website. http://www.xfi.ex.ac.uk/workingpapers/0709.pdf.

[56] We elaborate on recent discussions of the CC's conclusion on the ERP in Appendix F.

> *"A sample of about 400 finance professors estimates the 1-year equity premium and the 30-year geometric equity premium to be about 5%, as of year-end 2007. The sample interquartile range is 4-6%. The typical range recommended in their classes is a little higher (from 4-7%, with a mean of 6%). Since 2001, participants have become more bearish (by about 0.5%).*
>
> *The participants estimate the 30-year arithmetic equity premium estimate to be about 75 basis points higher than its geometric equivalent; and they estimate the 30-year geometric expected rate of return on the stock market to be about 9%.*
>
> *…*
>
> *"… (I)n class, survey participants use a 6% estimate, which is higher than their own beliefs—but they also advocate a range from 4% to 7% that comfortably encompasses their own opinion."*[57]

Our review of the latest academic evidence on the ERP in this paper suggests that the majority of academic opinion supports the use of arithmetic averages of historic returns as the basis for estimating the ERP, in contrast to the CC's preference for geometric averages. This evidence is set out in Section 4.4 below.

4.3. Alternative Methods of Estimating the ERP

The ERP has been largely debated by academics and practitioners and different methods have been used to estimate it. The different approaches to estimating the ERP are summarized by Ibbotson and Chen[58] and restated by Song[59] who categorize the estimation methods into four groups:

1. *Historical method*. The historical ERP, or difference in realized returns between stocks and the risk-free rate (proxied by bonds, bills or cash), is projected forward into the future. See Ibbotson and Sinquefield (1976), which is updated annually by Ibbotson Associates (now Morningstar), and Dimson, Marsh, and Staunton (2007), which is also updated on an annual basis.
2. *Supply-side models*. This approach uses fundamental information, such as earnings, dividends, or overall economic productivity, to estimate the ERP. The most prominent approach within this group goes back to Gordon and Shapiro's suggestion that a dividend discount model (DDM) can be used to estimate the expected return on equity.
3. *Demand-side models*. This category uses a general equilibrium or macroeconomic model to calculate the expected equity return by considering the payoff demanded by investors for bearing the risk of equity investments. Mehra and Prescott (1985) is the best known

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[57] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1084918

[58] Roger Ibbotson and Peng Chen, "The Supply of Stock Market Returns," Ibbotson Associates, 2001.

[59] Zhiyi Song, "The Equity Risk Premium: An Annotated Bibliography", The Research Foundation of the CFA Institute, 2007.

example of this approach, and the "puzzle debate" is an attempt to reconcile the results of this approach with the much higher ERP estimates given by the other approaches.

4. *Surveys*. An estimate of the ERP is obtained by surveying financial professionals or academics (e.g., Welch 2000).

In the present study, we have estimated the ERP using the "historical method".[60] Using time series data on actual realised returns to estimate expected returns has theoretical support and is widely used by academics and practitioners. We note that an estimate of the ERP using long run time series data is consistent with our approach to the other CAPM parameters.

We cross check the results of the historical data by analysis of the forward-looking ERP for the UK using dividend and earnings growth models. Using these methods, we derive a "current" estimate of the ERP for the UK using 2007 forward-looking data.

We do not use demand side models or survey-based estimates of the ERP in this study. These types of models are not widely used in regulatory contexts due to disputable input assumptions. By contrast, an estimate of the ERP based on historical data is highly objective, easily understood and produces stable results over time which is all important criteria in a regulatory context.

4.4. Historical ERP Based on DMS Database

Dimson, Marsh, and Staunton (DMS) provide long-term time series data on returns on stocks, bonds, bills, and inflation for 17 countries over the period from 1900 to 2006.[61] The DMS database comprises annual returns and is widely regarded as the best-quality capital appreciation and income series available for each country.[62] We use DMS' estimate of the ERP based on long-term bonds as our preferred measure of the ERP.[63]

This approach indicates the ERP in the UK is between 4.2-5.4%, depending on whether an arithmetic or geometric mean is used (see Table 4.1).

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[60] See Appendix E for further discussion of the use of historical versus forward-looking data.

[61] Dimson, Marsh and Staunton, London Business School / ABN Amro "Global Investment Returns Yearbook 2007", February 2007.

[62] The data sources for DMS database is reported in Dimson, Marsh and Staunton "The Worldwide Equity Premium: A smaller Puzzle", Handbook of the Equity Risk Premium, 2008, Appendix 2, pp.507 – 514.

[63] The use of long-term bonds is justified by academics. For example McGrattan and Prescott (2003) argued that short term bills provide considerable liquidity services and are a negligible part of individuals' long-term debt holdings. As a result, long-term bonds should be used as the riskless asset in equity premium calculations.

Table 4.1
ERP based on 106 Years of Equity Returns

	Arithmetic Average (%)	Geometric Average (%)	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 Average	5.2	4.1	1.4

Source: Dimson, Marsh and Staunton and LBS / ABN Amro 2007

Substantial debate has taken place over whether average realised historical equity returns should be calculated using either geometric or arithmetic averages. The debate about arithmetic or geometric returns is essentially a debate about market efficiency. Holmans (1996) summarises the arithmetic versus geometric mean controversy as follows:

> *"The arithmetic versus geometric controversy is basically about market efficiency and how one believes the stock market functions. Market efficiency implies that equity returns are serially independent (i.e. no mean reversion and no method of predicting future returns). In these circumstances, the correct estimator of the future market return is the long term ex post arithmetic mean (AM)."*

There have been a large number of studies to test for market efficiency. The empirical evidence (e.g. the surveys undertaken by Fama (1991) and Fama (1998)) generally supports the idea that prices do seem to be weak and semi-strong efficient but is less clear as to whether markets are strong form efficient.[64] There is also some mixed evidence of mean reversion in returns over the very long term which is why the debate on the use of arithmetic versus geometric averages has never been fully resolved.[65]

Some academics believe that the correct ERP for forecasting purposes is a weighted average of historical arithmetic and geometric averages. In a very recent report Professor Stewart Myers (2008), refers to a paper by Jacquie, Kane and Marcus (JKM) (2005) to show that the appropriate weight that should be given to arithmetic averages when estimating the ERP in a regulatory context for five years is 98% and the geometric average gets 2%.

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[64] Finnerty (1976), Muelbrouk (1992) found evidence that insider trading is slightly profitable but Jensen (1968), Blake, Lehman and Timmerman (1997) when analysing the performance of mutual funds found that they do not generate abnormal returns, which is consistent with strong form efficiency.

[65] For example, there are academic papers that show "small firm effects", "January effects", "excess volatility", and "time of day effects". All of these are not fully consistent with fully efficient equity markets. Other studies (e.g. De Bondt and Thaler (1985 JF, 1987 JF)) found that loser (winner) portfolios subsequently outperformed (underperformed) which again is evidence against pure market efficiency.

A large number of recent academic papers have stated a strong preference for the use of arithmetic means of historical data to estimate a prospective ERP. In his book "Regulatory Finance", Morin (1994) argues, "*One major issue relating to the use of realized returns is whether to use the ordinary average (arithmetic mean) or the geometric mean return. Only arithmetic means are correct for forecasting purposes and for estimating the cost of capital.*"

More recently, Grabowski and King (2003) surveyed the academic literature and concluded the arithmetic average still receives the most support: *"The arithmetic average receives the most support in the literature, other authors recommend a geometric average, and still others support something in between."*[66]

Examples of recent academic papers that support the use of arithmetic averages are as follows:

- Dimson, Marsh and Staunton (2000) argue (p.9) that "*When decisions are being taken on a forward looking basis, however, the arithmetic mean is the appropriate measure since it represents the mean of all the returns that may possibly occur over the investment holding period*".[67]
- In his 1999 book on the ERP, Cornell argues that the arithmetic mean is appropriate as a forecast for short (year by year) returns, whereas the geometric mean is more appropriate for the estimation of the average ERP over a longer period (citing 50 years).[68]
- Ibbotson and Goetzman (2006), when forecasting the ERP through supply side models based on historical data, convert the geometric mean to the arithmetic mean, stating that *"When we present our forecasts, we convert the geometric average returns to arithmetic average returns" "…because almost all the variation in equity returns is from the equity risk premium rather than the risk-free rate, we need to add … to the geometric estimate of the equity risk premium to convert the returns in to arithmetic form."*[69, 70]

On the basis that equity markets are generally efficient, the use of arithmetic averages for estimation of the cost of capital is favoured since it represents the rate of return that investors expect. Consistent with recent mainstream academic consensus, we favour the use of the arithmetic rather than the geometric mean in deriving the ERP.

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66 Standard & Poor's Corporate Value Consulting/Grabowski & King:" Equity Risk Premium", Valuation Strategies, Sept/Oct 2003 "Equity Risk Premium: What Valuation Consultants Need to know about Recent Research"

67 Risk and Return in the 20th and 21st Centuries", Business Strategy Review 2000, Volume 11 Issue 2, pp1-18.

68 Cornell (1999) "The Equity Risk Premium".

69 Ibbotson and Goetzman (2006) "The Equity Risk Premium: Essays and Explorations"

70 This is consistent with Ibbotson's views expressed in the "Stocks, Bonds, Bills and Inflation Valuation Edition 2003 Yearbook" which states that *"the arithmetic average ERP can be demonstrated to be most appropriate when discounting future cash flows. For the use as the expected ERP in either the CAPM or the building block approach, the arithmetic mean or the simple difference of the arithmetic means of stock market returns and risk less rates is the relevant number".*

4.5. A Forward-Looking Estimate of the ERP

In this section we estimate a forward looking ERP for the UK. Expected market returns (R_m) are derived for the FTSE 100. Our annual forward-looking estimates for two years (2006 and 2007) are based on a 'multi-step' DGM, set out as follows:

$$P_t = \sum_{n=1}^{N} \frac{D_{t+n}}{(1+R_t)^n} + \frac{D_{t+N}(1+g)}{(1+R_t)^N (R_t - g)}$$

D_t is the mean analyst forecast of dividends for year t; g is the long term dividend growth rate (e.g. GDP growth rate); P_t is the stock price on the dividend ex-date in year t. N is the number of years of analysts' forecasts up to four depending on data availability included.[71]

Table 4.2
FTSE-100 Forward Looking ERP

	Expected real rate of return on equity	ERP
2006	6.6%	4.2%
2007	7.4%	5.0%

Real cost of equity estimates obtained by applying a multi-stage DGM to each FTSE 100 company at each company's dividend ex-date. The estimates use analysts' forecasts of dividends adjusted, via the Fisher formula discussed in Equation (2.1), for expected inflation. The number of stages depends upon the availability of analysts' forecasts. The long term growth rate of dividends is assumed equal to Consensus Forecasts of real GDP growth over 5-10 years. The ERP is obtained by subtracting the risk-free rate from the cost of equity. The RFR is estimated using the approach set out in Section 2.4. The market return on equity and ERP are market capitalisation weighted averages of company estimates.

We estimate the expected real rate of return to be 6.6% in 2006 and 7.4% in 2007 (Table 4.2). After subtracting our estimate of the risk-free rate we estimate the ERP to be 5.0% in 2007, up from 4.2% in 2006.

Fluctuations in the ERP reflect general macroeconomic and stock market conditions. As a result the estimate for 2008 may be higher as equity prices have fallen, or lower if dividend forecasts have fallen more than commensurately.

The estimates of 4.2-5.0% are within the range of historical ERP estimates for the UK presented earlier, reinforcing our earlier evidence.

[71] Daily share price data and short term dividend forecasts (which are then deflated for forecast inflation, via the Fisher formula discussed in Equation (2.1)) are collected from Bloomberg on the final dividend ex-dividend dates. All dividend forecasts and share prices are adjusted for stock splits. The long term growth rate of GDP is assumed equal to the Consensus Forecasts of real GDP growth over 5-10 years. These forecasts are 2.3% and 2.5% per annum for 2006 and 2007, respectively.

4.6. Conclusions on the Equity Risk Premium

Dimson, Marsh, and Staunton (DMS) database is widely regarded as the best-quality capital appreciation and income series available for each country. We use DMS' estimate of the ERP relative to bonds as our preferred measure of the ERP.

The ERP is based on the results of long run time series evidence on historical equity returns. The ERP is presented as a range of 4.2-5.4% due to uncertainty over the correct method for *averaging* historic returns. The lower end of this range represents the results of geometric averages whereas the upper part of this range represents the result of the arithmetic average of historic returns. Our survey of the academic literature on the ERP has shown that the majority academic opinion supports an arithmetic average in calculating the ERP and hence an estimate which is towards the top end of our range.

5. Conclusions on the Cost of Equity Based on the CAPM

Table 5.1 presents our conclusions on the cost of equity from the CAPM analysis at different levels of gearing. Specifically we test the CAPM results against a 60% gearing (A-) assumption and a 68% (BBB+) gearing assumption. Evidence on the relationship between gearing and credit rating is considered in more detail in Section 9.

Table 5.1
Real Cost of Equity using the CAPM

	A- Rated	BBB+ Rated
Real Risk-free Rate	2.60%	2.60%
Equity Risk Premium	4.2% - 5.4%	4.2% - 5.4%
Gearing	60%	68%
Asset Beta	0.39	0.39
Equity Beta	0.98	1.11
Real Cost of Equity (post-tax)	**6.7% - 7.9%**	**7.3% - 8.6%**

Source: NERA anlaysis

We present estimates based on the longest available time series of data as this gives the most reliable guide to the likely cost of equity in future. Current market conditions are not conducive to estimating the cost of equity as the current period of high volatility biases several of the parameters, most notably the risk-free rate.

Our estimate of the cost of equity for A- rated companies is in the range of 6.7 - 7.9%, while the corresponding range for BBB+ rated entities is 7.3 - 8.6%.

The lower end of our cost of equity range is based on an ERP calculated as the *geometric* average of historic returns, whereas the upper range represents the result of an ERP calculated as the *arithmetic* average of historic data. Since the consensus academic opinion supports the use of *arithmetic* averages (or a slight downward adjustment to the arithmetic results) to derive the ERP, the true cost of equity will be toward the top of the range.

6. Further Evidence on the Cost of Equity: the Dividend Growth Model

This section is structured as follows: Section 6.1 discusses the Dividend Growth Model methodology. Regulatory precedent is considered in Section 6.2. Section 6.3 sets out our approach, including data sources and assumptions, and our results are described in Section 6.4. Section 6.5 presents our cost of equity estimates based on the DGM. Section 6.6 concludes.

6.1. Methodology

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

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

Where:

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

Solving for r yields:

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

Equation (6.2) states that a firm's cost of equity is equal to (1) its *prospective dividend yield* (expected next period dividend per share *divided* by stock price on the ex-dividend date of the previous dividend paid out) *plus* (2) the long-term expected rate of growth in its dividend.

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

The "two period dividend growth model" is the standard formulation of the DGM model for use in US regulatory proceedings and is widely used elsewhere to estimate a company's cost of equity. This model allows for non-constant dividend growth for a short time horizon, usually matching the business planning period, followed by a constant rate of dividend growth for following years. Equation (6.3) shows a two-stage DGM incorporating non-constant dividend growth for the periods for which analysts' forecasts are available (normally three or four years), followed by a constant long-term dividend growth rate. Specifically, we solve for the cost of equity (R) in the following equation:

$$P_t = \sum_{n=1}^{N} \frac{D_{t+n}}{(1+R_t)^n} + \frac{D_{t+N}(1+g)}{(1+R_t)^N (R_t - g)} \quad (6.3)$$

D_t is the mean analyst forecast of dividends for year t; g is the long term dividend growth rate (e.g. GDP growth rate); P_t is the stock price on the dividend ex-date in year t. N is the number of years of analysts' forecasts included.

6.2. Regulatory Precedent

At PR04, Ofwat (p.224) stated that they used "*the dividend growth model to assess the robustness of any result presented using a CAPM framework*". Ofwat state that this evidence suggests a range for the real post-tax cost of equity of 7.25-8.3% which they note is higher than their CAPM range of 6.5-8.0%.[72]

We believe Ofwat's application of the DGM at PR04 contained two important errors.

- First, a DGM that is applied correctly should calculate the cost of equity using the *prospective* dividend yield (where the dividend used is next year's expected dividend). By contrast, Ofwat appears to have used a current (or historical) measure of the dividend yield. This is incorrect and leads to an under-estimation of the cost of equity when expected dividend growth rates are positive (since the historical dividend yield will be lower than the prospective dividend yield).
- Second, a correct application of the DGM requires use of the share price on the ex-dividend date in the calculation of the dividend yield. However, Ofwat does not explicitly make any attempt to base the dividend yield on "ex-dividend" share prices. The use of a share price on a date other than the ex-dividend date may lead to overstatement of share prices (because of the inclusion of dividends in the price) and underestimation of the cost of equity.

In some previous inquiries, the CC has also used the DGM alongside the CAPM in estimating the cost of equity such as in the Mid Kent Water Inquiry in 2000.[73]

In their most recent inquiry for BAA, the CC do not use the DGM to derive the cost of equity for BAA directly based on BAA's own dividend yields and forecast dividend. However, the CC (para. F.69) states that it has considered evidence from the Dividend Growth model (DGM) in its assessment of the ERP. The CC attempts to derive an estimate of the ERP based on current dividend yields in the market and "a growth assumption" but its choice of growth assumptions (either historical dividend growth or real GDP/capita growth) is subjective and may be contradicted by analysts' forecasts. The CC also appears to have made a number of errors in its application of the DGM that leads to underestimation of the ERP – similar to the errors made by Ofwat at PR04:

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[72] P.224 Ofwat, Final Determination.

[73] Competition Commission (2000a), "Mid-Kent Water Plc: A Report on the References under Sections 12 and 14 of the Water Industry Act 1991".

- First, the CC appears to have used a historical measure of the dividend yield – rather than the *prospective* dividend yield. This is incorrect and leads to an under-estimation of the cost of equity when expected dividend growth rates are positive.
- Second, the CC uses a dividend yield for the FTSE All Share as a whole and does not explicitly make any attempt to base the dividend yield on "ex-dividend" share prices, again leading to an underestimate of the cost of equity.
- Third, the CC estimates the growth rate assumption in the DGM using historical real dividend growth. However, they have ignored evidence on forecasts of future divided growth rates. There is evidence that analysts' forecasts provide a reasonable proxy for investors' expectations.[74]

Overall, the CC's specification of the DGM is incorrect and the errors will likely result in an underestimation of the ERP for the market.

6.3. Our Methodology

Our dividend growth model requires three primary data inputs for each company: (1) share price at the ex-dividend date, (2) short-term dividend forecasts, and (3) estimated long term dividend growth rates. We estimate the model for 2006 and 2007.

- **Share Price Data**

Share price data is collected from Bloomberg for each listed water company on the final dividend ex-dividend date for the years 2006 and 2007.[75] We included the following water companies in our analysis: Severn Trent, UU, Kelda, Pennon, and Northumbrian.

- **Short Term Dividend Forecasts**

We use explicit forecasts of dividend payments provided by analysts to Bloomberg. These numbers are deflated using inflation forecasts for the year of dividend forecast from Consensus Forecasts (HM Treasury) for the UK economy. This means our estimates of the cost of equity are then derived in *real* terms.

Due to low analyst coverage of forecasts for 2011 and beyond we restrict N in Equation (6.3) to 4 for 2006 and 3 for 2007.

Table 6.1 shows analysts' forecasts of average real dividend growth rates between years 1 and 4 for UK water companies were in the range of 1.6-2.6% in 2006 and 2007.

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

[75] All dividend forecasts and share prices are adjusted for stock splits.

Table 6.1
Analyst Forecasts Average Real Dividend Growth Rates for Listed Water Companies

Year of Data (Y0)	Y0-Y1	Y1-Y2	Y2-Y3	Y3-Y4	Average
2006	1.6%	2.0%	1.9%	2.0%	1.9%
2007	2.6%	1.8%	1.6%	--	2.0%

Source: NERA analysis of Bloomberg data.

- **Long Term Dividend Growth Forecasts**

The second part of the DGM is constructed using the assumed annual long-term dividend growth rate.

There is no universal standard by which long-term dividend growth rates are derived. We considered four bases for the assumed long run dividend growth rate (g):

1. Historical dividend growth;
2. Long run real UK GDP growth at time of estimation (i.e. g = 2.5% p.a.);
3. Zero growth (i.e. g = 0% p.a.), and;
4. Ofwat projected real RCV growth for 2005-10 (i.e. g = 2.2%).

Historically, water companies have pursued a 'balance sheet' dividend payout policy. Companies have taken out debt to pay dividends in order to meet a target balance sheet gearing ratio.[76] This payout policy of dividends is largely not-linked to company performance (i.e. earnings growth), which makes the historic trend of dividend growth unreliable to estimate long-term sustainable growth of the industry.

Since utilities will (generally) have slower product growth than the economy, we expect lower long-run dividend growth than GDP growth. On the other hand, investors typically expect some dividend growth, suggesting a zero long term growth rate is too low. According to Merrill Lynch investors expect dividend in the UK water sector to grow by 2-3% (see Merrill Lynch presentation at the UK Water City Conference 2008). Further, Severn Trent has publicly announced a dividend policy that includes real growth of 3% until 2010.

Based on Ofwat's published projections of RCV for the five (including Kelda, which has been de-listed recently) listed water companies over AMP4, long-run growth is assumed to be 2.2% per annum. Growth in RCV should flow directly through to dividend growth, via the (RCV-linked) allowed rate of return, if a constant capital structure is maintained. We use this estimate of projected long-term RCV growth of 2.2% as our preferred estimate of the sustainable long-term growth rate of dividends.

[76] Our analysis shows that historically dividends for the four listed water companies have increased by 4.0% on average over the period from 1991 to 2007.

6.4. NERA Results

Table 6.2 presents our estimates of the DGM-based real post-tax cost of equity for the five quoted UK water companies (selected as comparators) using Bloomberg-constructed mean analysts' forecasts of dividends where available and using the assumption of 2.2% long-term real dividend growth thereafter. We also show average gearing levels for all companies in each year and across this period.

Table 6.2
UK Water Company DGM-derived Real Cost of Equity

Company	2006	2007	Average 2006 - 2007
Severn Trent	8.5%	6.9%	7.7%
United Utilities	8.8%	8.0%	8.4%
Kelda	5.9%	5.5%	5.7%
Pennon Group	6.0%	5.3%	5.6%
Northumbrian	6.5%	6.1%	6.3%
Average Real Cost of Equity (post-tax)	**7.1%**	**6.4%**	**6.8%**
Average Gearing (D/(D+E)	*48.0%*	*48.2%*	*48.1%*

Source: NERA analysis of Bloomberg data

We stress that these results are not directly relevant for the cost of equity that Ofwat should be using in estimating the WACC at PR09. Instead these results show the cost of equity of UK water companies over the period 2006-07 consistent with the actual gearing levels of these companies over this period. The average gearing level of these companies is about 48% across this period but is significantly below the gearing level of 60% that Ofwat is likely to use for calculation of the WACC at PR09.

The average 2007 estimate is 6.4%, down from 7.1% in 2006 (Table 6.2). The 2007 estimate decreased relative to 2006 because share prices increased relative to dividends over this period.

6.5. Re-levered Estimates of the Cost of Equity

In order to draw inferences from our DGM estimates, we also adjust for differences in gearing and state all numbers on a notional 60% gearing level.[77] The DGM-derived estimates of the real cost of equity at 60% gearing are shown in Table 6.3. By re-levering to 60% gearing our cost of equity estimates are on a comparable basis to our CAPM estimates.

[77] The technical procedure for de-levering DGM cost of equity estimates and re-levering them to a notional 60% gearing level is presented in Appendix G.

Table 6.3
UK Water Company Real DGM-derived Cost of Equity
(Re-Levered for 60% Gearing)

Company	2006	2007	Average 2006 - 2007
Severn Trent	10.8%	8.1%	9.5%
United Utilities	10.6%	9.5%	10.1%
Kelda	8.1%	7.2%	7.6%
Pennon Group	7.0%	6.3%	6.7%
Northumbrian	6.1%	6.1%	6.1%
Average Real Cost of Equity (post-tax)	**8.5%**	**7.4%**	**8.0%**

Source: NERA analysis of Bloomberg data.

Table 6.3 shows the re-levered cost of equity estimates are much higher than previously, reflecting the lower level of actual gearing on these companies' balance sheets.[78] That is, a notional UK water company with 60% gearing would, because of its higher level of riskiness, need to pay more in order to attract equity than actual UK water companies. The average measure of the cost of equity is 7.4% in 2007, down from 8.5% in 2006.

6.6. Conclusions on DGM-derived Cost of Equity

Table 6.4
Average Results, Re-Levered Estimates at 60% Gearing

	Cost of Equity
2006	8.5%
2007	7.4%

Source: NERA analysis

Table 6.4 summarises the cost of equity estimates from the DGM approach. The estimate is lower for 2007 than 2006, which could be associated with falling analyst expectations about the post-PR09 profitability of UK water companies as more information about PR09 (from Ofwat) came to light.

Based on 60% gearing, the central cost of equity is in a range of 7.4-8.5%. These estimates are broadly consistent with our indicative cost of equity range from our CAPM analysis (see Section 5). Overall, we interpret the results of the DGM analysis as reinforcing our CAPM-derived estimates of the cost of equity for UK water companies.

[78] A gearing ratio of 60% equates to a debt to equity ratio of 150%. All companies except Northumbrian had D/E ratios less than 150% in 2006 and 2007. Northumbrian had a D/E ratio in excess of 150% in both 2006 and 2007.

7. Cost of Debt

This section discusses the estimation of the cost of debt for water companies.

- Section 7.1 presents recent UK regulatory and CC precedent with respect to cost of debt decisions.
- Section 7.2 sets out our proposed approach to estimating the cost of debt for the water sector at PR09.
- Section 7.3 presents evidence on the cost of debt in the UK and Euro bond markets.
- Section 7.4 presents evidence on funding costs of E&W water company loans and finance leases.
- Section 7.5 investigates the impact of the credit crisis on the forward looking cost of debt.
- Section 7.6 sets out transaction costs and pre-funding costs on new debt issues
- Section 7.7 concludes.

7.1. Regulatory Precedent

In estimating the cost of debt at PR04, Ofwat used long-term historical time series data. Ofwat states that "*In our assessment of the cost of debt we have placed greater emphasis on longer term historic averages*".[79]

In the Final Determination at PR04, Ofwat concluded on a range for the real cost of debt of 3.3-4.4%. Ofwat derived the range by adding a debt risk premium of 80 - 140 bps including transaction costs to the risk-free rate of 2.5% - 3.0%. Ofwat based bond spreads on time series data on publicly traded bonds stating that *"(T)he current very low debt spreads are unlikely to be sustained throughout the next five year period and there is a much greater risk that spreads will rise over the period than that they will remain unchanged or fall"*.

At PR04, Ofwat placed more emphasis on the longer-term trend in determining the cost of debt. Ofwat's March 2008 Setting Price Limits Paper indicates that it intends to change its cost of debt methodology at PR09. Ofwat states:

> "*For this review [PR09], we will set the cost of capital reflecting the current market data (but not mechanistically observing spot rates). We will continue to recognise that the industry may have raised finance efficiently at a different part of the interest rate cycle and that a company raises finance over periods longer than the price control period.*"[80]

This quote shows that Ofwat's proposed approach at 2009 will place some emphasis on current data. However, this quote also makes clear that Ofwat will not completely ignore historical debt costs.

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[79] Ofwat (2004) Final Determination, p225.

[80] Ofwat (March 2008) "Setting price limits for 2010-15: Framework and approach", p45.

By contrast, the CC (October 2007) has followed a different approach in calculating BAA's allowed cost of debt for Heathrow and Gatwick airports. The CC used solely current data – directly observing the current yields of benchmark bonds and removing the expected RPI inflation from the current value to derive the real cost of debt.

The CC calculated nominal yields of 6.05-6.40% for A and BBB rated benchmark yields. This translates into a real cost of debt of 3.2-3.5% respectively. The CC's estimate of the range of the cost of debt was further discussed with and checked with an investment bank, though the CC does not quote the exact figures provided by the bank. The CC also added 15 basis points to the forward looking cost of debt estimate, to "*make allowance for the ongoing commitment, agency and arrangement fees paid respectively to lenders, rating agencies and arrangers of finance*". The CC then concluded on a real cost of debt of 3.55%.

Ofgem, at the Gas Distribution Price Control Review (GDPCR) in December 2007, adopted a methodology which could be said to be a hybrid of the Ofwat approach at PR04 and the CC 2007 approach. Specifically, Ofgem had regard to the following in estimating the cost of debt:

- Short-term trends in the market cost of debt including evidence from actual debt costs achieved by the companies;
- Trends in the market cost of debt over a ten-year period; and
- Longer-term equilibria in the market cost of debt.

Ofgem states in its Final Proposal on the GDPCR: "*Within initial and updated proposals, Ofgem concluded that the cost of debt of 3.55% appropriately balanced the spot rates for the cost of debt, the ten year trailing average, and the long-term averages*."[81]

We note this represents a shift from Ofgem's approach at the Transmission Price Control Review (TPCR) in 2006, where Ofgem used ten year trailing averages.

Table 7.1 summarises recent regulatory and CC precedent on the cost of debt and the methodology adopted.

[81] Ofgem (December 2007) Gas Distribution Price Control Review: Final Proposals, p102.

Table 7.1
Summary of Regulatory Precedent on Cost of Debt

Regulator	Determination	Real allowed cost of debt	Issuance cost premium	Methodology
Ofwat	PR04 (2004)	4.3%	Allowed for in final debt premium	Time series evidence on bond spreads; Transaction costs not explicitly stated
Ofgem	GDPCR (2007)	3.55%	No allowance	Balanced spot rates and ten year trailing average Evidence on benchmark yields
Ofgem	TPCR (2006)	3.75%	No allowance	Time series on long term average spreads
CC	BAA (2007)	3.4%	0.15%	Current market evidence; Evidence based on benchmark yields and discussion with an investment bank

7.2. Our Approach

We present data on cost of debt for UK water companies drawing on both current and time series information. We then assess the merits of different approaches to inform our cost of debt based on market evidence over the long-run and the most recent period.

In our assessment of the cost of debt, we consider the costs of the different types of funding used by water companies, i.e. bonds, loans and finance leases. Our estimate of UK water companies' cost of debt for AMP5 is composed of the following elements:

- Funding costs based on yield data drawn from primary and secondary markets;
- Costs of existing debt in companies' debt portfolios;
- Transaction costs including legal fees, payments to loan arrangers and fees for structured and proprietary funding products, and;
- Pre-funding costs relating to the (necessary and efficient) arrangement of funding before it is required.

We start by considering evidence from bond markets, on the basis that this represents the main source of finance for water companies over AMP4 and likely over AMP5.

7.3. Evidence from Bond Markets

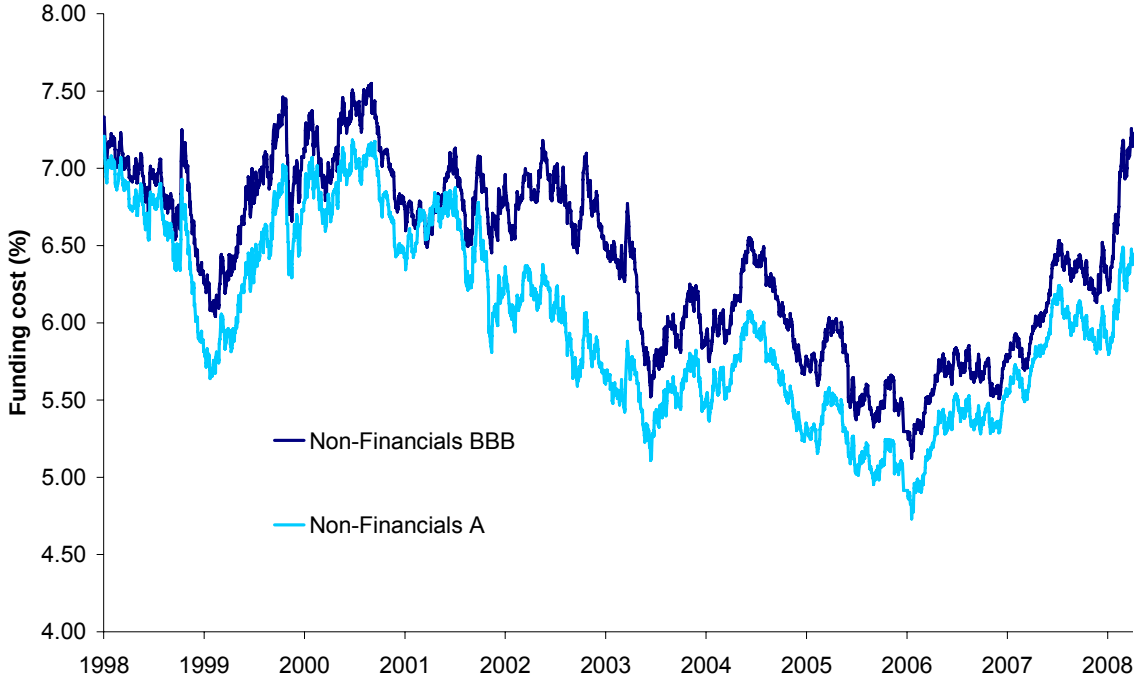
UK water companies have access to a range of alternative debt-funding sources, including nominal bonds, IL bonds, bank loans, EIB loans and finance leases. Table H.1 in the Appendix reports the sources of funds for the UK water sector as of March 2007. Nominal sterling denominated bonds represent 30% of total sources of debt, followed by Euro denominated nominal bonds (27%) and sterling denominated IL bonds (16%). Overall, bonds make up around 77% of the sector's financing structure and loans and financing leases the remaining 23%, according to companies' 2007 financial accounts.

7.3.1. Evidence from UK Sterling Bond Market

Figure 7.1 shows sterling denominated A and BBB funding costs faced by companies (excluding financials) over the last ten years.[82]

The figure also shows that yields have increased substantially since the end of 2006 from 4.8% to around 6.4% (for nominal A rated bonds) and from 5.0% to above 7.2% (for BBB rated bonds). Yields are now around their levels in 2000 and 2001. Figure 7.1 also shows increased divergence of A and BBB yields since the beginning of 2008, which reflects the worsening of the credit crisis since the beginning of this year.

Figure 7.1
Sterling Benchmark Yields (Non-Financials)
(March 1998 – March 2008)



Source: iBoxx

Table 7.2 summarises the cost of funding for sterling denominated debt for different rating classes over the long-term period (March 1998 to March 2008) for A, A-, BBB+ and BBB ratings.

[82] We use benchmark yields for A and BBB rated corporate bonds omitting financial institutions as financial institutions have been disproportionately affected by the current market turmoil. The maturities on the benchmark yields change slightly over the period but are 10 to 15 years.

Table 7.2
Sterling Cost of Funding for Non-financials (%)

Rating	Long-term Nominal (March 1998 – March 2008)	Implied Real
A	5.98	3.30
A-	6.12	3.43
BBB+	6.26	3.56
BBB	6.39	3.69

Source: NERA analysis of iBoxx, Bloomberg and Oxford Economic Forecasting data. The average yield to maturity on the iBoxx benchmark bond series ranges between 10 and 15 years. Note: Quality financial data providers such as S&P, Bloomberg or iBoxx do not compile Sterling benchmark yield indices for sub-ratings within the envelope of one rating class (e.g. there is no Sterling A- or BBB+ index available). We derived A- and BBB+ numbers, based on Bloomberg Fair Market Value (FMV) indices for US corporates with 15 years to maturity considered further in Section 9. Inflation expectations over period is 2.60%; Real yields were calculated using the Fisher formula set out in Equation (2.1).

Table 7.2 shows that the average A- rated yields for sterling bonds is around 6.1% over the past ten years. In real terms, this equates to about 3.4%.

By comparison, yields on UK water bonds issued during PR04 show average trailing yields to maturity of 5.27-6.21% (see Table H.3 in the Appendix). This is broadly consistent, but slightly lower on average, than yields for A- rated benchmark yields presented above.[83] We note that water bonds are likely to be less liquid than benchmark bonds presented above and so average yield to maturities are less reliable as a measure of the day-to-day market prices.

7.3.2. Evidence from Euro Bond Market

UK water companies have issued a significant amount of Euro denominated debt. Table 7.3 sets out Euro denominated cost of debt.

[83] The average yield to maturity on the water bonds is lower than for the non-financials benchmark because the averages are computed over different periods. The earliest water bond we have considered was issued in 2005, so the average yield is calculated only over a period of historically very low yields, while the average yields on the benchmark bond is calculated from 1998 and accordingly includes the period of higher yields in 2000 and 2001.

Table 7.3
Euro Cost of Funding for Non-financials (%)

Rating	Long-term Nominal (March 1998 – March 2008)	Implied Real
A	4.98	3.06
A-	5.13	3.21
BBB+	5.37	3.45
BBB	5.52	3.59

Source: NERA analysis of iBoxx, Bloomberg and Consensus Economics data. The average yield to maturity on the iBoxx benchmark bond series ranges between 5 and 10 years. Note: Quality financial data providers such as S&P, Bloomberg or iBoxx do not compile Sterling benchmark yield indices for sub-ratings within the envelope of one rating class (e.g. there is no Sterling A- or BBB+ index available). We derived A- and BBB+ numbers, based on Bloomberg Fair Market Value (FMV) indices for US corporates with 5 years to maturity considered further in Section 9. Inflation expectations for Eurozone over period is 1.86%; Real yields were calculated using the Fisher formula set out in Equation (2.1).

A comparison of the real costs of debt across currencies shows that Euro denominated cost of debt is closely in line with Sterling denominated cost of debt:

- Euro denominated cost of debt (Table 7.3) appears to be 0.1-0.2% cheaper than Sterling debt (Table 7.2).
- However, we note the cost of Euro debt does not incorporate any bank costs associated with exchange rate swaps which companies usually take out to swap against exchange rate fluctuations. After adjusting for these expenses the cost of Euro debt is likely to be equal to the cost of Sterling debt.[84] This point was illustrated by Severn Trent's most recent bond issue (of €700m on 11 March 2008 with eight year maturity): after including hedging costs, the cost of funding in Euro was only marginally more expensive than funding in Sterling.

The Euro and Sterling debt capital markets are sufficiently liquid so that arbitrage between the two markets causes real yields to converge. Therefore, we can focus our cost of debt analysis upon Sterling denominated debt as this is also a good proxy for real funding costs for Euro denominated debt.

7.3.3. Evidence from UK IL Bond Market

There have been no UK IL bond issues since October 2007.[85] Many of the problems in the IL market are related to the financial difficulties currently being experienced by monoline

[84] In the absence of exchange rate swaps the effective cost of Euro denominated debt – paid from Sterling revenues - could vary substantially from the costs stated in Table 7.3. However, the use of exchange rate swaps as a hedging tool is ubiquitous across the UK water industry; we are unaware of any foreign-currency transactions which do not have an accompanying foreign exchange swap.

[85] The most recent IL issue was by Anglian, dated 23 October 2007. The bond is for £50m at a fixed coupon of RPI plus 1.52% maturing 1 July 2055. The bond was issued without at face value i.e. without a discount.

insurance companies, which had previously guaranteed (or 'wrapped') IL bonds. We discuss the impact of monoline insurers on the availability of IL debt in more detail in Section 7.5.

Notwithstanding the problems in the IL market, companies can achieve similar funding by issuing nominal coupon debt accompanied by an inflation swap. This practice has been adopted by several water companies in the past and most recently by Anglian in February of this year.[86] However, companies have indicated to us that the ability to asset swap is limited by the depth of swap markets and, in some cases, by covenants related to existing debt. Further, the attractiveness of asset swapping is reduced for listed companies because of the application of accounting rules which mean asset swapping "does not qualify for treatment as hedge accounting … and therefore can introduce earnings volatility".[87] In combination, the practice of asset swapping is unlikely to be widely prevalent, and appears highly unlikely to provide companies in future with inflation-linked debt on a similar scale to that provided by properly functioning IL debt markets augmented by monoline insurers.

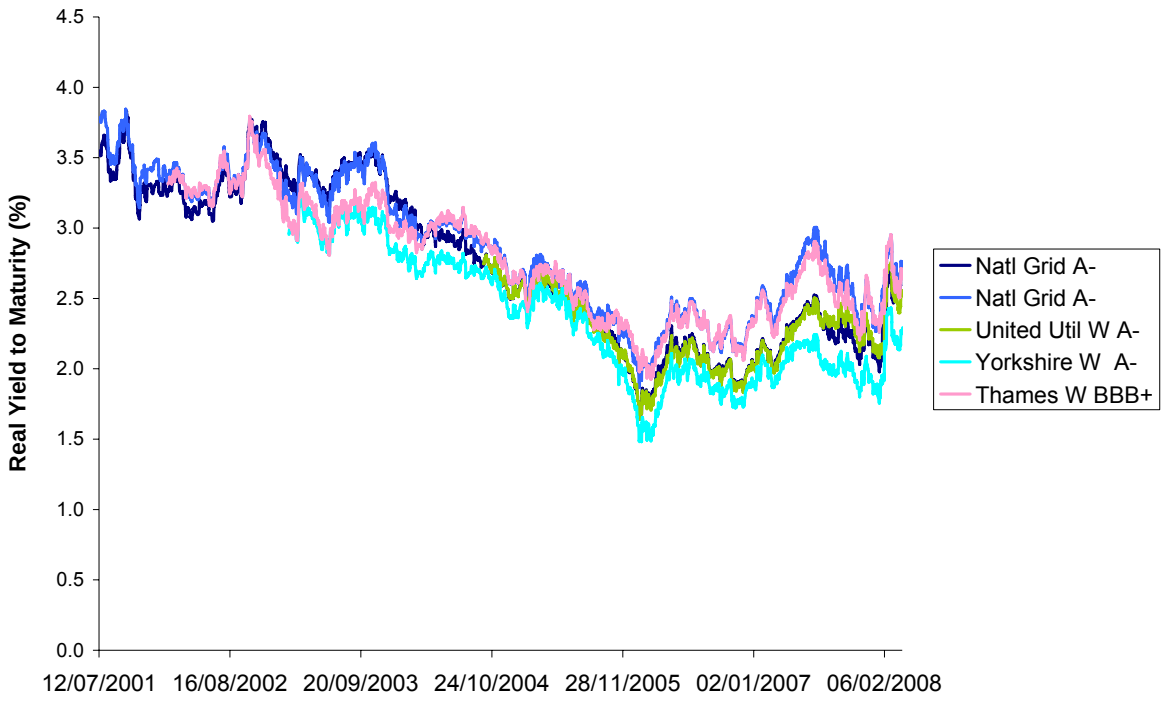
Figure 7.2 shows yields to maturity of IL bonds (since issue) for which time series data is available.[88] We selected IL bonds which were issued prior to 2003 (in order to get a long run consistent time series on debt costs). There are only five IL bonds in issue which meet this criterion. Figure 7.2 shows that yields to maturity trended lower until late 2005, but have since oscillated between 2.0-2.5%.

[86] Anglian issued £110m on 28 February 2008, maturing 27 February 2043, with a floating coupon of LIBOR plus 85 bps. The bond was issued at face value i.e. without a discount. However, we do not have any data on the effective after-swaps terms of the debt.

[87] Ofgem and Ofwat (February 2006), "Financing Networks: a discussion paper", p50.

[88] We note that there are more IL bonds in issue than those presented in Figure 7.2. However, a time series of yield to maturity data is unavailable through Bloomberg for these bonds.

Figure 7.2
IL UK Utilities Bonds: Yields to Maturity Since Issue



Source: Bloomberg.

Table 7.4
IL Bond Costs

	Long-term (March 1998 – March 2008)
A-	**2.60**
BBB+	**N/A**

Source: NERA analysis

Figure 7.2 summarises the trailing average yield to maturity of the five bonds where time series data is available.

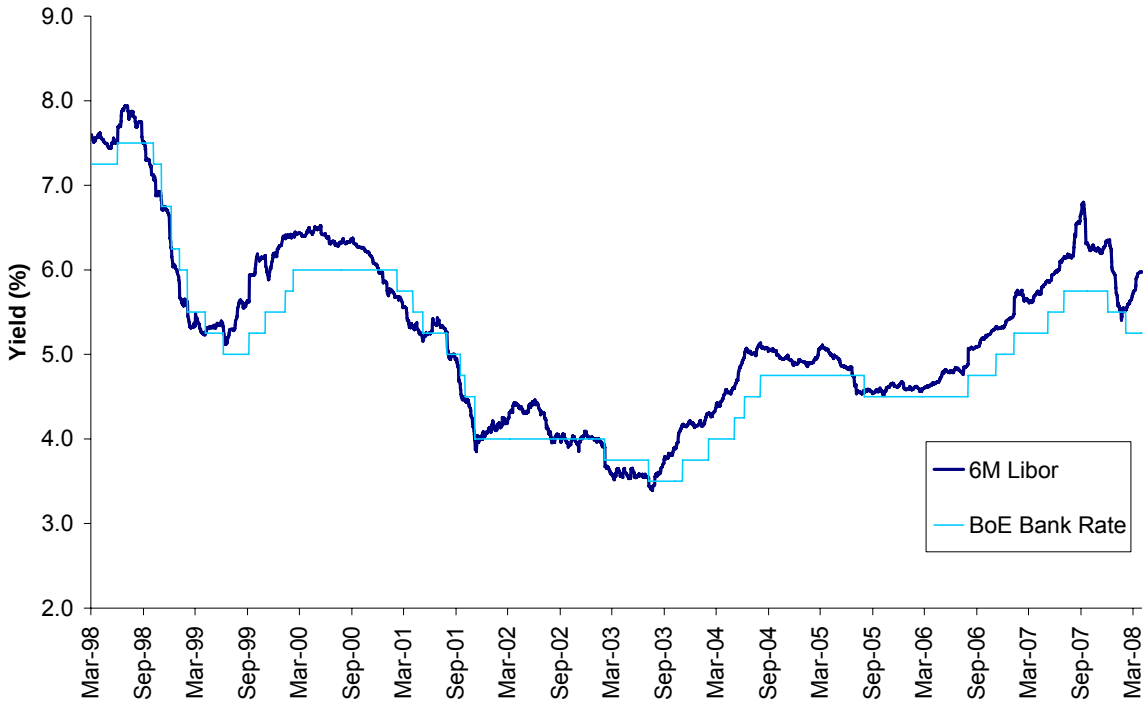
Table H.4 in the Appendix presents yields on all UK Utilities IL bonds for which pricing data is available. We note that there is only one IL bond in issue with a BBB+ credit rating issued prior to 2003. Based on the scant time series evidence available we cannot infer reliable funding costs for BBB+ IL bonds.

7.4. Loans and Finance Leases

Libor is typically used as a benchmark for bank loans. The cost of bank loans is the sum of Libor and a 'margin which reflects current market conditions and the credit risk of the borrower'. Figure 7.3 shows six month Libor over the historic period from March 1998 to

March 2008. Figure 7.3 also shows that Libor follows closely the official Bank Rate set by the Bank of England.

Figure 7.3
Six Month Libor Benchmark Yield
(March 1998 to March 2008)



Source: Bloomberg

Table H.5 in the Appendix presents historic margins on bank loans for UK water companies as reported by Bloomberg. Historically, margins have been in the range between 30 to 125 basis points and averaged 67 basis points over the historic period. The 6-month LIBOR has averaged 5.24% over the long run (March 1998 to March 2008) and 5.67% in the current three month period.

Turning to EIB loans, many companies regard these loans as one of the cheapest sources of funding. Our consultation with companies has shown that historically yields have been only slightly above Libor, but have risen in recent months. According to companies, the availability of new EIB loans before 2009 is limited. Nevertheless, it has been suggested that the EIB is becoming more comfortable with the securitised structure of water companies, which may lead to a greater proportion of EIB funding for the sector in future.

Our consultation with companies has shown that a number of companies make use of finance leases. Some companies mentioned that they aim to take out more finance leases in the future. It is important to note that this source of finance can be accessed by companies without going through the costly process of receiving a credit rating, which makes this source particularly attractive to smaller water companies which do not have a credit rating. According to companies, finance leases are still a competitive source of finance, albeit tax advantages of this type of funding have been eroded over the past decade.

Table 7.5 presents average interest rates for finance leases and EIB debt based on financial accounts. Evidence on bank loans is based on time series evidence of Libor and average margins companies paid above Libor for short term credit facilities.

Table 7.5
Costs of Loans and Finance Leases (%)

	Nominal	Real
Bank Loans	5.91[1]	3.23
Finance leases	5.59	2.74
EIB loans	6.18	3.32

Source: NERA calculations. WoC and WaSC Annual Reports. Actual inflation (RPI) has been used to deflate nominal figures. Note 1) equals the sum of ten-year average of 6-month Libor (5.24) and average margin over LIBOR on existing bank loans (0.67). See Table H.6 for historic costs on finance leases and EIB loans. Real yields were calculated using the Fisher formula set out in Equation (2.1).

7.5. Impact of the Credit Crisis on Cost of Debt

There is substantial market evidence pointing to the significant impact of the ongoing financial turbulence on the cost of raising debt for all market participants. The impact of this crisis that is especially relevant to water company financing includes:

- The re-pricing of credit risk, as reflected in the substantial rise in the price of credit default swaps (CDS) and an increase in the average issuance premium for new debt issued during the credit crisis;
- Detrimental developments in the market for monoline insurers, including difficulties in wrapping new debt using monoline insurers, and a sharp increase in yields of existing wrapped debt;
- A significant reduction in the volume of bonds issued, highlighting the risk that debt capital might be unavailable. (Bond issuances in Europe in November 2007 decreased by $123 billion compared with November 2006[89]).

Overall, this evidence indicates that the ongoing financial turmoil is having a significant impact on the cost of debt in the most recent period. Below we present evidence of the following aspects of the credit crisis to inform our "current" estimate of the cost of debt:

- *Evidence on pricing:* the crisis has led to a re-pricing of risk, which is reflected in higher new issuance costs in bond markets;
- *Volume of sources of debt:* the crisis has led to a significant impact on the availability and the terms and conditions for which debt is currently available;
- *Types of debt:* examine the developments in the market for monoline insurers and its impact on the availability and cost of debt; and

[89] Data from Dealogic quoted in Financial Times (2007), 'Markets & Investing: Corporate Bond Costs Climb To Five-year High', November 29th, available at http://search.ft.com/ftArticle?queryText=bond&y=7&aje=true&x=19&id=071129000171&ct=0&page=5

- *Judgment on time horizon*: assess the potential duration of the credit crisis.

7.5.1. Evidence on pricing

Current market evidence shows that companies have to offer substantial premiums above observed benchmark yields for issues rated below A-.

Table 7.6 lists all new bond issues for non-financials since January 2008 and presents their funding costs (i.e. coupon costs).

Table 7.6
2008 Sterling Bond Issues

Issuer	Rating	Issue Date	Maturity	Coupon (%)	Implied Real Coupon (%)
GlaxoSmithKline	A+	06/03/2008	09/03/2039	6.375	3.64
National Grid Gas	A-	03/03/2008	03/03/2020	6.375	3.64
British American Tobacco	BBB+	12/03/2008	12/03/2024	7.250	4.50
Thames Water*	BBB+ (expected)	09/04/2008	09/04/2058	7.241	4.49

*Source: Bloomberg and NERA analysis; * The Thames Water bond has a 'puttable callable reset' structure which effectively means the bond was issued with a ten year maturity, but there is an option to re-issue for another 40 years. Current medium-term inflation expectation is 2.64%; Real yields were calculated using the Fisher formula set out in Equation (2.1).*

In the current market situation, the issuance premium is around 75 bps for BBB+ rated bonds, but close to zero for A- rated bonds. This is calculated as the difference between current benchmark yields in the secondary market (not shown) and coupon costs in the primary market (see Table 7.6).[90]

We also note that Thames Water recently announced a bond issue for the beginning of April 2008 with a coupon of 7.241% and an expected credit rating of BBB+. This is around 75 bps higher than yields currently observed in the secondary market.

[90] We calculated the issuance premiums by comparing the coupon yields in Table 7.6 to the average yield to maturity on the Non-Financials A and BBB benchmark bond series from iBoxx averaged over January through March 2008 adjusted to A- and BBB+ based on US corporate bond yields discussed further in Section 9. The three month average yield to maturity for the A and BBB benchmarks were 6.18% and 6.79%, respectively. The adjustment to A- and BBB+ was based on the average difference in yield to maturity on US corporate A and A-, and BBB+ and BBB, calculated over January to March 2008. The adjustments equaled +17 bps for A to A- and -33 bps for BBB to BBB+. The three month average yield to maturity on A- and BBB+ notional benchmark bonds was, therefore, 6.35% and 6.46%, respectively.

Regulators have traditionally focused upon yields on existing bonds, traded in the secondary market, for evidence on debt costs. Indeed, this was the approach taken by the CC in its recent (October 2007) decision regarding BAA. A possible explanation for this practice may be that there has historically been a very small difference between yields on primary market and yields on the secondary market across all investment grade rating classes. However, at the current time, it is clear that there is an issuance premium on new debt issues that needs to be factored into the overall cost of debt.

Market evidence on margins charged by banks above Libor for short term credit facilities, such as bank loans or Floating Rate Notes (FRN) has increased significantly since the onset of the financial crisis. According to companies, banks have historically charged margins above Libor of around 25 bps to 50 bps, which has increased to over 100 bps. For instance one UK water company recently issued a FRN at margin of 105 bps above Libor. Adding this margin to the current period average of 6-month LIBOR (5.67%) we obtain a current nominal cost of bank loans of 6.72%, which, once deflated by expected inflation produces a current real cost of bank loans of 4.0%.

It is equally important to note that not only have margins increased since the onset of the financial crisis, but also Libor has become increasingly volatile and has very recently increased substantially above the Bank of England's Official Bank Rate (see Figure 7.3). This trend is also documented in the European Central Bank's (ECB) lending survey, which shows that the recent conditions on financial markets have created a situation which makes it more difficult for banks to access the wholesale funding market. According to the ECB survey, banks are expecting this to continue over at least the next three months.[91]

7.5.2. Volume of sources of debt

Interest rate risk is not the only concern in the current credit crisis. Companies have expressed their mounting concern regarding liquidity and financing risks over AMP5.

Market evidence shows that there is a significant reduction in the volume of bonds currently issued.[92]

We are unaware of any corporate bond issuance below BBB+ since the beginning of this year (up to end March). Market evidence also shows that there has been no issuance of IL debt since the onset of the crisis for any credit rating.

The Bank of England's Credit Conditions Survey (2008 Q1) has shown that banks' willingness to lend has been impaired by the effect of the financial turmoil and is expected to

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91 ECB (January 2008) "The Euro Area Bank Lending Survey January 2008".

92 Dealogic suggests that bond issuance in the USA and Europe for November was at its lowest level since 2001. A number of companies have either delayed or cancelled new bond issues due to the credit crisis, reflecting higher costs of debt or lack of access to credit markets. For instance, at the end of February and March 2008, Procter & Gamble and Fiat scrapped and delayed deals worth billions of euros due to the ongoing impact of the credit crisis (see Reuters, 23 March 2008). Further, Drax expected to embark on a refinancing of existing facilities in December 2007. However due to the difficult market conditions, Drax has chosen not to proceed with a refinancing at the present time (see Drax Interim Results Statement 2008).

continue to be affected over the next three months. Further, the Survey shows that corporate non-price terms and conditions have tightened over the past three months:

- Maximum credit lines had been reduced;
- Loan covenants were stricter;
- Collateral requirements were higher, and;
- A further reduction in maximum credit lines, together with a further strengthening of covenants was expected over the next three months.

To conclude, there is a high risk that credit is not as readily available as during the period prior to the current crisis. Banks' willingness to lend has been substantially impaired by the crisis and investors have tightened the terms and conditions under which they are prepared to lend.

The implication of this trend is that credit quality is more important going forward, meaning the optimal credit rating assumption for water companies may be higher than over AMP4.

7.5.3. Types of debt

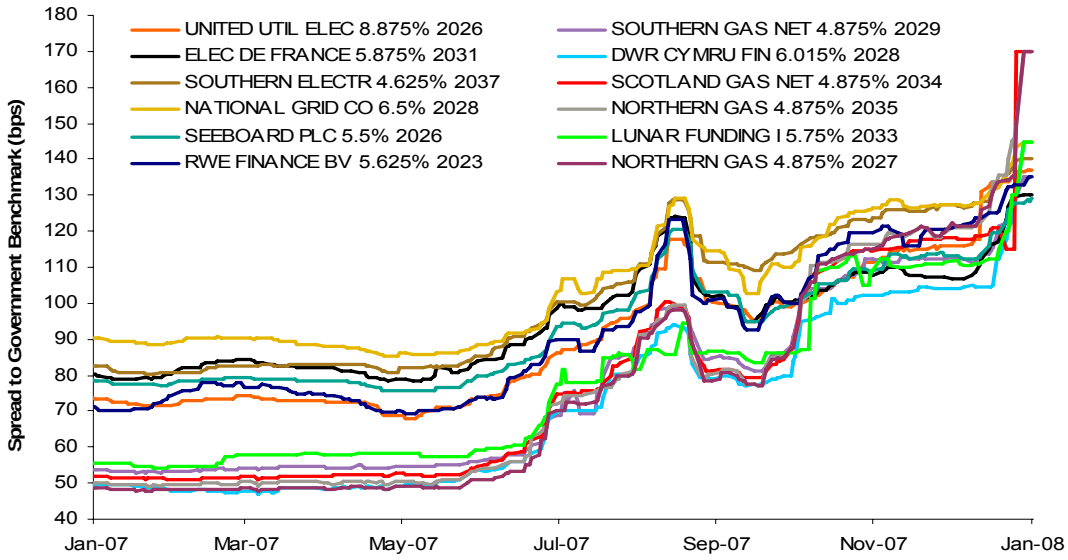
There are mounting signs of fundamental changes to the types of debt companies are able to raise over the long term. This will have an impact on companies' future funding costs. One particular issue is whether structured finance options that have facilitated access to relatively cheap, long-term debt financing for water companies over the recent period will remain available over AMP5. Growing concerns about the creditworthiness and liquidity of the monoline insurers have an important adverse impact for the ability of water companies to raise funding, and in particular using structured finance solutions such as wrapped debt.[93]

The lack of access to structured finance solutions (including wrapping) will increase companies' borrowing costs. Historically, companies were able to reduce overall funding costs by around 15 basis points by using structured products such as wrapping.

Figure 7.4 shows that spreads of wrapped bonds have increased above spreads of unwrapped debt. The benefits of wrapping have disappeared over the recent period and have even turned into higher spreads for wrapped bonds versus unwrapped bonds.

[93] As a result of the credit crisis, Ambac, FGIC, and SCA have been downgraded by Fitch. MBIA and CIFG are currently on negative credit watch by all three credit rating agencies. Further, Moody's and S&P have recommenced their reviews, leaving all save FSA and Assured in danger of downgrade.

Figure 7.4
Spreads of Wrapped vs. Unwrapped Debt



Source: RBS

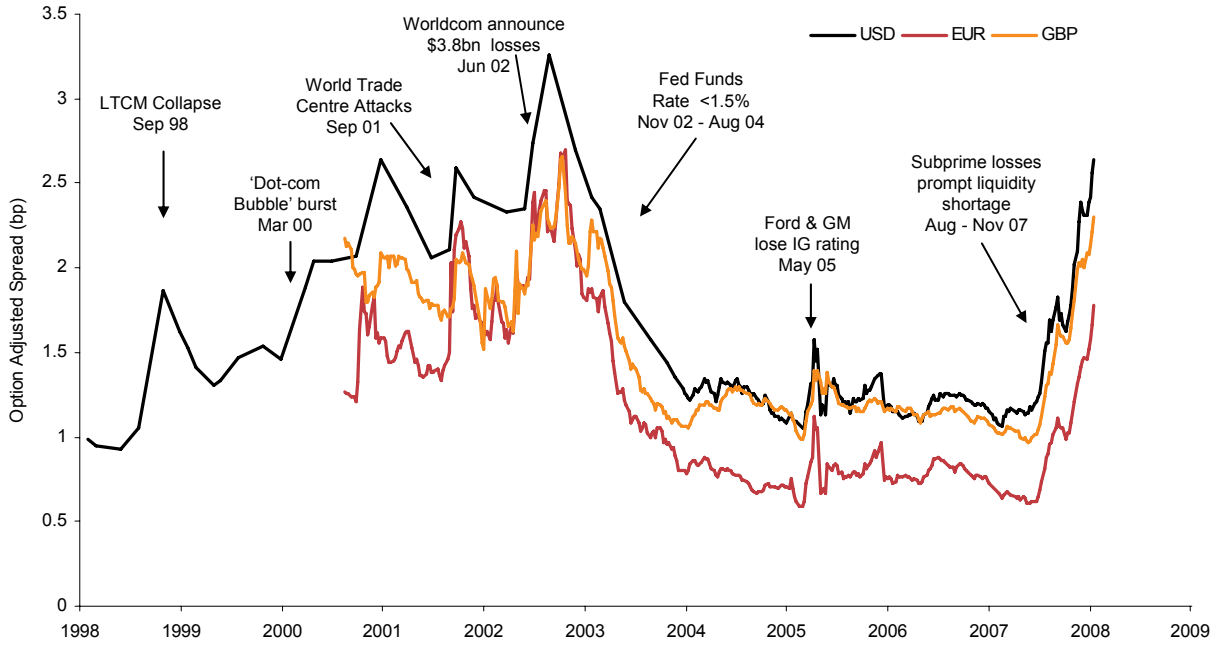
The credit crisis has led to some fundamental changes that will affect the types of debt companies are able to raise over the long term. Specifically, relatively inexpensive structured finance options such as wrapping are likely to be significantly more limited in availability over AMP5.

7.5.4. Potential duration of the credit crisis

In this section we investigate the potential duration of the credit crisis. Indications from previous financial crises might mean that this current crisis is unlikely to be of short-term nature.

Figure 7.5 shows how credit spreads for sterling denominated corporate debt have increased since the onset of the financial crisis and puts the widening spreads in the context of past crises.

Figure 7.5
Widening Spreads in Context of Crises
(1998 - 2008)



Source: RBS

As shown in Figure 7.5 the evidence from previous financial crises suggests that they last for periods of months and years. For example, after the collapse of the LTCM fund, the period of high market volatility, which led to higher credit costs, lasted for about 43 months.

Similarly, spreads for BBB corporate debt were high for approximately 26 months after the burst of the Dot-com bubble in March 2000. If the current credit crisis were to last for a medium to long-term period of around 20 – 40 months (an estimate which can be backed-up by previous crises), companies will face costs of debt higher than those estimated by time series evidence and potentially higher than our estimate of funding costs at the very recent period.

Other commentators support the fact that the current market conditions of increasing funding costs will prevail for the foreseeable future. There is a common view that the market correction is a fundamental shift and that there is no expectation that spreads will tighten in the near future.

To conclude, our analysis of past financial market crises suggests that the current credit crisis is unlikely to be of a short-term phenomenon. This means that the currently observed significant premiums for new bond issues and unavailability of inexpensive sources of debt need to be considered in a forward-looking estimate of the cost of debt.

7.6. Other Costs

Transaction costs

It is important to emphasise that the costs of debt finance considered above exclude transaction costs such as bank, legal, trustee and agent fees. In the BAA case, the CC (2007) allowed for transaction costs of 15 bps, which was added to its estimate of the real cost of debt. The CC, however, does not provide a basis for its estimate of 15 bps.

Table H.7 in the Appendix provides evidence on transaction costs for vanilla bond issues. Our analysis shows that transaction costs are normally in the range of 5 to 7 bps, based on confidential information supplied to us by a UK water company.

During the consultation process with companies it emerged that transaction costs going forward might increase. Specifically, Thames Water expects the sector's future funding requirements to be increasingly satisfied by structured and proprietary funding products. These types of funding products incur additional transaction costs which will be necessary, and hence should be included within the cost of debt. According to Thames Water, structured debt issues are expected to incur additional up-front fees of between 50-70 basis points. These costs will need to be amortized over the life of the bond. If we assume a notional average maturity of 20 years, these costs will increase annual transaction costs by around 3 bps.

On this basis we conclude on historic transaction costs of 7 bps and on 10 bps for the current, forward looking period.

As discussed in Section 7.3.2 the cost of issuing in Sterling or Euros is very similar once the costs of exchange rate and interest rate swaps are included. As a result we focused our analysis upon Sterling markets, and it is unnecessary to include an additional allowance for hedging and swapping costs.

Pre-funding costs

Companies typically raise finance prior to when it is needed. Since companies cannot be assured that finance will be available in sufficient quantities when it is required, pre-funding is an efficient debt-raising strategy. Also, from a pure cost-benefit point of view, pre-funding is likely to be cost effective: taking out debt incurs fixed costs, such as due-diligence fees charged by banks. It is therefore less costly to take out debt in larger sizes (and incur pre-funding costs) than in a series of smaller facility sizes.

The cost of pre-funding can be expressed as follows:

(7.1) $$PFC = C \times \%AMT \times HP$$

where PFC is the pre-funding cost, C is the interest cost of pre-funded debt measured in percentage points, %AMT is the proportion of total debt pre-funded and HP is the holding period in years.

Funds can usually be pre-funded in two ways: (i) by borrowing in advance and depositing the funds for the holding period, or (ii) through the use of revolving credit facilities or bank overdrafts. Companies indicated that pre-funding is typically split 50:50 between these two sources. Therefore, the cost of pre-funded debt, C, comprises two components:

- The interest rate margin measuring the difference between the interest rate paid on the debt and the interest rate that can be obtained on the deposit of the same funds, and;
- The interest rate payable on any revolving credit facility or bank overdraft.

According to companies, the interest rate margin is currently around 100 bps, but prior to the onset of the credit crisis the margin was closer to 50-60 bps. Revolving Credit Facilities (RCFs), by contrast, usually only attract an interest cost of around 20 bps. RCFs, therefore, are less costly source of pre-funded debt, but cannot usually be used to secure 100% of pre-funding requirements. Based on these figures, C is calculated to be 60 bps in the current period, up from about 40 bps over the longer-term.

Water companies indicated to us that the pre-funding requirement (which represents around two years worth of cash outflow) over AMP5 (i.e. %AMT) will amount to slightly less than 30% of total debt. Companies aim to secure funding about 12 months in advance i.e. HP is equal to 1.

Setting C equal to 60 bps (for the current period) and 40 bps (for the long-term average), %AMT equal to 30% and HP equal to 1, we calculate total pre-funding costs of 18 bps per year across all debt in the current period, up from about 11 basis points per annum in earlier periods.

Table 7.7 summarises our analysis of transaction and pre-funding costs.

Table 7.7
Transaction and Pre-funding Costs (bps, p.a.)

	Long-term	Current
Transaction costs	7	10
Pre-funding costs	11	18
Total	**18**	**28**

Source: Company consultation and NERA analysis

7.7. Conclusion on the Cost of Debt

Our analysis presents data on both time series data and current debt costs for different rating classes. Time series evidence shows that average real debt costs for BBB+/A- rated debt have been in the range of 2.6-3.6% across a range of debt instruments over a ten year period. However, recent evidence on A- debt costs over January-March 2008 shows average costs of

new debt issues at an A- rating are in the range of 3.6-4.0%. Our results are summarised in Table 7.8 below.

Table 7.8
Summary of A- Sterling Real Cost of Debt by Type of Debt (%)

	Capital Structure	Time Series (March 1998 – March 2008)	Current
Bonds	60	3.4	3.6
IL debt	17	2.6	N/A
Bank loans	23	3.2	4.0[1]
EIB loans		3.3	N/A
Finance leases		2.7	N/A
Range		**2.6 – 3.4**	**3.6 – 4.0**

Source: NERA analysis. Note (1) Current real cost of bank loans equals three month average of 6-month LIBOR (5.67%) plus current margin on loans (1.05%), deflated for expected inflation. Details on the margins charged on bank loans are discussed in more detail in Section 7.5.1.

The regulatory decision that Ofwat must make is how to make sense of the evidence on current and time series cost of debt when setting the cost of capital at PR09.

There are different regulatory approaches to determination of the cost of debt in setting the allowed cost of capital. Ofwat's approach at PR04 was primarily based on time series averages of debt costs. This approach has been followed by Ofgem at the Transmission and price review in 2006. However, the CC more recently estimated the cost of debt for BAA based on "current" market data.

There is an argument for setting the cost of debt at each price review equal to the current costs of debt at the time. However, we do not think that it would be appropriate for Ofwat to shift its cost of debt methodology completely to a "current" cost methodology, at a time when current debt costs are high. This would lead to windfall gains to companies with low embedded costs of debt of long maturities.

Instead, we propose a new regulatory methodology to estimate the cost of debt, which takes into account that the sector has raised debt in the past at more favourable rates than currently observed and that companies face higher debt costs in financing AMP5 than in the past. We propose that the sector will be allowed a cost of debt which is the weighted average of the following two components:

- Long-term time series evidence on the cost of debt for the proportion of debt the sector will not be refinanced over AMP5;
- Current evidence on the cost of debt for the proportion of new debt (i.e. refinancing of existing debt and new debt to finance AMP5).

We looked at the maturity profile of the sector to estimate the proportion of debt that will need refinancing prior to the end of the regulatory period in 2015. Further, we investigated the requirement of new debt to finance AMP5. We have calculated that around 60% of total debt costs over PR09 will reflect new debt costs and around 40% of total debt costs will

reflect existing funding costs (see Table H.2 in Appendix H for a derivation of these weightings).

We believe that this methodology has the following merits:

- First, our approach recognizes that the industry may have raised finance efficiently at different points in the interest rate cycle and that the sector raises finance over periods longer than the price control period. We also note this approach relies on historic benchmark yields (as opposed to actual embedded debt costs), which continues to give the companies an incentive to outperform the average benchmark yield over the interest rate cycle. Benefits of outperformance will eventually feed through to customers.
- Second, since this approach relies on benchmark yields (as opposed to company specific embedded debt costs) interest rate risk is still born by the regulated entity (as opposed to by customers). Companies are better able to manage this type of risk.
- Third, this approach also mitigates the risk that companies are not able to raise new funding in times of market turbulences (as the cost of debt reflects the cost and proportion of new debt as well as embedded debt).
- Fourth, our approach does not represent a significant departure from Ofwat's methodology at PR04 and appears to be consistent with Ofwat's view in SPL (March 2008) that costs of debt should take account of current and time series evidence. Moreover, our approach can be considered as a concrete formulaic interpretation of Ofgem's approach at GDPCR in December 2007, when Ofgem concluded that its estimate of the cost of debt "*appropriately balanced the spot rates for the cost of debt, the ten year trailing average, and the long-term averages*."[94]
- Finally, our new regulatory approach to the cost of debt is transparent and can be updated at future price reviews. We strongly believe that such an approach could win the support of both companies and the customers during the current regulatory debate.

Table 7.9 summarises total real cost of debt for A- rated debt after transaction and pre-funding costs. This table shows average debt costs for A- rated debt of around 3.4% using ten year time series data and 4.0% using current data, after allowance for transaction costs. Based on this evidence the range for the cost of debt at PR09 is 3.4-4.0%.

Based on our proposed methodology of using a weighted average cost of debt (using the 60:40 proportions of new and existing finance required for AMP5), our recommended allowance for the real cost of debt is 3.7%. However, we emphasise that it will be necessary to update our assessment of the cost of capital closer to the time when Ofwat will be making its estimates of the cost of capital and decision on the allowed rate of return.

[94] Ofgem (December 2007) Gas Distribution Price Control Review: Final Proposals, p102.

Table 7.9
Summary of Sterling A- Real Total Costs of Debt (%)

	Time Series	Current (January 2008 - March 2008)	Weighted Avg of Historic + Current
A- rated	2.6 - 3.4	3.6 – 4.0	3.2 - 3.7
Other cost	0.18	0.28	0.24
Total funding cost A-	2.8 - 3.6	3.9 - 4.3	3.4 – 4.0
Total weighted funding costs A-	3.4	4.0	3.7

*Source: Bloomberg, iBoxx and NERA analysis. Note: *in calculating the weighted average cost of current funding cost we set current funding costs for IL debt equal (in real terms) to the cost of debt for nominal bonds; for finance leases and EIB loans, we set the current costs equal to the current cost of bank loans.*

8. Weighted Average Cost of Capital

This section sets out our WACC estimate for UK water. Our WACC range is based on the following assumptions:

Gearing: We assumed a capital structure of 60% gearing. This is consistent with an A-credit rating. Our analysis of the optimal capital structure (see Section 9) has shown that this assumption is likely to minimize the overall WACC and ensures that companies can raise debt in periods of market turbulence.

Cost of Equity: We have relied most heavily on evidence from the CAPM and cross-checked our estimate by the DGM. Our analysis shows the real post tax cost of equity for the UK water sector at 60% gearing is in a range of 6.7-7.9% using the CAPM, and 7.4-8.5% using the DGM. Overall, we conclude on a range for the cost of equity of 7.4-7.9% for UK water at 60% gearing which represents the overlapping of the CAPM and DGM ranges. By comparison, Ofwat assumed a cost of equity of 7.75% at 55% gearing at PR04.

In concluding on our central WACC estimate, we have used a "point" estimate of 7.65% as the cost of equity, which is the mid-point of the range of 7.4-7.9%.

Table 8.1
Cost of Equity Consensus Range (%)

	CAPM	DGM
Real Risk-free Rate	2.6	
Equity Risk Premium	4.2 - 5.4	
Gearing	60	60
Asset Beta	0.39	
Equity Beta	0.97	
Cost of Equity (real, post-tax)	**6.7 - 7.9**	**7.4 - 8.5**
Overlap Range	***7.4 - 7.9***	

Source: NERA analysis

Cost of Debt: In our assessment of the cost of debt, we consider the costs of the different types of funding used by water companies, i.e. bonds, loans and finance leases. Our recommended approach is to take into account historic time series data and current data on the cost of debt. This approach points to a central range for the cost of debt of 3.4-4.0%, with the lower bound reflecting historic borrowing costs based on time series evidence and the upper bound forward-looking funding costs based on very recent market data.

In concluding on our central WACC number, we have derived a central estimate of the cost of debt by calculating a weighted average cost of debt based on historic and very recent market evidence on the cost of debt. The weights are based on our analysis that around 40% of total debt costs over PR09 will reflect existing debt costs and around 60% of total debt costs will reflect new funding costs. Using this approach, our "point" estimate of the real cost of debt for PR09 is 3.7%.

Table 8.2 presents our best estimate of the real post tax cost of capital for the UK water sector. The WACC ranges (i.e. vanilla and post-tax) are based on the range of estimates for *both* the cost of debt and the cost of equity.

Table 8.2
Range of Real WACC Estimate (%)

	Estimate
Gearing	60
Real Cost of Debt	**3.4 – 4.0**
Real Post Tax Cost of Equity	**7.4 - 7.9**
Post-tax WACC (Net of tax shield)	4.4 - 4.9
Vanilla WACC (Gross of tax shield)	*5.0 - 5.5*

Source: NERA analysis

9. Optimal Capital Structure

This section analyses the optimal capital structure for UK water. Section 9.1 examines the WACC sensitivity to capital structure. Section 9.2 looks at potential downside scenarios to inform the optimal capital structure. Section 9.3 concludes.

9.1. WACC Sensitivity to Capital Structure

Based on Moody's credit rating matrix (see Section 10), we investigate the sensitivity to WACC for the following two scenarios:

- A capital structure of 60% gearing (consistent with A- credit rating); and
- A capital structure of 68% gearing (consistent with BBB+ credit rating).

We focus our analysis of the WACC sensitivity to capital structure upon current debt costs, since the optimal capital structure will allow new debt to be raised as cheaply as possible. Table 9.1 shows that the our central WACC estimate (net of debt tax shield) increases slightly from 4.8% for 60% gearing and A- credit rating to 5.0% for 68% gearing and BBB+ credit rating.

This shows that the tax benefits from an increased leveraged capital structure do not offset the extra costs associated with a BBB+ credit rating. As a result, the higher geared financial structure associated with a BBB+ rating does not minimize the WACC and hence appears to be sub-optimal.

Table 9.1
WACC Sensitivity to Capital Structure

	A- Rated	BBB+ Rated
Gearing	60%	68%
Cost of Equity (real, post-tax)	**7.65%**	**8.91%**
Real Current Cost of Debt	3.8%	4.3%
Transaction & Pre-funding Costs	0.24%	0.24%
Cost of Debt (real, gross of tax shield)	**4.0%**	**4.5%**
Vanilla WACC	5.5%	5.9%
Corporate Tax Rate	28%	28%
WACC (net of tax shield)	**4.8%**	**5.0%**

Source: NERA analysis

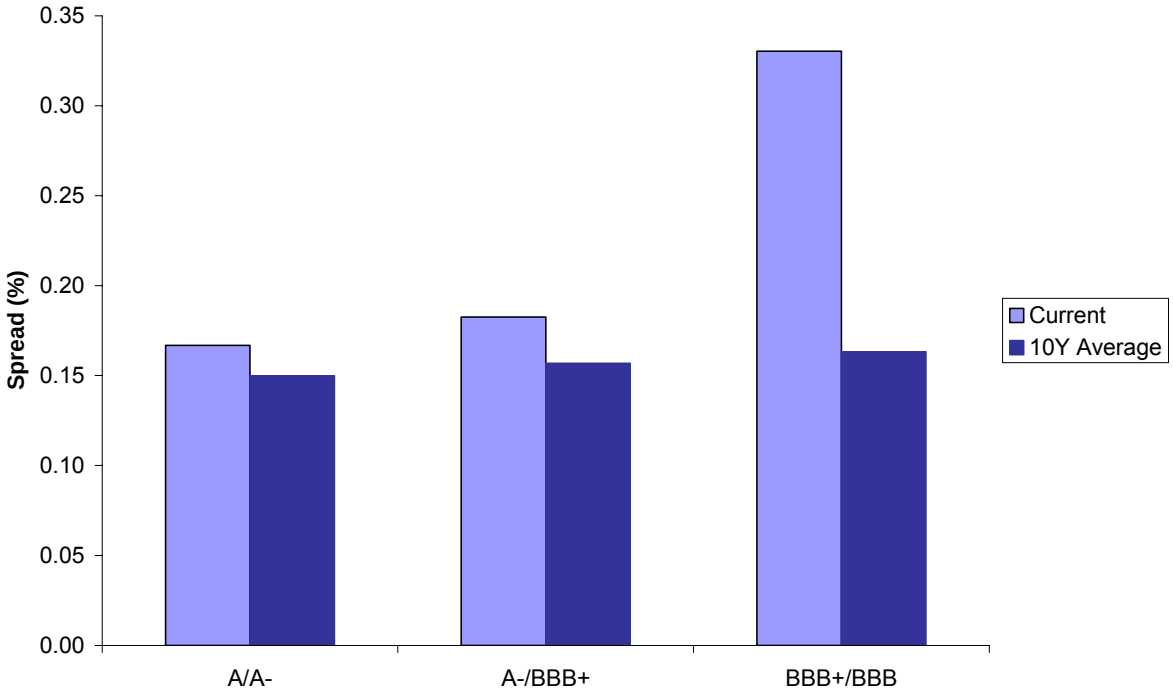
9.2. Scenario Analysis

Regulators should consider downside scenarios when determining the optimal capital structure for companies as part of setting the allowed WACC. The optimal capital structure must consider the implications for WACC in the event of an unforeseeable down- or upgrade from the base case assumption. Further, in a downside scenario, regardless of any implications for WACC, a company must be able to have access to capital markets to finance its activities.

To inform the potential increase in the cost of debt with respect to financial structure, we examine the cost of debt associated with different gearing and credit rating assumptions. To this end, we draw on US corporate benchmark bond data to examine the relative risk (measured as the difference in yields to maturity) for A, A-, BBB+, BBB and BBB-.

Figure 9.1 presents differences in the yield to maturity of corporate bond indices for different adjacent rating classes for the current three month period and for the long-term 10 year period.

Figure 9.1
Differences in Yield to Maturity for Adjacent Rating Classes
(Current Period vs. 10Y Average)



Source: NERA analysis of Bloomberg Fair Value Indices (15Y maturity) for A, A-, BBB+, and BBB; current period is calculated January 2008 – March 2008; 10Y period is calculated March 1998 – January 2008.

We now consider two downside scenarios to infer an optimal capital structure and credit rating.

Base Case BBB+

Current market evidence shows that a one 'notch' downgrade from BBB+ to BBB in a possible downside scenario would substantially increase the cost of borrowing at the current time. Market data on US corporate BBB+ and BBB bonds shows that borrowing costs could increase by more than 30 bps (based on yields to maturity observed in the secondary market) compared to around 16 bps over the long-term. This effect is likely to more than offset any tax benefits from a more highly leveraged financial structure.

This analysis shows that the current credit crisis has disproportionately increased investors' demand for compensation of risk at credit classes below BBB+.

However, more importantly, a downgrade to BBB would materially impair the ability of a company to raise capital under the current market turbulences. Our analysis of bond issues since the onset of the financial crisis shows that no company has been issuing Sterling denominated debt at BBB. Further, certain types of debt, such as IL debt might not be available at all at a rating below BBB+. This might suggest that companies would face severe credit rationing at a BBB credit rating.

To conclude, an allowed WACC based on a BBB+ rating would, in a downside scenario, increase companies' borrowing costs disproportionately. More importantly, companies are likely to face severe financing and liquidity risk in a possible downside scenario.

Base Case A-

Very recent US market data shows that the difference between A- and BBB+ benchmark yields is around 17 bps. We note this evidence is based on yields to maturity in the secondary market and this difference does not reflect any additional issuance premiums currently observed for new bond issues in the primary market (see Section 7.5.1). However, a potential downgrade from A- to BBB+ will have a relatively smaller impact on companies borrowing costs than a comparable downgrade from BBB+ to BBB.

In the case of an unforeseeable downgrade to BBB+, companies would still have access to sources of capital. For instance, our analysis of new issues in Section 7.5.1 has shown that companies have been able to issue BBB+ rated debt in the current market situation.

To conclude, an A- credit rating appears to leave companies the necessary leeway to cope with a potential downgrade in the case of an unforeseeable event.

9.3. Conclusions on Optimal Capital Structure

We conclude on an optimal structure of 60% gearing which is consistent with A- credit rating. A BBB+ credit rating is likely to impair companies' ability to raise debt in the case of an unexpected downgrade. This means a BBB+ credit rating will impose substantial liquidity and financing risk on companies. Further, our analysis has shown that a BBB+ rating is likely to lead to an increase in borrowing costs over and above the benefits of a higher geared financial structure and hence appears to be sub-optimal.

10. Financeability

At PR04, Ofwat made upward adjustments to the revenue allowances derived from the basic 'building block' approach to setting price limits, in order to ensure that certain companies would be able to finance large investment programmes. These financeability adjustments were not a new invention: some similar adjustments had been previously been made by Ofwat at PR99 and by a number of other UK regulators.[95] However, the adjustments made by Ofwat at PR04 were more significant and more widely applied than previously.

This section is structured as follows: in Section 10.1, we present an overview of Ofwat's approach to assessing financeability at PR04. In Sections 10.2 and 10.3 we summarise and appraise Ofwat proposed approaches for dealing with financeability issues at PR09 as set out in Setting Price Limits. In Section 10.4 we make recommendations on some changes that are required to Ofwat's process for dealing with financeability at PR09. In Section 10.5 we examine financial ratios constraints at PR09 based on our consultations with rating agencies.

10.1. Overview of Ofwat's Financeability Adjustments at PR04

The bulk of the £430m financeability adjustments made at PR04 were allocated to the WaSCs, all of which received an adjustment:[96]

- The total adjustment received by the WaSCs amounted to an average increase of 0.3% in the allowed rate of return over 2005-10.
- By comparison, the WoCs received less than £10m in financeability adjustments which is less than a 0.1% increase in the allowed rate of return.

At PR04, Ofwat stated that the reason why financeability adjustments were necessary was to take account of the intertemporal mismatch between costs and revenues under the RPI-X regulatory regime that arises from the fact that: (1) the current UK regulatory regime price caps is intended to deliver *stable real revenues* based on the combination of a *real* allowed rate of return and an inflation linked asset base; whereas (2) companies generally use mainly *nominal financing costs*.[97]

The timing problem means that in the early years of an asset's life, the level of a regulated company's actual revenue for the asset is lower than the nominal costs of financing it, and vice-versa in later years, as illustrated in the diagram below.

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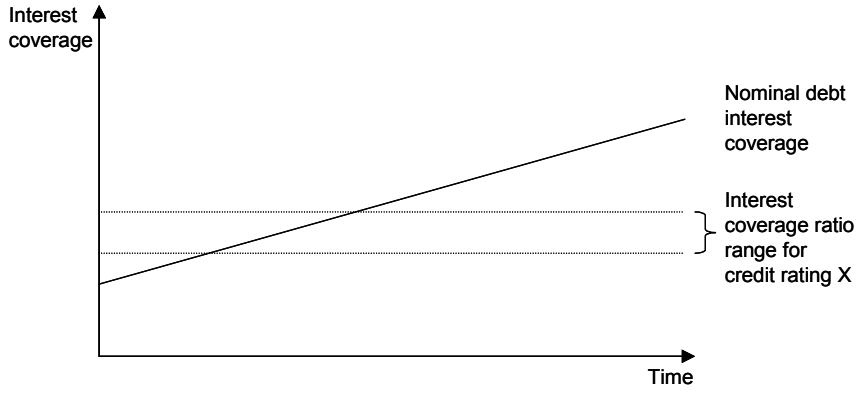
95 For example, Ofgem at 2004 Electricity Distribution Price Control Review for EdF-SPN.

96 The total of £430m is based on Figure 17 in Ofwat (2004) "Future water and sewerage charges 2005-10: Final determinations", p235. NERA analysis calculates that the effective rate of return on the RCV for the WaSCs, after allowing for financeability, is 6.1% over 2005-10, compared with the allowed Vanilla WACC of 5.8%. The effective rate of return on the RCV for the WoCs is 6.4%, the same as the allowed WACC of 6.4% (including the "Small Company Premium").

97 Ofgem and Ofwat (February 2006), "Financing Networks: a Discussion Paper", p.48.

Figure 10.1
Interest Coverage Ratios under a Real Revenue Stream and Nominal Financing Costs



The degree to which companies face pressure on financial ratios arising from the intertemporal mismatch between costs and revenues depends on the availability and relative costs of IL debt vis-à-vis nominal debt (including the level of inflation which has a direct impact on the cash flow gap) and the level of new capital investment.

Ofwat's approach to determining financeability adjustments was primarily based on the testing of companies' projected financial indicators against a package of minimum financial ratios for the E&W water industry. Revenue uplifts were granted for individual companies in selected years to comply with these financial ratios under central case assumptions. The complete set of indicators used by Ofwat at PR04 is set out in Table 10.1 below.

Table 10.1
Financial Indicators Used by Ofwat at PR04

Ratio	Range
Cash interest coverage	Around 3 times
Adjusted cash interest coverage I (funds from operations less capital charges expenditure divided by gross interest)	Around 1.6 times
Adjusted cash interest coverage II (funds from operations less capital maintenance expenditure divided by gross interest)	Around 2 times
FFO:debt	Greater than 13%
RCF:debt	Greater than 7%
Gearing (net debt: regulatory capital value)	Below 65%

Source: Ofwat 2004 Final Determinations, p.233

10.2. "Financing Networks" Consultation on Financeability

Following PR04, Ofwat and Ofgem issued a discussion paper ("Financing Networks") that evaluated the merits of different approaches to dealing with financeability issues. In particular the regulators consulted on whether the use of "revenue uplifts" was the right approach for dealing with financeability.[98]

The Financing Networks paper presented a number of alternative options that regulators could take to dealing with residual issues of financeability that include the following: (1) taking a more flexible approach to financial indicators; (2) a revenue uplift; (3) accelerating depreciation; and (4) using a nominal cost of capital to ease pressure on cash flows.

In its discussion of the responses to SPL (March 2008), Ofwat stated that options (3) and (4) would lead to undesirable outcomes and would not be considered further. Specifically, Ofwat stated that revenue advancement through accelerated depreciation "*might prove unsustainable in the longer term*" and the use of a nominal cost of capital "*would lead to material increases in price limits*".[99]

Ofwat has currently left open a number of alternative approaches to dealing with financeability that include:

- A more flexible approach to financial indicators;
- The use of IL debt
- Equity investment
- Revenue uplift (applied in a NPV neutral manner)

In the next section we appraise these different options for dealing with financeability issues at PR09.

10.3. Possible Approaches for Dealing with Financeability at PR09

This section evaluates the relative merits of different financeability options, currently under consideration by Ofwat at PR09.

- **Taking a More Flexible Approach to Financial Indicators**

Ofwat has stated that they do not consider the package of financial indicators to be significantly different from what they considered at PR04. However, they state that they "*would expect to use flexibly the levels for specific ratios within the overall package in assessing financeability*".

It is unclear what Ofwat mean by "use flexibly" in their assessment of financial ratio constraints. However, it suggests that Ofwat might use its discretion to try to remove certain

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98 Ofgem and Ofwat (February 2006), "Financing Networks: a discussion paper".

99 "*Setting Price Limits*" (March 2008), Ofwat. p.52

ratio levels as constraints. This is a worrying suggestion and it is not likely to provide the necessary assurance that the water companies can finance their activities over the coming regulatory period.

While regulators might prefer to take a more flexible approach to financial ratios and use their discretion in ways that remove them as a constraint, investors are unlikely to be so flexible. That is, regardless of the financial ratios the regulator chooses to rely upon, investors are likely to continue to rely upon metrics similar to those used by rating agencies. Accordingly, changes to the financial ratios that trigger a financeability adjustment will not remove the "residual" financeability problem.

In practice, taking account of companies' actual ability to finance their functions under all scenarios is central to ensuring that investors' requirements are satisfied. Financial modelling should undertake sensitivity checks on actual, as well as notional, capital structures in order to ensure that companies can feasibly raise finance. Other sensitivity checks around projected ratios under "low-case" scenarios are vital for ensuring that investors and lenders have confidence in the ability of the regulatory regime to maintain financeability under all cases.

- **The Use of IL Debt**

Issuance of IL debt (rather than nominal debt) and/or issuance of new equity both provide market-based solutions to financeability issues that might arise from cash flow timing problems in the future. We agree that the regulatory methodology should take account of these financing options before looking for alternative financeability solutions.

Our discussions with water companies have shown that many water companies have issued IL debt over AMP4 at favourable rates, and most water companies view their optimal capital structure as incorporating some proportion of IL debt finance. A median view here was that companies were willing to consider the use of IL debt up to around 20-30% of the overall debt portfolio, but that higher levels of IL debt would not be prudent as it would expose the companies to higher levels of refinancing risks and inflation risks.[100]

However, as discussed in Section 7.5, there are aspects of current credit market demand and supply that mean that IL debt may not be a cost-effective form of new finance over AMP5.

These can be summarised as follows:

- Recent credit market conditions have had a detrimental impact on the market appetite for wrapped bonds. The premium on wrapped bonds has recently increased due to market concerns regarding the monolines' US subprime exposures and general turbulence in the credit markets. [101]

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[100] The WUK Investor Survey (2008) highlighted that IL debt is an attractive form of finance when inflation is low but that (investors thought) this situation might not continue.

[101] FSA, the monoline which has wrapped Artesian Finance, has been affected less by subprime concerns but it appears that all the monolines have been affected and wrapped spreads have increased across the board. RBS have told us that these concerns have particularly hit spreads on Ambac (who wrapped the South East Water bond) and MBIA owing to higher subprime credit exposures of these monolines relative to FSA.

- Appetite for long dated wrapped IL bonds (such as those issued by Artesian) is currently dominated by a limited number of asset swappers. City sources told us that some traditional pension fund investors may directly take unwrapped issues but we understand that these investors would only look at single A for IL debt. Companies (especially WoCS) at underlying BBB credit ratings would not be likely to benefit from this demand, even if these investors were to buy illiquid stand alone single water company issuance.[102]
- Monoline insurers may wish to charge higher fees for wrapping and/or limit smaller and higher credit rating deals as risk margins widen in the market.[103]

In summary therefore, there are a number of reasons why demand for IL finance is likely to be lower in AMP5 than previously and IL finance costs may increase by more than costs of traditional WaSC nominal bonds in the event that corporate credit market conditions continue to tighten and/or the gilt market bubble unwinds. The latter is a particular possibility as pension fund demand relative to supply will be expected to eventually reach satiation. Further, asset swapping is unlikely to mitigate these problems on a significant scale.

For these reasons, it may not be prudent for Ofwat to be able to assume a significant proportion of IL (or similar) debt finance in undertaking its financeability tests, especially for WoCs who have not yet issued IL debt and may not be able to without access to new Artesian Finance facilities (which RBS report are not currently planned). It is too early to conclude on this issue before the PR09 review, and the debt markets will need to be monitored closely over the coming months to take account of developments.[104]

- **Equity Investment**

Another approach to financeability is for the regulator to assume that new capex not funded by internal resources will be funded by debt and equity in a way that maintains a constant capital structure. This approach is the only one that is potentially consistent and transparent from one review to the next. However it is only viable if several key criteria are met.

Firstly, the cost of capital must include sufficient allowance for the cost of issuing new equity and debt. Previous NERA analysis (2004) has shown that equity issuance costs are in the region of 0.3% of the cost of equity finance.[105]

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[102] A number of WoCs may not be able to issue sufficient amounts of debt to enable a standalone bond, on the basis of liquidity and other investor requirements.

[103] Their ability to raise prices however may be hampered by reduced market appetite for wrapped bonds (owing to subprime credit concerns as above and spread widening on monoline wrapped bonds). However, if credit markets continue to tighten but specific concerns over monolines and subprime exposures decline then monolines may be able to raise prices for wrapping.

[104] WoCs may also be more generally vulnerable to unwinding of the long dated IL gilt 'bubble' that has developed as a result of high pension fund demand for assets to match with long-dated liabilities.[104] This is because WoCs typically have single maturity long issue financing structures. The WoCs do not have the maturity and instrument flexibility of the WaSCs who can better exploit and navigate such bubbles. This is evidenced by the substantial amount of WaSC debt issuance, particularly in 2006 and early 2007 which took advantage of historically low gilt yields, an issuing flexibility not available to the WoCs with their smaller asset bases and lack of standalone bond programmes to tap the long end of the curve.

[105] Previous reports written by NERA for the UK water sector and electricity sector estimated an equity issuance costs premium of 0.3%, based on the "conventional approach" used to account for flotation costs in US regulatory

Secondly, financial ratio projections must not only satisfy debt related ratios but minimum levels of target equity indicators as well. This is because companies must, in order to retain equity investors, be able to pay satisfactory dividends, which can be characterised by reference to a number of ratios such as dividend growth, dividend cover and dividend yield. The Water UK Investor Survey (2005) presented evidence showing that the three most important indicators considered by equity investors when making investment decisions are dividend growth, dividend yield and dividend cover.

Even though it is possible that new equity could be a mechanism to deal with financeability issues, the fact that water companies (except UU) have not raised new finance through the issuance of new equity in practice suggests that this is not viewed as a cost-effective solution. In our consultations with companies on financeability mechanisms, no company reported plans to issue new equity and companies unanimously stated that new equity would only be issued in extraordinary circumstances. In the 2008 Water UK Investor survey, only one respondent (out of 35) considered that rights issues or greater dividend retention was the correct regulatory assumption to deal with financeability issues.

Our recommendation is therefore that new equity issues should be regarded as a last resort in Ofwat's modelling of financeability at PR09 and Ofwat should not assume widespread new equity issuance across the industry, without significant consultation on the market appetite for new equity and the costs of issuance.

If there is a need for Ofwat to assume new equity on a company specific basis, it must recognise that issuing equity imposes an additional cost, for which the company requires a revenue allowance (whether in the estimated WACC or otherwise).

- **A Revenue Uplift**

A revenue uplift is the approach that was used by Ofwat to deal with issues of financeability for a range of companies at PR99 and PR04. It was also used by Ofgem to ensure that the Distribution Network Operators (DNOs) financial ratios were satisfactory at the 2004 Distribution Price Control Review.

A conceptual issue with the use of revenue uplifts as a way to deal with financeability is its incentive properties. Simply providing companies with revenue uplifts rather than adjusting the cost of capital and other regulatory assumptions undermines the CAPM and building blocks approach to setting revenues. If it is expected that at the next price review the regulator will choose a rate of return on a company specific basis that is consistent with threshold financial constraints, it will reduce incentives for companies to achieve efficient and/or desirable financing structures and provides an additional source of regulatory risk in the form of a potentially discretionary claw-back mechanism.

The incentive properties of this mechanism can be improved significantly by increasing the degree of clarity and transparency in the process. If the theoretical reason for financeability

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proceedings. This approach is based on a company/sector-specific formula (taking into account dividend forecasts, required cost of equity and other factors) which is cited in corporate finance textbooks such as Brigham and Gapenski (1991) and Morin (1994). See NERA (2004) "UK Electricity Distribution Cost of Capital: A Report for EdF."

adjustments arises as a result of *cash flow timing* differences between the allowed return in price limits and companies' payments to investors, then the financeability payments should be explicitly linked to this and they should take account of the market constraints facing companies on their abilities to issue IL debt and new equity to mitigate for this effect.

Ofwat has indicated that if there is a need for revenue uplifts to deal with financeability issues, then it will apply them in a NPV-neutral manner. However, it is not yet clear what this means and how it differs in practice to other forms of revenue advancement such as accelerated depreciation. Accelerating depreciation - has been used by some regulators (eg. Ofgem in 1999) in the past to solve short term financeability issues but it simply postpones the problem to a future period. Unless it is certain that financeability constraints are going to ease in the future, which would require long term certain capex and financing projections, accelerating depreciation allowances now may require further and more severe financeability adjustments in the future.

Any revenue advance mechanism simply represents a loan from customers. The additional revenue should not be booked as revenue, and hence a contribution to profit. Instead, the additional inflow of funds from customers is a loan, which should be recorded as incoming cashflow and which is offset by a growing liability (the obligation to repay the loan). Such an option can only be effective if the financial markets do not see through this off-balance-sheet liability, which is unlikely to be the case in the long term.

In summary, we are very sceptical about whether a revenue uplift in the form of a NPV neutral adjustment will deal with financeability issues over the AMP5 period. Regulators have investigated a number of ways to shift cashflow into the next regulatory period, but all effectively represent loans from future customers, which must be paid back in the form of lower cashflows at some future date. It is unclear whether these temporary manipulations of cashflow will be enough to satisfy investors.

10.3.1. A Basic Solution – Adjust the Cost of Capital

The intertemporal mismatch between costs and revenues in the regulatory regime provides a theoretical reason for financeability adjustments. However, it is important not to overstate the impact of this effect. The RCV contains a portfolio of investments, some of which over-recover and some of which under-recover in any particular year. Since many of the investments made by water companies are now in the latter years of their asset lives, the impact of the regulatory formula on cash flow timing will, *per se,* be over-recovering the nominal costs of financing for these assets in these years.

A more basic line of defence to inadequate financial ratios is for Ofwat to consider whether its estimate of the WACC is correct. The WACC is a combination of many different factors, each of which may have been understated. It seems unlikely that the regulatory WACC is correct if similar adjustments for financeability are required for nearly all water companies, as at PR04, regardless of the specific capital investment programme, age of the asset life and other company specific factors.

Further evidence that Ofwat's adjustments for financeability at PR04 were not rigorously based on the timing problems caused by the building blocks methodology comes from the fact that none of the WoCs received significant financeability adjustments. If the 'building

blocks' regulatory regime leads to a mismatch between the level of allowed revenues and actual capital costs faced by companies, then financeability adjustments should have been made for *all* those companies where there is significant net new investment to compensate for this effect.

The Water UK 2008 Investor Survey also showed that investors believed that the best single option for dealing with financeability issues was for the regulator to increase the cost of capital.

10.4. Looking Forward to PR09

More clarity in Ofwat's process for testing for financeability is necessary to increase objectivity and reduce the potential for regulatory discretion. Reducing the potential for regulatory discretion will allow review of the regulator's decisions, reduce perceptions of regulatory risk and as a result, reduce the cost of financing. In practice, this means (a) linking the financeability adjustments to the drivers for these adjustments more robustly; (b) reporting the results of market consultation for inputs (eg. proportions of ILG debt, availability and costs of new equity, explicit rating criteria) wherever possible; (c) adopting a given formula (e.g. a binding threshold on certain ratios).

We expand on these points below:

- **Linking the financeability adjustments to the drivers for these adjustments more robustly:** by linking future financeability adjustments more clearly to the main theoretical drivers for these adjustments, namely the level of net new capital investment over the period and the degree to which companies can efficiently use market mechanisms such as IL debt and new equity to mitigate cash flow timing mismatches. Further cross-checking of the cost of capital against other models than the CAPM will also increase the robustness of this assumption.[106]

- **Fuller discussion of public consultations with rating agencies and the financial markets:** Ofwat's consultation process with rating agencies and the markets is reported to have improved significantly after PR99. However, whilst we recognise that full publication of consultation may not be desirable in all cases, *conclusions* drawn by market and rating agency consultations should be made public to enable scrutiny by all stakeholders. Further consultation is also needed on practical constraints facing companies that may lead to cash flow timing differences in reality, such as the availability and cost of market-based solutions to financeability issues such as IL debt and issuance of new equity.[107] At PR04, Ofwat discussed IL debt and new equity issuance but ignored these in its financial modelling even though both had been used by companies as methods to finance new capital investment over AMP3.

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[106] Ofwat could test for the cost of capital by assuming in the notional balance sheet that *all* debt finance raised by companies is IL debt (since the real IL regulatory cash flows will then be aligned with real IL payments to investors). Under this scenario, if the financial ratios are still insufficient to maintain a strong credit rating, then this will provide *prima facie* evidence that Ofwat's cost of capital has been set incorrectly. .

[107] The use of equity to fund investments obviates the inflation-payment mismatch problem associated with nominal debt, since dividends implicitly include an inflation allowance commensurate with an IL return on the RCV.

- **Final tests on bankability should then be based on very clear criteria:** The final tests on bankability should be based on very clear criteria, perhaps using a binding threshold on certain ratios. The tests should also, where possible, take into account actual constraints on the availability of market based solutions to financeability.

Overall, increased clarity in the process for making financeability adjustments will substantially reduce the degree of regulatory discretion in the process, reducing perceived regulatory risk. It will then also be clear to all companies and stakeholders how the adjustments have been made. Greater transparency will also lead to increased discussion regarding the methodologies and mechanisms used for making financeability adjustments, leading to better representation of all stakeholders' views and improving consultation processes.

10.5. Financial Ratios at PR09

Companies must maintain a satisfactory credit ratio to ensure ongoing access to capital at a cost that does not lead to undue charges for customers. Credit ratings are based upon several criteria aimed at measuring a company's ability to meet its ongoing debt obligations. We present the relevant criteria Moody's applies to rating regulated businesses in the UK in Table 10.2.[108] A company's rating reflects its performance across all relevant metrics, not just one. Accordingly, a company may still attain a particular rating even where it falls outside the ranges shown for one (or even more) metrics. For example, a company may still be rated A1 even if its debt to RAV ratio exceeds 50%.

The net adjusted debt to RAV ratio (or regulated asset ratio) is Moody's preferred measure of leverage, or net indebtedness.[109] The adjusted interest cover ratio (ICR) "is a normalised cash flow-based measure of the financial flexibility of a water company to service, in terms of interest payments, its financial obligations".[110] The RAR and ICR are the two key metrics used by Moody's "to assess and monitor the financial strength of a water company". A third metric sometimes employed is the Retained Cash Flow (RCF) to Net Adjusted Debt ratio.[111] This is an alternative measure of leverage, which because it does not incorporate regulatory measures, is more easily comparable to other investment grade publicly listed companies.

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[108] We focus upon Moody's ratings because more information is publicly available than for Standard & Poor's or Fitch. However, we expect other ratings agencies to apply broadly similar metrics in a parallel fashion.

[109] The RAR is defined as (Debt – Cash & Cash Equivalents)/RAV: Moody's (2006) "UK Water Sector: Key Ratios Used by Moody's in Assessing Companies' Credit Strength", March.

[110] Moody's (2006); ICR = (Funds From Operations – Regulatory Capital Charges + Net Interest)/ Net Interest. The regulatory capital charges are Infrastructure Renewals Charge (IRC) and Current Cost Depreciation (CCD).

[111] The RCF/NAD ratio = (Funds From Operations – Dividends Paid) / (Debt – Cash & Cash Equivalents).

Table 10.2
Moody's Regulated Business Credit Ratings

	Net Adjusted Debt to RAV Ratio	Adjusted Interest Cover Ratio	Retained Cash Flow to Net Adjusted Debt Ratio
A1	> 40% & < 50%	> 2.5 & < 3.5	> 14% & < 18%
A2	> 50% & < 60%	> 1.8 & < 2.5	> 10% & < 14%
A3	> 60% & < 68%	> 1.6 & < 1.8	> 8% & < 10%
Baa1	> 68% & < 75%	> 1.4 & < 1.6	> 6% & < 8%
Baa2	> 75% & < 85%	> 1.2 & < 1.4	> 4% & < 6%

Source: Moody's published research. Ratio guidelines are for ratings of stand-alone regulated business on a corporate basis. Actual ratings may be based on the consolidated financial risk profile of the group or reflect the benefits of structural enhancements.

Table 10.3 shows that the ratios Moody's applies are largely unchanged since PR04. The debt to RAV ratio consistent with an A3 rating (equivalent to Standard & Poor's A-) has increased slightly to 68% at PR09 from 65% at PR04, while there have also been some small changes to the RCF / Net Debt ratio. Importantly, however, these changes have been to the division between A3 and Baa1 ratings, rather than to the overall boundaries delimiting these ratings - the ratios a company must meet in order to maintain a satisfactory credit rating in the eyes of Ofwat are unchanged between the two price reviews.

Table 10.3
Moody's Regulated Business Credit Ratings at PR04 and PR09

		PR04	PR09
Net Adjusted Debt to RAV Ratio	A3	> 60% & < 65%	> 60% & < 68%
	Baa1	> 65% & < 75%	> 68% & < 75%
Adjusted Interest Cover Ratio	A3	> 1.6 & < 1.8	> 1.6 & < 1.8
	Baa1	> 1.4 & < 1.6	> 1.4 & < 1.6
Retained Cash Flow to Net Adjusted Debt Ratio	A3	> 7% & < 10%	> 8% & < 10%
	Baa1	> 6% & < 7%	> 6% & < 8%

Source: Moody's published research. Ratio guidelines are for ratings of stand-alone regulated business on a corporate basis. Actual ratings may be based on the consolidated financial risk profile of the group or reflect the benefits of structural enhancements.

In general Ofwat's choice of ratios at PR04 appears to be still broadly consistent with the indicators that are used by credit rating agencies in assessing companies' credit strength. However, there are clear differences across the rating agencies in the emphasis that is given to different ratios. Whilst Moody's rating agency focuses on the post depreciation adjusted interest coverage, Standard and Poor's rating reports[112] typically focus on FFO interest

[112] For example, see Standard and Poor's (August 2004) "Three Valleys Water Plc" and Standard and Poor's (August 2004) "Wessex Water Services".

coverage, while Fitch IBCA appear to place more emphasis on a post maintenance ICR ratio arguing that there is increased divergence between the theoretical CCD and actual cash maintenance spend as a result of such factors as Ofwat's broad equivalence methodology.[113]

If equity issues are to be considered as a financeability mechanism, it is therefore important at PR09 that Ofwat's tests on bankability reflect those indicators of the financial stability of companies important to equity investors in addition to those assessed by ratings agencies in determining credit ratings.[114]

10.6. Conclusions on Financeability

The financeability issue arises because of a mismatch between real revenues and nominal costs, with those companies facing disproportionately large capex programmes most likely to be affected. We have reviewed a range of potential solutions:

1. **Cost of Capital adjustment**: the first line of enquiry should be the allowance for the cost of capital (WACC) since this is unlikely to be correct if financeability adjustments required across the industry.
2. **Index linked debt:** IL debt can ease financeability constraints but limited availability of IL debt in the current market.
3. **Increases in the allowed rate of return:** might be best solution for company specific factors (eg. high operational leverage), but poor incentive properties and additional source of regulatory risk.
4. **Revenue advancement:** akin to a loan, if revenue neutral. Might be solution to "timing problem" but may just defer problem to the future.
5. **Rights Issues**: companies do not plan to issue new equity or retain a significantly greater share of earnings. Allowances for costs of issuing new equity must be included in WACC.

In summary, we recommend that Ofwat set a cost of capital that is consistent with the assumed credit rating underlying the cost of capital. That is, if the allowed cost of capital is accurate then the need for widespread financeability adjustments should be avoided.

A second best solution is to rely upon market based remedies including IL debt and issues of new equity. However, in the current market conditions, assumptions about the future availability of IL debt should be very conservative. Further, since companies face significant obstacles to re-financing existing IL debt, the proportion of IL debt (as a share of total debt) is unlikely to rise above the 20-30% that companies target.

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[113] FITCH IBCA (January 2004) "UK Water Sector – Topical Questions Answered".

[114] By contrast to the UK, regulated utilities in the US regularly issue new equity to maintain balance sheets in two ways: (a) employee stock options and incentive plans (which generally account for up to 3-4 percent of new equity annually for companies with such plans; and (b) periodic major equity issuances, of perhaps 10-20 percent new equity, coming generally every 5 to10 years. The use of equity to fund investments alleviates the inflation-payment mismatch problem associated with nominal debt, since dividends implicitly include an inflation allowance commensurate with an IL return on the RAB.

With respect to new equity or retained earnings, companies and investors have indicated that these are extremely unlikely to be significant sources of funding over AMP5. Further, equity investors have indicated significant reservations about the impact of new equity upon key equity ratios. If new equity is considered by Ofwat, then for consistency Ofwat must make an allowance to reflect the associated issuance costs.

In the event market based solutions prove unsatisfactory then a NPV-neutral financeability adjustment appears more palatable than taking a more flexible approach to financial ratios. However, we have reservations about how an NPV-neutral adjustment would be applied in practice.

Since each of Ofwat's mooted solutions have practical or theoretical shortcomings (or both), setting a cost of capital that allows companies to sustain appropriate credit ratings is the preferred remedy to any financeability problem in principle and in practice.

Regardless of the preferred adjustment method, Ofwat should adopt a clearer and more objective approach to future financeability adjustments. In particular, Ofwat should link the adjustments to the drivers of those adjustments more robustly, provide fuller discussion of consultations with ratings agencies and financial markets, and base financeability tests on a very clear criteria which could be based on financial ratios used by rating agencies.

11. Weighted Average Cost of Capital Using Market-to-Asset-Ratios

This report sets out evidence on recent Market to Asset Ratio (MAR) values and their implications for the cost of capital for UK water at PR09. Section 11.1 discusses the theory and drivers of MARs and the theoretical link to the cost of capital. Section 11.2 presents our estimates of MARs for the listed WaSCs, while section 11.3 discusses the uncertainty that valuation of non-regulated businesses introduces to MAR calculations. Section 11.4 contains a model of the relationship between WACC and MAR and discusses the range of WACC implied by observed MARs over AMP4. Section 11.5 presents evidence on the impact of an infrastructure bubble, with focus upon recent acquisitions in the UK water and utilities sectors and trends in market valuations. Section 11.6 concludes.

11.1. Market to Asset Ratios – the Theory

The MAR is the ratio of the market value of regulated business to its regulatory capital value (RCV):

$$\text{MAR} = \frac{\text{Market Cap} + \text{Net Debt (of regulated activity)}}{\text{RCV}} \tag{11.1}$$

The market value of the regulated business is calculated as the sum of the market value of net debt and the market value of equity. The values of net debt and equity should relate to the value of regulated business only, but in reality the presence of significant non-regulated business leads to substantial practical difficulties, which we consider in Section 11.3.

Putting those issues to one side for the moment, we now show algebraically how the MAR can be derived as a function of key value drivers.

The value of an asset is equal to the NPV of cash flows, discounted at the cost of capital. If investors expect constant allowed cash flows at the rate of return allowed on the RCV into perpetuity (i.e. assuming no outperformance and growth in RCV), the market value of assets and MAR can be expressed as follows:

$$\text{MV} = \frac{\text{RCV} \times \text{ARoR}}{\text{WACC}} \Leftrightarrow MAR = \frac{\text{ARoR}}{\text{WACC}} \tag{11.2}$$

Where

- MV is the market value of debt and equity;
- ARoR is the regulated allowed rate of return, and;
- WACC is the investors' expected cost of capital.

Equation (11.2) shows that the MAR equals one if and only if the regulated allowed rate of return is equal to investors' expected cost of capital. That is, if investors expect that the regulated company performs exactly in line with regulatory assumptions underlying price limits into perpetuity then the market value of the company will be equal to the RCV – that is, the MAR would equal one.

Investors generally expect growth in the RCV. If we assume a constant growth rate *g* of the RCV, equation (11.2) can be restated as follows:

(11.3) $$\text{MV} = \frac{\text{RCV} \times (\text{ARoR - g})}{\text{WACC - g}} \Leftrightarrow MAR = \frac{\text{ARoR - g}}{\text{WACC - g}}$$

Where

– g is the perpetual growth rate of RCV.

Investors may also expect cash flows in excess of the regulated rate of return allowed on the RCV:

(11.4) $$\text{MV} = \frac{\text{RCV} \times (\left[\text{ARoR} + \text{c}\right] - \text{g})}{\text{WACC - g}} \Leftrightarrow \text{MAR} = \frac{(\text{ARoR} + \text{c}) - \text{g}}{\text{WACC - g}}$$

Where

– c is the annual additional allowed revenue as a % of RCV.

In particular *c* represents cash flows in excess of the return allowed on the RCV, including (but not limited to) opex/capex incentive mechanisms, penalties, quality-of-service incentives, tax outperformance, and over- or underspend on capex.

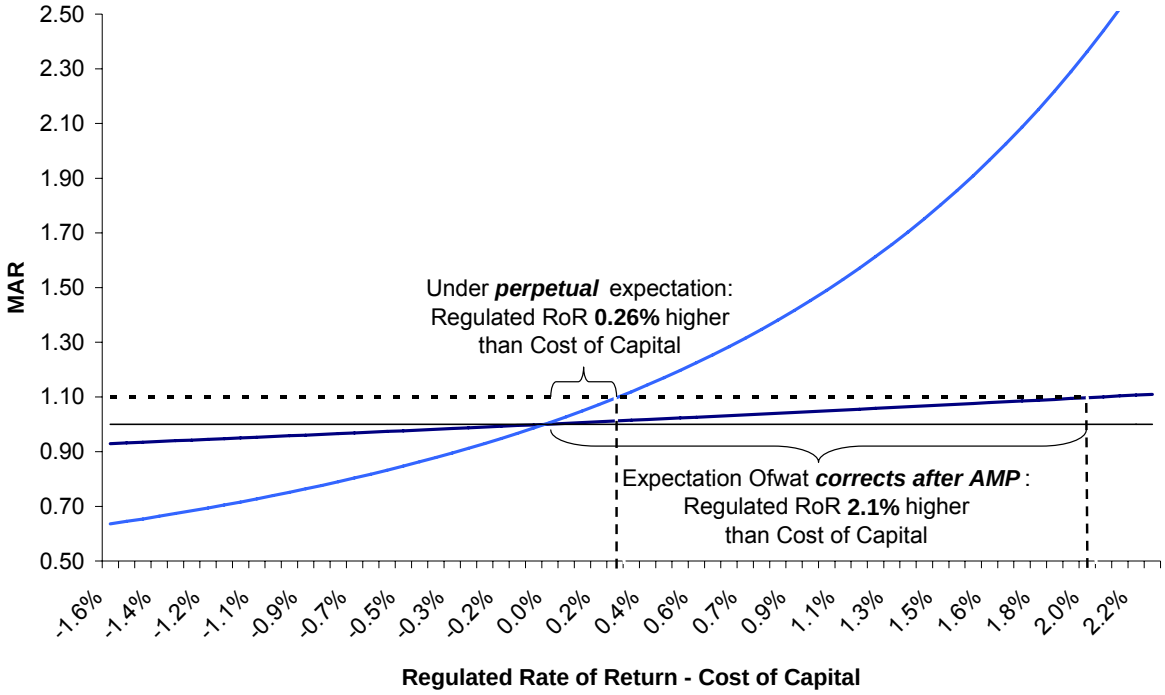
The formula above represents an overly simplified relationship between MAR and the key value drivers. The formula cannot take into account the timing factors that are considered by investors in valuing regulated infrastructure assets. For instance, the formula assumes that cash flows remain constant in perpetuity, but investors are likely to have different views on cash flows in the short- and in the long-run.

Of particular concern is that the formula assumes that the wedge between the allowed rate of return on RCV and the cost of capital remains constant into perpetuity. A rational investor, however, is likely to assume that at the next regulatory review the regulator will set the allowed regulated rate of return equal to the cost of capital.

To demonstrate the importance of this issue Figure 11.1 shows MARs explained by the difference between the regulated allowed rate of return and the cost of capital over the next AMP *and* in perpetuity (assuming no other outperformance).[115]

[115] We assumed a growth rate of RCV of 2.2% p.a. (parameter *g* in Equation (11.4)). This assumption is based on projected RCV growth over AMP4 for the listed WaSCs.

Figure 11.1
Relationship between Regulated Rate of Return and MAR
(No Outperformance)



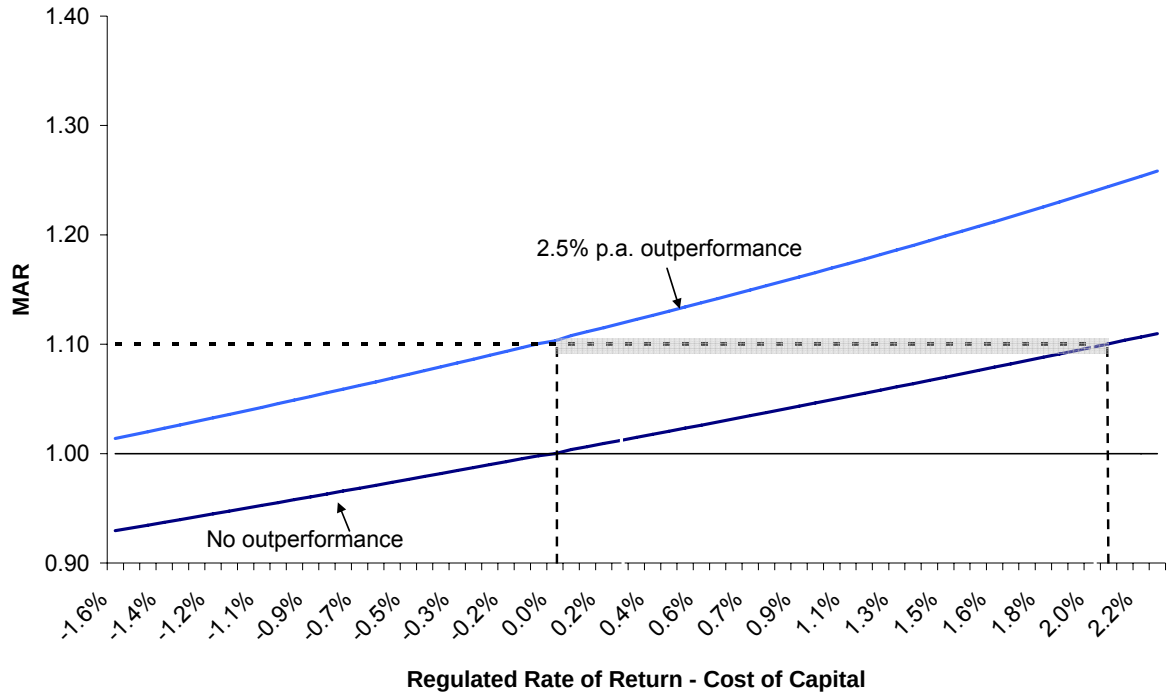
Source: NERA illustration

Assuming investors expect the divergence of the regulated rate of return and the cost of capital to persist in *perpetuity*, Figure 11.1 shows that a MAR of 1.10 is consistent with a cost of capital which is only 0.26% lower than the regulated allowed rate of return. However, based on the more realistic assumption that investors are likely to expect Ofwat to correct for the divergence, investors must anticipate that the cost of capital is 2.1% lower than the regulated rate of return, in order to justify a MAR of 1.10. This wedge seems implausibly wide, which might suggest that there are other factors at work.

Figure 11.2 illustrates how the MAR changes if we assume the company to outperform on regulatory efficiency targets. A MAR of 1.10 is consistent with perpetual expected opex outperformance of 2.5% per year[116], assuming no divergence between the regulated allowed rate of return and the cost of capital. Alternatively, the grey shaded line in Figure 11.2 presents all possible combinations of expected outperformance and the cost of capital to allowed rate of return wedge that explain a MAR of 1.10 (assuming investors expect Ofwat to correct for the wedge after the end of the regulatory period).

[116] Opex outperformance of 2.5% p.a. translates into additional allowed revenues of 0.8% p.a. of RCV. This is calculated as follows: annual outperformance (3.0% p.a.)*4.5*opex as a % of RCV (7%). Note, companies are allowed to keep opex outperformance for five years; (which is equal to around 4.5 times annual outperformance in NPV terms) and opex is assumed to be around 7% of RCV for the sector.

Figure 11.2
Relationship between Regulated Rate of Return and MAR
(With Opex Outperformance)



Source: NERA illustration

In summary, there are a number of factors that may cause MARs to deviate from 1.0, and, interpretation of MARs must be done with care, as they reflect a number of factors. Aside from investors' expectations about the divergence of the cost of capital from the allowed regulated rate of return, there are a variety of incentive mechanisms within the regulatory framework that provide incentives for companies to outperform and to generate cash flows over and above what Ofwat assumes in price limits including:

- 'carrot'/'stick' mechanism to incentivise opex and capex efficiency improvements;
- the company may spend more or less on capex/opex than assumed by the regulator;
- overall performance assessment incentives (OPA);
- financeability adjustments (in case they are NPV positive), and;
- tax outperformance (actual tax being lower than modelled allowed tax).

We consider these factors in more detail in Section 11.4.

11.2. UK Water MARs

Figure 11.3 presents MARs for each of the listed WaSCs since April 1998 and an aggregated MAR for the listed WaSCs.[117,118] Figure 11.3 shows the following trend in aggregate MARs for the sector:

- MARs fell sharply in the late 1990s following PR99, which was widely considered to be a harsh review;
- A period of stable MARs of around 0.9 until 2004;
- An upward trend in MARs over most of AMP4;
- The aggregate MAR dropped sharply in June 2007, but rebounded shortly thereafter. Over January and February 2008 the aggregate MAR has again decreased to a level of around 1.1, and;
- The sector aggregate MAR over AMP4 ranges from 1.01 – 1.20. Individual companies' MARs over AMP4 range between 0.94 – 1.36.

The decrease in MARs in June 2007 largely coincided with a fall in share prices worldwide (e.g. the FTSE 100 fell by 1.8% in June and by a further 7.2% by the end of August) triggered by the onset of the financial crisis.

- SouthWest's MAR dropped significantly from above 1.3 to about 1.1. However, this drop can be partly explained by data uncertainty: in May 2007 JP Morgan valued SouthWest's non-regulated business at £960 million, but in June 2007 Credit Suisse valued the same business 17% higher at £1,127 million. This increase in value of the non-regulated business largely explains the fall in MAR in June 2007.
- Kelda's MAR fell from around 1.3 to around 1.0. It is likely that Kelda's MAR included some acquisition premium at the time (Kelda was acquired in February 2008 at a premium to RAB of 31%) and that this was unwound with the onset of the financial crisis in June 2007.

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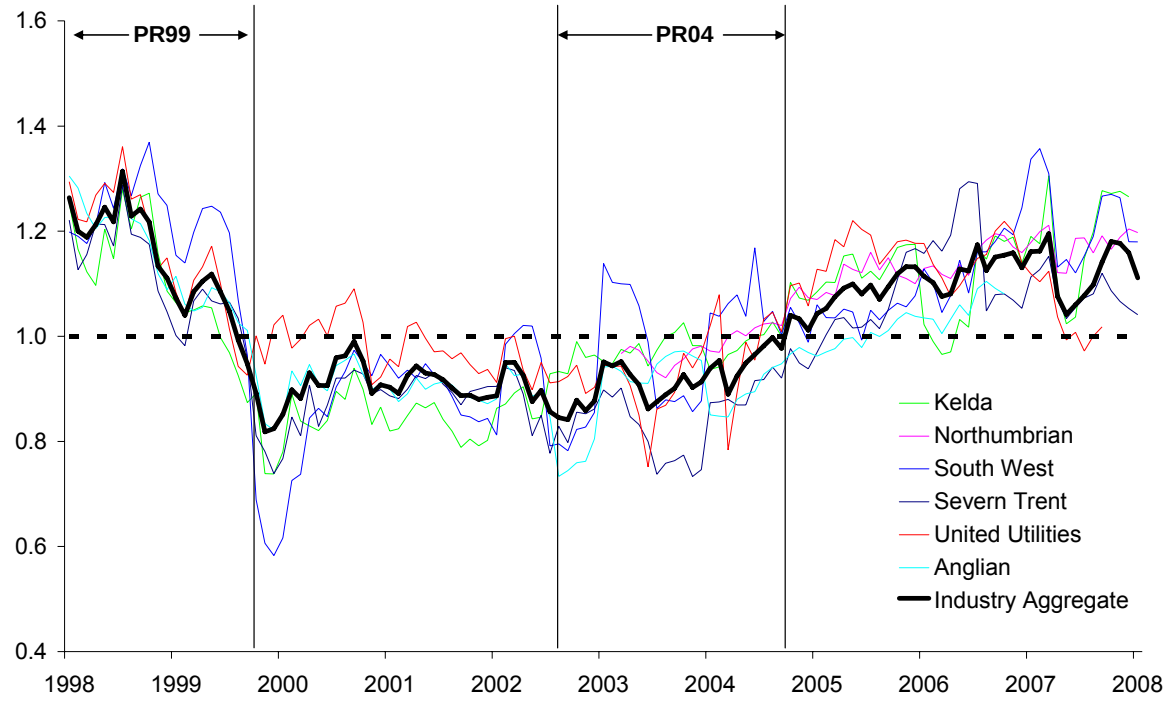
117 We consider six WaSCs which have been listed over some part of PR04: Severn Trent, United Utilities, Northumbrian, Yorkshire (Kelda), Pennon (SouthWest) and Anglian.

118 We calculated the MAR by subtracting an estimate of the market value of the non-regulated business from enterprise value to derive an estimate of the market value of the regulated water business. This 'value of regulated business' is then divided by RCV (in current prices). Enterprise values are from Bloomberg; the market value of non-regulated business is based on analyst valuations. RCV is from Ofwat publications.

Subsequently, Kelda's MAR increased back towards 1.3 after the official announcement of the acquisition. It is likely that bid speculations also increased the MARs of other WaSCs. In particular, the MARs of SouthWest and Northumbrian quickly returned to their pre-crisis level, but the MARs of United Utilities and Severn Trent were (at our most recent estimate) some way below their level prior to the credit crisis.[119] The relatively larger increase of Northumbrian's MAR could be due to its relatively small size, which makes it a more likely acquisition target than either United Utilities or Severn Trent in the current market conditions.[120]

Figure 11.3
Market to Asset Ratios for Listed UK WaSCs



Source: NERA analysis of Bloomberg data and analyst reports. Aggregate MAR constructed by summing RCV, EV and non-regulated businesses across companies, then applying our MAR formula. Price review periods are between the release of the final 'Setting price limits' document and the publication of the Final Determination.

[119] We have not calculated UU's MAR since December because of a timing mismatch between enterprise value data and non-regulated business valuation. Analysts' NRB valuations have been updated to reflect the recent sale of the electricity distribution arm, but enterprise value data (from Bloomberg, 2007) will not be updated to reflect this transaction until the next release of company accounts data (which will retrospectively take effect from March 2008). Whether the book value of debt should be adjusted to reflect market value or not is another important issue for calculating MAR. Ofwat has stated a preference for unadjusted debt values (see Speech by Ofwat Chairman Philip Fletcher at City Briefing, 1 November 2006, p14) but many analysts prefer to use market value.

[120] The influence takeover speculation has had on listed share prices was acknowledged by Ofwat Chairman Philip Fletcher at the City Briefing 2006 when he stated "recent movements in share prices of all the listed water companies are being affected by this take-over speculation". See Speech by Ofwat Chairman Philip Fletcher at City Briefing, 1 November 2006, p13-14.

Table 11.1 presents the range and average MARs for the six listed WaSCs over AMP3 and AMP4.

Table 11.1
Average MARs

	AMP4		AMP3	
	Range	Average	Range	Average
Kelda[1]	0.97 - 1.31	1.13	0.74 - 1.03	0.90
Anglian[2]	0.96 - 1.10	1.02	0.73 - 1.01	0.90
SouthWest	0.99 - 1.36	1.13	0.58 - 1.17	0.91
United Utilities[3]	0.97 - 1.22	1.12	0.75 - 1.09	0.96
Severn Trent	0.94 - 1.29	1.09	0.73 - 0.96	0.86
Northumbrian[4]	1.07 - 1.21	1.14	0.92 - 1.03	0.98
WaSC Aggregate	**1.01 - 1.20**	**1.11**	**0.82 – 1.00**	**0.91**

Source: Bloomberg, analyst reports and NERA analysis. Note: (1) Kelda's MAR is not calculated for March 2008 due to de-listing following takeover; (2) Anglian's MAR for AMP4 calculated only until December 2006 when de-listed; (3) United Utilities' MAR is not calculated from December 2007 due to divestment of Norweb, and; (4) Northumbrian's MAR over AMP3 calculated from May 2003 when first listed.

Table 11.1 shows the following:

- MARs have varied significantly over the two AMPs and across companies;
- MARs were below 1.0 over AMP3, but have been above 1.0 on average so far over AMP4;
- Average MARs have generally been fairly tightly clustered around the WaSC aggregate average;
- Average MARs for either AMP do not fully reflect the volatility in MARs at a company level over the AMP, and;
- The range of company MARs in either AMP is far in excess of the range of the aggregate.

Overall, the data shows there is a very large degree of volatility in the data over AMP4 and that there is considerable dispersion of MARs across companies. Therefore, to avoid the excessive volatility present in company level data, we focus upon the sector MAR, which ranged between 1.01 – 1.20 over AMP4. Clearly, it is very difficult to be precise about the MAR even at an aggregate level.

11.3. The Impact of Non-Regulated Business on MAR

The calculation of MAR requires some estimate of the value of non-regulated business. For this purpose we have relied upon reported valuations provided by City analysts. However, problems arise because of differences in the way analysts value non-regulated assets. While analysts generally value water companies using sum-of-the-parts analysis, analysts use different approaches to value the parts of the business. For example, some valuations use a multiples approach (i.e. the asset's value equals current earnings multiplied by some factor), others use a discounted cash flow analysis, while others are valued by reference to RCV. As a result, the valuations can vary dramatically across analysts and are explained largely by the valuation method used and the judgements and assumptions of the analyst, and not by company fundamentals at the time of valuation.

But analysis of analysts' forecasts shows that there is at least ±20% uncertainty surrounding the estimate of the value of non-regulated assets. This 20% figure is based on clusters of analyst estimates of non-regulated assets for (1) Pennon between January and June 2007 (inclusive) which varied between £609m and £1127m; (2) Severn Trent between November 2007 and February 2008 (inclusive) which ranged from £179m to £282m, and; (3) United Utilities between November 2003 and August 2004 (inclusive) that included valuations up to £3034m from £1795m.[121] In each of these cases the maximum (minimum) non-regulated asset value lay at least 20% above (below) the mid-point between the maximum and the minimum.

Therefore, the larger the value of non-regulated assets the less precise our MAR estimates will tend to be. Table 11.2 presents non-regulated assets as a proportion of enterprise value, averaged over AMP3 and AMP4. This proportion, on an industry wide basis, decreased from around 20% during AMP3 to 16%, on average, over AMP4. This trend suggests that the precision of MARs should have improved over time, but there are still considerable uncertainties due to the significant prevailing share of non-regulated assets. Interestingly, United Utilities' share has decreased and is now among the lowest in the industry following its recent divestment of its electricity distribution arm, Norweb.[122]

Table 11.2
Average Non-Regulated Business to Enterprise Value Ratio

	AMP4	AMP3
Kelda[1]	10%	19%
Anglian[2]	5%	12%
SouthWest	22%	18%
United Utilities[3]	28%	29%
Severn Trent	10%	23%
Northumbrian[4]	10%	8%
Aggregate	**16%**	**22%**

Source: Bloomberg, analyst reports and NERA analysis. Note: (1) Kelda's NRB/EV ratio is not calculated for March 2008 due to de-listing following takeover; (2) Anglian's NRB/EV ratio for AMP4 calculated only until December 2006 when de-listed; (3) United Utilities' NRB/EV ratio is not calculated from December 2007 due to divestment of Norweb, and; (4) Northumbrian's NRB/EV ratio over AMP3 calculated from May 2003 when first listed.

Based on our assessment of ±20% uncertainty surrounding the estimate of the value of non-regulated assets, we can calculate an indicative "confidence interval" around the central range of MARs presented in Table 11.1.

Table 11.3 presents ranges of MARs for the aggregate and for each of the companies based on the confidence interval we have constructed around the value of non-regulated business.

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[121] We provide a full list of analyst forecasts by company and date in 0. We note that during the periods considered there were some small transactions that should have affected the value of non-regulated business, but these were very small relative to the total value and should not have led to the large scale variation we observe in analysts valuations.

[122] We note that United Utilities, following its divestment of Norweb, will have a non-regulated business to EV ratio of less than 10%. However, the calculation of MAR following a divestment is quite difficult. Aside from issues of the value of the business sold, the timing of the sale must also be considered. The share price will immediately reflect the transaction, but enterprise value – as reported by Bloomberg – can only be updated with a substantial lag as key inputs to the calculation, such as net debt, are only updated with the release of new company accounts every six months.

The adjusted range of MARs is 0.96 – 1.24, around 0.10 wider than our central range of 1.01 – 1.20. The approximately 50% increase in the width of the MAR range demonstrates the uncertainty surrounding the non-regulated asset valuation.

Table 11.3
Confidence Interval's of MARs

	AMP4	AMP3
Kelda[1]	0.94 - 1.32	0.68 - 1.06
Anglian[2]	0.95 - 1.12	0.70 - 1.02
SouthWest	0.94 - 1.41	0.53 - 1.19
United Utilities[3]	0.89 - 1.31	0.67 - 1.17
Severn Trent	0.89 - 1.31	0.68 – 1.00
Northumbrian[4]	1.05 - 1.24	0.90 - 1.05
WaSC Aggregate	**0.96 - 1.24**	**0.77 - 1.05**

Source: Bloomberg, analyst reports and NERA analysis. Note: (1) Kelda's MAR is not calculated for March 2008 due to de-listing following takeover; (2) Anglian's MAR for AMP4 calculated only until December 2006 when de-listed; (3) United Utilities' MAR is not calculated from December 2007 due to divestment of Norweb, and; (4) Northumbrian's MAR over AMP3 calculated from May 2003 when first listed.

11.4. Implications for the Cost of Capital

In this section we try to assess the implications for the cost of capital of the observed gap between the market value of assets and the RCV.

We constructed a financial model which we use in order to assess the impact of various value drivers on MAR. We draw on data for RCVs, opex and capex as published in the Final Determination 2004. The financial model replicates Ofwat's regulatory framework, e.g. companies are allowed to keep outperformance on a rolling five year basis and at the start of each regulatory review opex/capex are reset to reflect efficient costs. Further, we assumed real growth in RCV of 2.2%, which is equal to projected RCV growth over AMP4 for the aggregated RCV of the currently listed WaSCs (including Kelda).

In Section 11.1 we highlighted that the MAR includes the impact of certain important drivers beyond the differential between the regulated rate of return and the cost of capital. The gap between the observed market value of assets and the RCV may arise for the following two reasons:[123]

- Investors' current and future beliefs of the difference between the regulated allowed rate of return on assets and the market cost of capital; and
- Investors' current and future expectation of allowed additional cash flows (or penalties) over and above of what is reflected in current and future price limits.

Various regulatory mechanisms in the UK water regulatory framework provide a potential source of additional allowed revenues and penalties. These schemes generally relate to the regulator's attempt to incentivise companies to outperform the quality and quantity targets underlying the price limits set by the regulator and include the following:

- ***Outperformance of regulatory assumptions:*** An important explanation for why cash flows could differ from regulatory assumptions is that companies may achieve greater cost savings than the regulator assumed in price limits. Such savings can primarily be realised on opex and capex. We reviewed city analyst reports, companies' statements and Ofwat's own assessment of expected opex and capex outperformance.
  - *City analyst reports*: we reviewed a large sample of analyst reports with respect to investors' anticipation of companies' outperformance on opex and capex. Over AMP4, analysts generally expect companies to outperform by 1-3% per year on opex and 2.5-5% per year on capex (see Table I.1 and Table I.2 in the Appendix). We note analysts generally do not state their outperformance expectations beyond AMP4.
  - *Company statements*: we reviewed companies own assessment of outperformance, based on statements in companies' annual reports and investor briefings. Our review suggests that companies expect to outperform Ofwat's opex targets by 1-3% per year and Ofwat's capex targets by around 1.5-3% per year (see Table I.3 in the Appendix).

[123] We do not consider the (very real) possibility that some investors do not understand the intricacies of the regulatory environment (as set out the somewhat complicated formulae and extended list of relevant factors) and accordingly incorrectly value the companies they invest in.

– *Ofwat pain/gain sharing mechanism*: Ofwat aims to allow the realisation of outperformance by companies as part of the overall incentive framework, i.e. Ofwat sets price limits based on efficiency improvements it believes are below what is achievable by the companies. Ofwat stated in the 2004 Final Determination that "*the scope for efficiency improvements is around 2.4% a year for operating expenditure and 3.6% a year for capital maintenance. [Ofwat] have assumed about half of this in price limits.*"[124] Therefore, Ofwat have built recurring outperformance into the regulatory regime and rational investors could reasonably expect the possibility of companies to earn additional allowed revenues.

Table 11.4 summarises expected outperformance stated by analysts, companies and Ofwat.[125]

Table 11.4
Outperformance Summary for AMP4

	Opex outperformance (%, p.a.)	Capex outperformance (%, p.a.)
Investor expectations	1.0 – 3.0	2.5-5.0
Companies' statements	1.0 – 3.0	1.5-3
Ofwat's 'carrots'	1.1	1.5[1]

Note: (1) average of maintenance outperformance of 1.8% p.a. and enhancement outperformance of 1.3% p.a.

- ***Tax**:* Investors might also expect companies to outperform Ofwat's modelled tax assumption. Companies may minimize tax through group relief or additional capital allowances. Companies are also able to benefit from the debt tax shield by increasing gearing above what Ofwat assumed in modeling taxes. However, since Ofwat uses companies' actual gearing to model taxes, perpetual gains from gearing-up can be ruled out. Nevertheless, investors might have anticipated companies would increase gearing over AMP4 to reap the benefits of the debt tax shield or other possibilities for tax savings.

- ***Overall Performance Assessment (OPA):*** Ofwat makes service-related price adjustments, based on companies' Overall Performance Assessment (OPA). A company that scores well in the OPA can charge its customers slightly more and those with poorer performance must charge slightly less. The one-off OPA adjustment is applied to the first year's price limit after all other decisions on price limit building blocks are made and therefore constitutes an additional income/penalty to companies' allowed revenues. At the 2004 Periodic Review (PR04), the possible OPA adjustment range was +0.5% to -1.0% of first year revenue. For PR09, Ofwat have not yet determined the range of financial adjustments, but investors could reasonably expect a similar range as at PR04.

- ***Financeability uplifts:*** At PR04, Ofwat made adjustments to regulated revenues amounting to £430 million over the five year period, which represented around 0.3% additional revenues per year as a percentage of the opening RCV. These additional funds

[124] Ofwat (2004) Final Determination.

[125] Full details of analyst and company statements are provided in Appendix I.

were to ensure that companies could meet certain financial ratios to ensure investor confidence. We note these additional uplifts are calculated outside Ofwat's building blocks of the price control determination, and are allowed on top of what Ofwat assumes in price limits. It is difficult to determine whether the same approach will be replicated in future regulatory periods. The revenue uplift approach adopted at PR04 has been subject to considerable debate and Ofwat discusses alternative, NPV neutral options in the 'Financing Networks' Paper (February 2006). In SPL (March 2008), Ofwat indicated that it would apply any revenue uplift in a NPV-neutral manner without, however, showing how this could work in practice. Nevertheless, the financeability allowance at PR04 will have had some impact on MARs, and it is reasonable to assume that some investors will have made a positive assumption of future financeability uplifts beyond AMP4 (at least during the early part of AMP4).

- ***Other factors:*** There are various other factors that can cause expected outturn cash flows to be different from expected cash flows allowed in price limits. One example would be investors' expectation of higher demand by metered customers than Ofwat assumed when setting price limits. Of course, not all regulatory mechanisms have a positive impact on MARs and there are other mechanisms (penalties, fines, serviceability adjustments, competition, etc.) that may also have a negative value consequence. However, objective evidence is not available to estimate the value impact of these factors.

All these factors can cause the MAR to differ from 1.0e and must be taken into consideration when assessing the implications on the cost of capital from observed MARs.

Based on our detailed financial model, Table 11.5 shows the NPV of the additional allowed revenues of the value drivers listed above as a percentage of the RCV. Our best "guess" is that expected outperformance could explain a MAR in the range of 1.06 – 1.14, but we note that there is a large confidence interval around this range.

Table 11.5
MAR Explained by Key Value Drivers

	Outperformance Assumption		Impact on Market Value
	AMP4	post-AMP4	% of RCV
Opex Outperformance (% p.a.)	1.0 - 3.0	1.0 - 3.0	4.8 - 11.8
Capex Outperformance (% p.a.)	2.5 - 5.0	2.5 - 5.0	0.2 - 0.3
Tax Outperformance	5% higher gearing	*no outperf.*	0.3
OPA (% every 5 years)	-1.0 - 0.5	-1.0 - 0.5	-0.8 - 0.4
Financeability (% p.a.)	0.3	0.0	1.4
Other factors	?	?	?
MAR explained by outperformance			**5.8 - 14.2**

As set out above, over AMP4 the aggregate MARs for the sector of listed companies ranges from 1.01 – 1.20. Table 11.5 shows that of this range 0.06-0.14 can be explained by factors

other than the difference between the regulated allowed rate of return and investors' expectation of the cost of capital, leaving a range of MARs of 0.87 - 1.14 unexplained.

Adjusting the observed MAR range of 1.01 -1.20 by the range of 0.06-0.14 that *might* be explained by additional allowed revenues leaves an unexplained MAR of 0.87-1.14 that could be due to difference between the regulated allowed rate of return and the cost of capital. However, we do not know what investors assume about the regulated allowed rate of return post AMP4. If we assume that investors' expect Ofwat to correct for the difference in the regulated allowed rate of return and the cost of capital post AMP4, then the implied market cost of capital (real post-tax WACC) could lie anywhere in the range of 2.1-7.9% (see Table 11.6 below).

If, on the other hand, investors expected that the wedge between the regulated allowed rate of return and the cost of capital persists in perpetuity, the implied market cost of capital would lie in a range of 4.7-5.5% (see Table 11.6 below). However, rational investors are highly unlikely to expect that a difference in the regulated allowed rate of return and the cost of capital persists in perpetuity.

Table 11.6
Implications for the Cost of Capital

Observed Sector MAR over AMP4	1.01 - 1.20
Premium Explained by 'Additional Revenue'	0.06 - 0.14
MAR "Unexplained"	**0.87 - 1.14**
Implied cost of capital (post-tax WACC, %)	
Ofwat *corrects* allowed RoR after next regulatory period to reflect CoC	**2.1 - 7.9**
Gap between allowed RoR and CoC persists in *perpetuity*	**4.7 - 5.5**

Source: NERA analysis

This analysis shows the MAR evidence over AMP4 implies a very wide range for the cost of capital. MAR analysis cannot, therefore, be used mechanistically to set the cost of capital at PR09.

In the next section we use data on recent transactions and on trends in company valuations to demonstrate the presence and impact of an "infrastructure bubble". This bubble distorts the evidence available from MARs as an input into cost of capital analysis.

11.5. Evidence of an "Infrastructure Bubble"

The changes to statutorily mandated investment strategies for pension funds (among others) both in Britain and elsewhere were considered in relation to the ILG market in Section 2. The search for higher yielding, but similarly low risk investments has seen spillover of demand from ILGs and other government securities into infrastructure assets. Ofwat has acknowledged the influence of the demand for infrastructure assets:[126]

> *"…it does appear that a particular set of equity investors, the pension and infrastructure funds, are prepared to pay significant premiums for utility assets. Supply and demand factors seem to be at play here. These investors like these assets because the companies' revenues and assets and the Funds' liabilities are all linked to inflation making them an ideal match. Currently demand by these funds for these companies is outstripping supply, forcing up the price these funds are prepared to pay for control of these assets."*

Market sentiment, epitomised by Standard & Poor's, is very similar:[127]

> *"pension funds in particular have been driving demand for infrastructure assets, attracted by their essential long-term nature, strong competitive position, and stable and relatively strong yield returns. …[T]he long-life inflation-indexed returns provide a very good match for the long-dated liabilities of pension funds."*

Likewise, a majority of respondents to the Water UK Investor Survey (2008) stated that the drivers of current market share price premiums "include a significant appetite for owning water assets" and that "changes in overseas pension requirements" had "led to a significant demand for assets that would match long term liabilities".[128]

This phenomenon has become known as the 'infrastructure bubble'.[129] As part of this phenomenon the class of infrastructure assets has widened in recent years from traditional asset types such as toll roads, airports, electricity and gas distribution and transmission, airwave network infrastructure, shipping ports, renewable generation and water and wastewater related assets to include "car parks, motorway service stations and motor vehicle

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126 Speech by Ofwat Chairman Philip Fletcher at City Briefing, 1 November 2006, p13.

127 Standard & Poor's, "The Amazing Growth of Global Infrastructure Funds: Too Good to be True?", 30 November 2006, p1.

128 See Water UK 2008 Investor Survey, A report by Indepen for Water UK, March 2008, p1.

129 Philip Fletcher referred to this as the "infrastructure boom". See Speech by Ofwat Chairman Philip Fletcher at City Briefing, 1 November 2006, p14. See also, for example, Standard & Poor's, "The Amazing Growth of Global Infrastructure Funds: Too Good to be True?", 30 November 2006, p1, which states "infrastructure transactions are becoming increasingly highly leveraged, reflecting what [we] believe to be a pricing bubble caused by a wave of new funds chasing limited assets".

certificates".[130] Further, not only has the number of infrastructure deals increased considerably, but there has been a dramatic increase in the size of these deals.[131]

The claim that an infrastructure bubble exists is supported by the long list of acquisitions of UK water companies in recent years that have involved infrastructure or pension funds (which we discuss in Section 11.5.1). As long ago as 2001 Swan Capital purchased Mid Kent water, but the infrastructure bubble is most clearly manifested by recent transactions: nine of the most recent ten UK water company acquisitions – dating back to 2004 – have involved one or more pension or infrastructure funds. Ofwat acknowledged the recent emergence of the infrastructure bubble when Philip Fletcher said "it has been observed that the infrastructure funds have only been active in the UK utility market very recently".[132] One recent estimate from UBS calculated that infrastructure funds supplied 64% of capital for recent acquisitions in the UK water sector, and pension funds comprised 24%.[133]

That the effects of the infrastructure bubble have already persisted since 2004 suggests it may not be a very short-lived phenomenon. Further, there is little reason to expect it to suddenly fade away in the near future given the continued growth in funds under management (fuelled by an ageing population in (rich) developed countries) and long horizon investment demands of these funds. The availability of cheap debt over recent years assisted infrastructure funds to make acquisitions, but analyst reports have also stated that the "recent turmoil in the credit markets does not seem to have dampened infrastructure funds' appetites for regulated utility names".[134] Likewise, Standard & Poor's wrote in November 2007 that "appetite for infrastructure assets is likely to continue into next year, despite the recent tightening in the credit markets".[135] Even more recently, UBS reported that "we believe that at least US$50m of the new infrastructure fund capital announced in 2006-07 is not yet invested in UK water. This does not include pension funds, listed infrastructure funds and sovereign wealth funds".[136] Further, respondents to the Water UK Investor Survey (2008) recognised "that the combination of appropriate lending vehicles and the fact that water companies represented unique and scarce assets implied that the [infrastructure bubble] was not just a transient feature".[137] Overall, the market does not appear to believe that the recent turbulence on financial markets will curtail demand for infrastructure assets over coming years, though some decrease in acquisition premiums may be anticipated.[138]

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130 Standard & Poor's, "The Changing Face of Infrastructure Finance: Beware the Acquisition Hybrid", 7 September 2007, p1.

131 S&P have recently stated that "in Europe the number of deals jumped to 402 so far in 2007 from 324 in 2005, a rise of 24%. Meanwhile, the total value of infrastructure deals jumped by 90% over the same period". See Standard & Poor's, "Another Phenomenal Year for Infrastructure Finance", 16 November 2007, p1.

132 See Speech by Ofwat Chairman Philip Fletcher at City Briefing, 1 November 2006, p14.

133 Based on transactions involving Anglian, Southern and Kelda, see UBS, *UK Water companies*, 11 February 2008, p6.

134 Morgan Stanley, "UK Water Utilities", 11 January 2008, p4.

135 Standard & Poor's, "Another Phenomenal Year for Infrastructure Finance", 16 November 2007, p1.

136 UBS, *UK Water companies*, 11 February 2008, p3.

137 See Water UK 2008 Investor Survey, A report by Indepen for Water UK, March 2008, p6.

138 See Water UK 2008 Investor Survey, A report by Indepen for Water UK, March 2008, p8 where "53% [of respondents] thought the level of the premium would decrease from current levels", but "the vast majority of respondents believed some sort of premium would continue over the next five years".

There is widespread acknowledgement of the existence of an infrastructure bubble with direct implications for the UK water sector. There is, however, no such consensus about the magnitude of the infrastructure bubble's impact and its implications for MAR analysis. In the next two subsections we consider evidence from transaction premiums and trends in valuations to demonstrate the impact of the bubble and why MAR analysis based on data over AMP4 should be interpreted very cautiously.

11.5.1. Evidence from Transaction Premiums

We have examined premiums to regulated asset values (i.e. the premium the acquirer paid over and above the regulated asset value) from recent transactions involving UK and international utilities.

Figure 11.4 plots utilities sales' premiums over time for UK WaSCs and other UK utilities.[139] We do not consider WoCs in this analysis (though data is presented in the Appendix) since WoCs may attract a small company premium, and WoCs typically have a larger proportion of non-regulated business which (as we have seen in Section 11.3) distorts valuations.

There is a pronounced upward trend in acquisition premiums for WaSCs over the period shown. Further, this trend would be substantially more sharply upward if our analysis focused only on the period from 2001; inclusion of transactions from the 1990s shows that recent acquisitions at a significant premium to RCV are not a new phenomenon. However, the driver of those earlier premiums was investors' beliefs that substantial cost efficiencies could be generated within the business leading to much larger profits. These investors gradually exited the sector in the following years when the anticipated efficiencies and profits did not materialise. The acquisitions were based on 'normal' business criteria and made in the course of 'normal' operations, rather than as a result of legislative mandated investment criteria which limited the pool of available investments.

The strongest evidence of the infrastructure bubble's impact on the UK water industry is the level-shift in valuations between the early part of this decade (during AMP3) where acquisition prices generally closely corresponded to regulated asset values, and the past few years (during AMP4) when buyers have been willing to pay well in excess of RCV. For example, transactions in 2000-2002 involving Southern Water, Wessex and Dwr Cymru all took place at a discount to RCV, but more recently (i.e. late 2007) Kelda and Southern have been sold at premiums to RCV of around 30%.[140]

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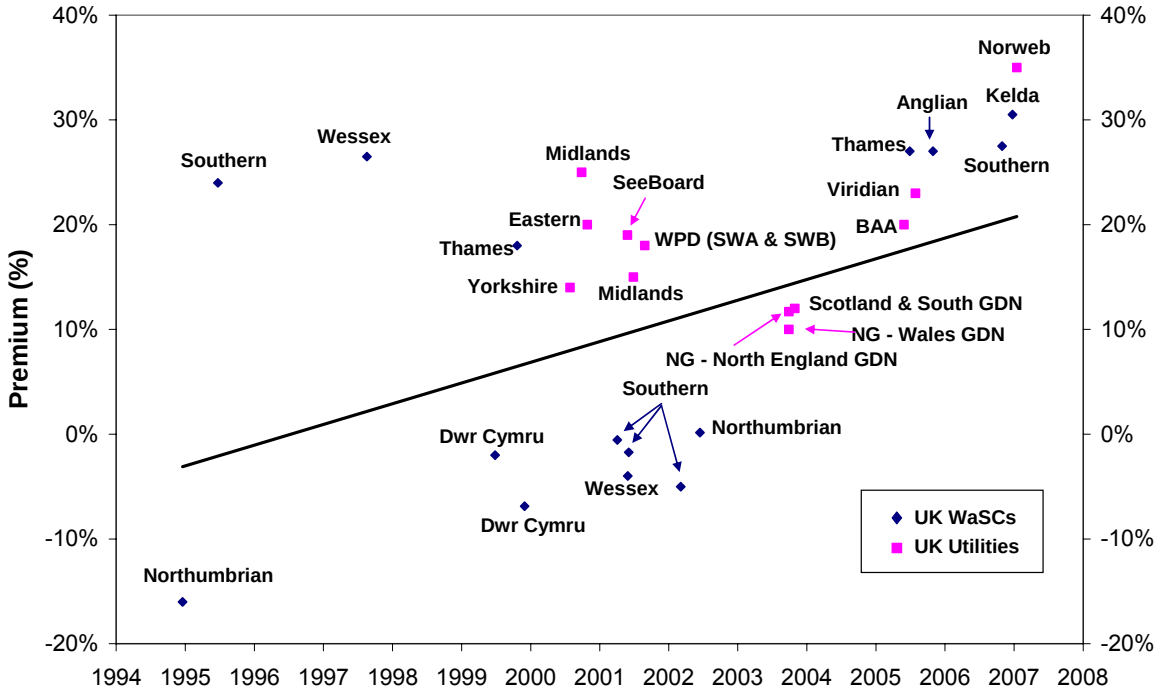
[139] A full list of the transactions and the associated premiums is included in 0.

[140] Such a trend, it could be argued, is consistent with changes in the perception of the regulatory environment between PR99 and PR04; PR99 was widely regarded as less generous for UK water companies than PR04, which should have been reflected in valuations.

Figure 11.4
Transaction Premiums: % of RAV



Source: NERA analysis.

A very similar trend is apparent in the acquisition premiums paid for other UK utilities, which generally comprises other network businesses such as electricity and gas. For instance, National Grid's sale of its gas distribution networks in 2004 attracted a premium of 10-12%, but United Utilities' recent sale of its electricity distribution arm, Norweb, was at a premium of 35%.[141] The presence of a similar trend across UK water and other utilities sectors suggests similar factors have driven the recent run-up in acquisition premiums. One possible explanation is that UK regulators set the allowed rate of return in recent years above the outturn cost of capital, leading to increased profitability of utilities. However, there is substantial international evidence to suggest that the acquisition premiums are not significantly related to the rate of return.

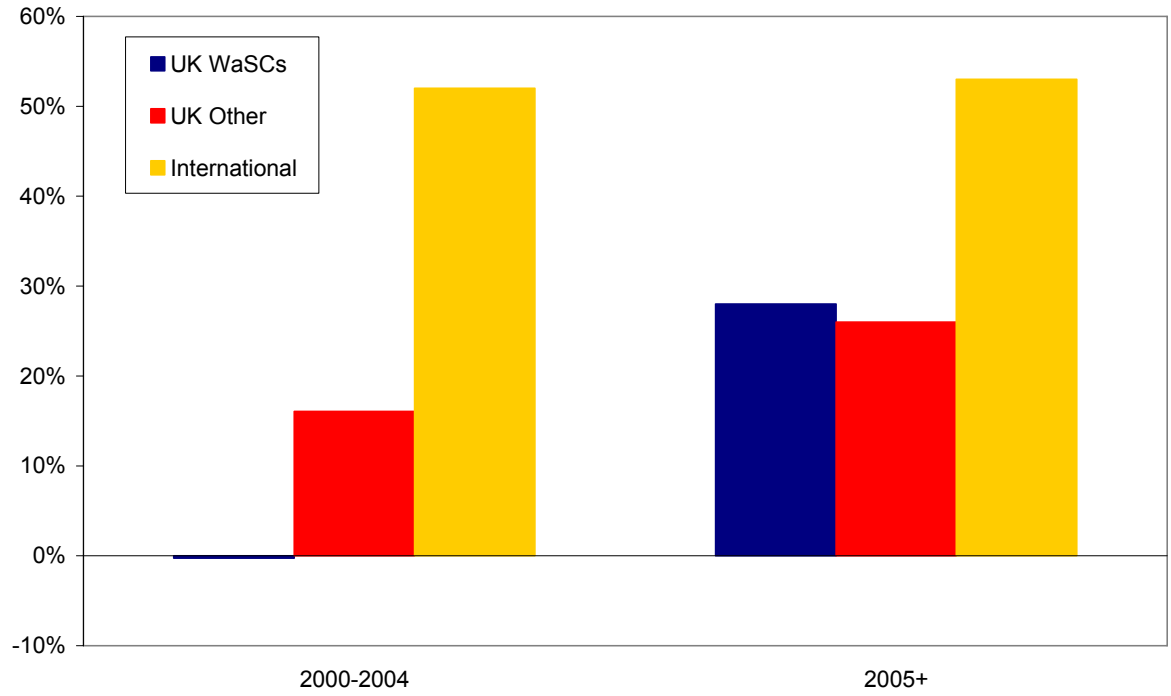
International evidence shows that substantial acquisition premiums are not confined to the UK, indicating the presence of substantial worldwide demand for utilities, which though related to the presence of a mature and stable regulatory environment, is not related to the allowed rate of return. To support this claim we have arrayed a range of international transactions, primarily from Australia; numerous recent UK water acquisitions have been funded (or part funded) by Australian infrastructure or pension funds, which suggests either

[141] We note that the 35% premium to RAB paid for Norweb materialised despite Ofgem's reduced rate of return of 4.4% set in 2006. While this is *prima facie* consistent with the allowed cost of capital not being a major driver of investors decisions, it could also be argued that the (new) lower allowed cost of capital is still in excess of Norweb's embedded cost of capital. This would be particularly relevant if Norweb has a limited requirement for new debt financing over the review period. Further analysis of Norweb's debt would be required to answer this question.

that UK water companies have been viewed as relatively cheap compared to Australian (if not on a wider geographical scale) infrastructure assets, or that the availability of suitable domestic investments has diminished. In either case it is strong evidence of the global demand for infrastructure assets, particularly within mature well-functioning regulatory frameworks.

Figure 11.5 shows average transaction premiums for UK WaSCs, UK utilities and international utilities from 2000-2008. Transaction premiums for UK WaSCs have increased considerably on average, from less than 0% to 28%, over the periods shown. There has also been an increase, though less pronounced, in average premiums paid for other UK utilities, from 16% to 26%, while transaction premiums internationally have been even higher at over 50% since 2000. This pattern of UK and international valuations (which, as we noted above, are Australia-centric) is consistent with infrastructure and pension funds increasingly searching abroad for appropriate investments.

Figure 11.5
Utilities Sales: Average Premiums to RAV



Source: : NERA analysis.

11.5.2. Trends in Valuations

We also illustrate the presence of the infrastructure bubble through a comparison of valuations of other infrastructure assets to the UK water sector. Specifically we look at:

- European water companies, and;[142]
- 'Other multi utilities', which comprise European and UK multi-utilities where more than 20% of total revenue is earned from regulated utilities.[143]

These other utilities (i.e. European water and utilities) share many features of UK water companies: all are infrastructure owners and operators and most are regulated. These companies should all share similar risk profiles and underlying business structures, particularly regarding steady long-term cash flows from low-risk long-lived assets.

We use our definition of MARs for UK water as set out in Section 11.1. For other infrastructure assets where as regulated asset value is not available, we use Enterprise Value (EV) to Book Value (BV) of total assets as a comparable valuation multiple. We note that EV to BV is not the same valuation multiple as MARs, since book value of total assets is based on historic cost accounts (whereas MAR reflects current costs). However, since we are primarily interested in general trends, we consider that the trend in EV to BV should be a good proxy for trends in MAR. To focus upon these trends we construct an index of the EV to BV ratio.

We are most interested in the distinction between infrastructure and non-infrastructure companies. To this end we include a set of non-infrastructure blue-chip UK stocks as a 'control' group.[144] These companies share many characteristics of regulated companies, such as low business risk, mature business models, stable asset structures, and stable and moderate long-term growth rates. Ergo, the key distinction between the control group and our utilities groups is not regulatory, but rather the presence (or absence) of infrastructure type assets.

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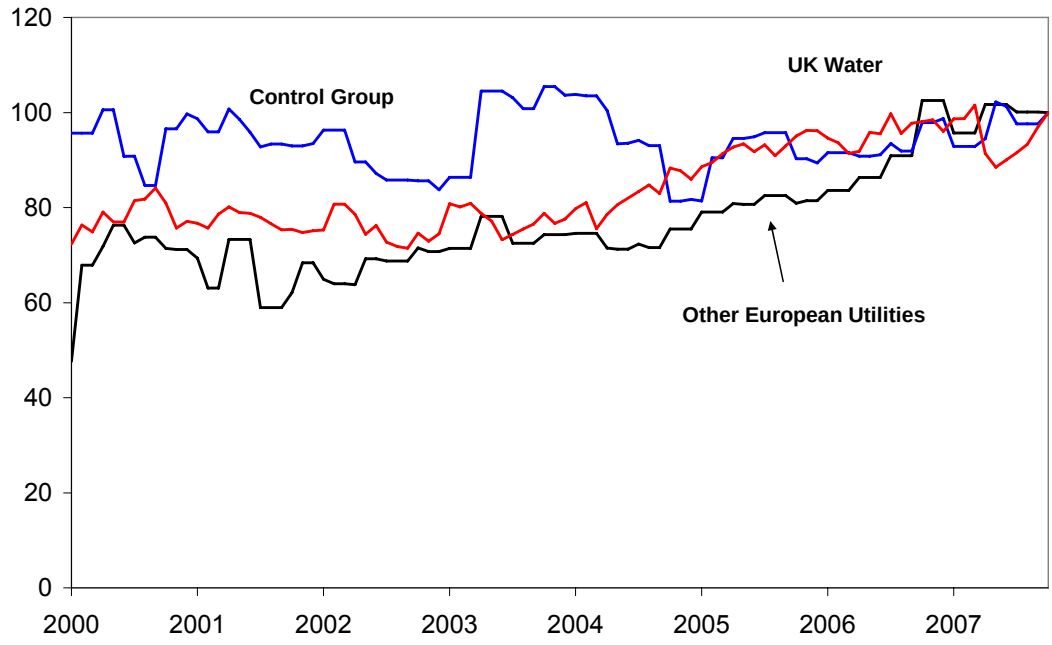
142 Comprises Parisienne Chauffage Urbain, STE Des Eaux De Douai SA, Veolia Environment, Fernheizwerk Neukoelln AG, Hydrotec AG, Gelsenwasser AG, Aguas de Barcelona (class A), Athens Water Supply & Sewage and Mediterranea Delle Acque SPA.

143 Comprises Red Electrica de Espana, TERNA, Elia, Energias de Portugal, Viridian Group, Scottish Power, ACEA, Gas Natural, ACSM Como, Snam Rete Gas , Enagas, Endesa, Union Fenosa, Fortum Oyj, Enel, A2A, Iberdrola, Scottish & Southern Energy, Electricité de France, Amga, Gaz de France, E.On, RWE and Edison.

144 The composition of this group draws on Zalewska (2000) and comprises Blue Circle Industries, BOC Group, Boots, British Airways, Cadbury Schweppes, Diageo, Granada Compass, ITV, ICI, Marks & Spencer, P & O Steam Navigation, Tate & Lyle and Tesco.

Figure 11.6
Enterprise Value to Book Value



Source: NERA calculations with Bloomberg and Ofwat data and analysts' reports. Sectoral indexes are constructed using enterprise value weights; 31/12/2007 = 100.

Figure 11.6 shows the valuation trend of UK water, other European utilities and the control group. The key point that emerges is that the trend growth rate of the two infrastructure groups is fairly similar, but the non-infrastructure control group exhibits a substantially different (essentially stagnant) trend growth rate.

11.5.3. Conclusions about the Infrastructure Bubble

We have presented a range of evidence from the UK and abroad, which indicates:

- a significant increase in valuations of infrastructure (including utilities) assets over the past few years;
- companies with very similar business profiles, but without infrastructure assets, have not had growth in valuations of a similar magnitude, and;
- transaction premiums have increased over the past several years.

This evidence is consistent with a substantial increase in demand for infrastructure type assets from infrastructure investors searching for low risk investments offering attractive yields (relative to government securities). This has been a significant driver of the recent increase in UK water companies' MARs.

11.6. Conclusions on Market to Asset Ratios

We have shown that there is considerable uncertainty surrounding the MAR exercise. This uncertainty arises because of difficulty valuing non-regulated business and because a wide range of factors, beyond the nexus between the allowed rate of return and the cost of capital, drive the market value of UK water companies above their RCV. These factors include opex/capex incentive mechanisms, penalties, quality-of-service incentives, tax outperformance, and over- or underspend on capex. Our analysis indicates that these factors, under plausible assumptions, imply a very wide range for the cost of capital that would be consistent with the observed sector MAR. On the basis of the uncertainty inherent in the MAR evaluation, this analysis should only be used as an input into the cost of capital with some caution.

The presence of an infrastructure bubble over AMP4 further undermines the use of MARs as an input to the cost of capital determination at PR09. It is extremely difficult in the presence of the infrastructure bubble to determine whether the market truly believes the allowed rate of return set by the regulator exceeds the cost of capital. Therefore, MAR evidence over the course of AMP4 is an unreliable input to the cost of capital exercise under current market conditions.

12. Company Consultations

To ensure this report reflected the practical realities companies face when raising capital we consulted widely with the industry, including teleconferences with WaSC Treasury teams. This consultation formed a critical input into our approach to this report and in its conclusions. We set out below the key points raised in our dialogue with companies:

- Debt finance including sources of debt and upcoming financing requirements;
- The impact of the credit crisis, particularly with respect to the cost of debt and the availability of IL debt;
- Optimal capital structure, where comments focused upon the target level of gearing and credit rating and the possible need for financeability adjustments over PR09, and;
- Asset valuations, particularly regarding the implications of Market to Asset Ratios for the cost of capital.

12.1. Debt Finance

12.1.1. Sources of debt

Most companies' primary source of debt is through corporate bond issuance. Other common sources of debt include loans from the European Investment Bank, finance leases, bank loans and bank overdrafts (or revolving credit facilities).

For bonds the GBP market is still considered the first option due to lower costs, but the importance of EUR issuance has increased in recent years and is expected to continue. Issuance in USD is still considered, but other currencies (such as the JPY) are gradually being phased out. One company considered the disclosures and covenants attached to USD issuance made it unattractive.

Companies indicated that IL debt has steadily increased in importance. Most companies reported having about 20-30% of IL debt. Most companies target a proportion of 25-30% though one company reported a 50% target.

EIB debt is generally regarded as being very low cost, with sub-Libor interest rates in the past. However, EIB debt is only available on a limited basis due to the portfolio requirements of the EIB. Loans are generally medium term (i.e. less than 10 years maturity) and carry a range of covenants. It was expressed to us by one company that the covenants on EIB loans essentially meant they were available only to A- (or better) rated companies.

The importance of finance leases has decreased over the past decade as erosion of their tax advantages has reduced their attractiveness. However, one company's primary source of finance remains finance leases.

All companies reported pre-funding debt to some degree and over varying time horizons. One company reported pre-funding about 12 months in advance for around two years of cash outflow.

12.1.2. Debt requirements

All companies reported significant debt funding requirements over AMP5. One company stated that it (and the water industry) did not have 50% of the funding it will require by 2015.

No companies reported plans to issue new equity and companies unanimously stated that new equity would only be issued in extraordinary circumstances.

12.2. Impact of Credit Crisis

Companies indicated that not only had the cost of debt substantially increased since last summer, but the availability of debt was now very limited. A theme of our dialogue was that a (if not 'the') major concern for AMP5 is not interest rate risk, but liquidity and financing risk.

12.2.1. Issuance premiums

All companies reported a substantial issuance premium in the current market conditions. Examples given included:

- One company had issued debt in December 2007 at Libor + 53 bps, but had to pay Libor + 105 bps in February 2008;
- Another company indicated that in early 2008 new issues incurred a premium of 50 bps to the secondary market;
- One company stated that spreads for issuing conventional debt were as low as 85 bps 12 months ago, but were currently around 140 bps, which is still lower than in 2001 when spreads were in the range of 165-230 bps (and more volatile);
- A company reported indicative pricing for a new 30 year IL bond of benchmark size would attract a debt premium after fees of about 150 bps;
- Foreign exchange swap costs (distinct from all other issuance costs) of raising in Euros has increased by 10-15 bps compared to two years ago, and;
- One company reported that the costs of banks (for arranging bond issuance) had increased to about 100 bps (over the life of the bond) from effectively zero pre-crisis (due to heavy competition between banks for business).

12.2.2. Availability of IL debt

Companies stated that wrapped debt was not available at the moment – due to issues affecting monoline insurance companies - and not expected to be available any time soon. A company reported that post-PR04 monoline insured IL debt had a cost advantage of about 25-30 bps over conventional nominal debt. One company stated that it felt that 30 year IL debt (unwrapped) may have been available, depending on credit rating.

12.3. Optimal Capital Structure

12.3.1. Optimal gearing and credit rating

All companies felt the optimal credit rating was at worst BBB+. Companies expected that it may be very difficult to raise debt at BBB during periods of market volatility, and this was the primary reason why companies aimed for a rating above BBB. Indeed, companies indicated that it would currently be very difficult to raise new debt at BBB. Many companies expressed a desire to maintain a rating of A- (or better) as this gave more leeway during periods of financial stress (such as the present one).

Companies generally perceived the difference in costs between A- and BBB+ to be small during periods of normal market trading, but the spread widened considerably during periods of volatility (such as the current period or around 2000). However, the spread between BBB+ and BBB was expected to be larger than the one between A- and BBB+. One company reported the difference in issuing costs between A and BBB was as low as 100 bps, but has recently expanded. The same company noted that the corresponding spread in the secondary market was much smaller because BBB debt was not traded.

Given these concerns companies felt Ofwat should set WACC based on a credit rating of at least BBB+.

Companies aim for gearing consistent with their target credit rating. This usually amounted to around 60% gearing (to RCV), though one company did report aiming for as much as 75% debt to RCV.

12.4. Financeability Adjustments

Most companies were satisfied with Ofwat's financeability adjustments over PR04. However, companies generally felt that looking forward the number of these adjustments could be reduced if the WACC set at PR09 actually enabled companies to maintain financial ratios.

12.5. Asset Valuations

All companies suggested recent increases in listed water company market valuations were related to possible acquisitions. The potential acquirers were primarily seen as infrastructure and pension funds. In support of this claim companies cited transactions since PR04, most of which have involved funds of these types. There was widespread agreement between companies that under these circumstances market to asset ratios were less useful than previously and felt little weight should be accorded to this approach in WACC deliberations.

The UK water sector was seen as attractive due to the close match between investment returns required by investors and long-term returns offered by water companies within a stable and mature regulatory framework. However, most of the transactions have been highly leveraged, which has only been possible due to easy access to low cost debt. Companies were pessimistic about whether acquisitions were likely in the near future given increased debt costs at the moment. One company stated that reduced access to leverage and rising costs of debt "makes the likelihood of further acquisitions in the sector less probable in AMP5".

Appendix A. Relative Risk of the England & Wales Water Industry

This Appendix presents key considerations for a qualitative assessment of the relative risk profile of the England and Wales water sector in comparison with other UK regulated sectors in order to inform the estimation of the cost of capital for the water companies at PR09. We compare the England & Wales water sector to UK gas and electricity transmission and distribution, BAA designated airports (Heathrow and Gatwick) and National Air Traffic Services (NATS).

A.1. Relevant Risks in the Estimation of the Cost of Capital

We consider three types of risks that are important for the allowed rates of return set by the regulators:

- ***"Beta Risks"***: according to the CAPM, many risks can be avoided by diversification and investors will not require a premium for being exposed to these types of risk. However, those risks that cannot be eliminated through diversification are described as "beta" risks (or "systematic" risks).
- ***"Asymmetric Risks"***: the CAPM model in its basic form cannot take account of skewed risks such as downside asymmetric risks where the perceived distribution of possible outcomes is asymmetric around the mean, with either greater likelihood of the upside or greater likelihood of the downside.
- ***"Regulatory Uncertainty":*** real options theory tells us that additional returns might be required to incentivise investment depending on the amount of regulatory risk and its potential to decline over time.[145,146] We measure regulated companies' exposures to general regulatory risks that may be expected to raise the hurdle rates on investments by analysis of free cash flow forecasts. Low levels of free cash flows delay the return of funds to the investors, increasing exposure of these cash flows to general regulatory risks. Large investment programmes commit the company to short term cash outflows. Differences in investment programmes across industries therefore give rise to different exposures across industries to general regulatory risks.

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[145] Options theory recognises that an investment may be irreversible, but may be undertaken in any one of a number of periods. It therefore has the characteristics of an option contract, which can be called once at any time during its period of validity. In these conditions, an increase in the volatility of returns from calling the option (i.e. the regulatory risk to returns on investment) raises the value of retaining the option (i.e. of not investing). Thus, uncertainty and regulatory risk increases the incentive to delay investment until more information becomes available. To encourage investors to invest now, investments must offer the prospect of a higher return. Hence, regulatory risk increases the cost of capital, i.e. the return needed to attract investment.

[146] The real options approach to investment decisions is based on work undertaken by Dixit and Pindyck (D&P) (1994). This work compares a firm's opportunity for investment with a financial option. D&P argue that the opportunity to invest is essentially a call option and, of itself, has a value. D&P identify three conditions which are necessary for the application of the real option approach. These are: (i) irreversibility in that investment costs are totally or partially sunk and cannot be recovered in full if the project is later abandoned; (ii) continuing uncertainty over future revenue; and (iii) the possibility of delay in that if a firm decides not to invest in the current period it retains the option of carrying out the project at a later date.

We have reviewed each sector's regulatory framework in detail to identify and understand the main sources of risk that affect investors' required rates of returns. Our analysis focuses on beta risk factors as these most clearly impact on the cost of capital. Beta risks are also more comparable across sectors than some other types of risks.[147]

A.2. Beta Risks

In this section we present a qualitative assessment of the relative exposure of the water industry to risk factors correlated with general market conditions: demand and revenue risk (including bad debt risk), operational leverage and input price risk.

A.2.1. Demand and Revenue Risk

Nature of the demand and its correlation with the business cycle

The nature of the demand and its correlation with the business cycle determines the incidence of macro-economic conditions on the level of demand for the different services. In order to measure the impact of the business cycle on demand we study the income elasticity of demand (IED) for the different services. The IED measures the change in the quantity demanded of a good as a result of a unitary change in the income of the consumer. As income is correlated with the business cycle, IED provides a good estimate of the responsiveness of demand to changes in macroeconomic conditions. The table below presents different estimates of income elasticity of demand for the different services.

Table A.1
Estimates of Income Elasticity of Demand across Sectors

(-)— Risk Exposure —(+)

Service	Income Elasticity of Demand (IED) Estimates	Source
Air transport	1.5 -1.8	CAA Report "Demand for Outbound Leisure Air Travel and its Key Drivers" (2005)
Electricity	0.131 (0.10-0.20)	Baker et al. (1989) Modelling household energy expenditure using micro-data. Range based on review of literature.
Gas	0.115 (0.10-0.20)	Baker et al. (1989) Modelling household energy expenditure using micro-data. Range based on review of literature.
Water	0.092 (0.10-0.20)	Nauges et al. (2000) Privately Operated Water Utilities, Municipal Price Negotiation, and Estimation of Residential Water Demand: The Case of France. Range based on review of literature.

Sources: Baker, P., Blundell, R. and Micklewright, J. (1989). "Modelling household energy expenditure using micro-data", Economic Journal, vol. 99(397) (September). Nauges, C. and A. Thomas (2000) "Privately Operated Water Utilities, Municipal Price Negotiation, and Estimation of Residential Water Demand: The Case of France", Land Economics, Vol. 76, No. 1, pp. 68-85. Civil Aviation Authority (2005) "Demand for Outbound Leisure Air Travel and its Key Drivers".

[147] We note that other categorisations of risks are possible. For example, respondents to the Water UK Investor Survey 2008 identify four types of risk facing the water industry over AMP5: (i) regulatory risks, (ii) management risk (management's ability to meet its capex and opex commitments and targets), (iii) *force majeure* risk and (iv) political risk. According to this survey, the most important risk perceived by the investors is "regulatory risk", and its importance is seen to have increased with respect to previous surveys. However, "regulatory risk" could mean a number of different things, and arguably all risks facing regulated companies can be classified as regulatory risks since it lies within the powers of regulators to alter companies' risk exposures through the regulatory framework. We choose to categorise risks in a slightly different, more specific, way than the WUK Investor survey for the purpose of this study.

The table shows that the domestic demand for utilities' services is inelastic (i.e.: changes in the income barely affect the level of consumption for these services). In contrast, air transport demand is elastic and is therefore more exposed to demand risk.

However, these estimates of IED only capture the potential volatility of domestic demand. Industrial demand is likely to be more responsive to changes in the economic cycle, i.e.: companies may invest in water efficiency solutions such as water reuse or auto-generation of electricity when facing an economic downturn.[148]

Price Control Mechanisms and Demand Risks

The form of the price control mechanism can exacerbate or alleviate the impact on companies' revenue of changes in demand arising from changes in the business cycle. Different price control formulae (price caps vs. revenue caps) imply different allocations of volume risks (i.e. the revenue the companies receive when the level of outturn demand differs from that projected in setting allowed revenues/prices) between the company and its customers. Under average price caps, prices are set and revenues vary with changes in demand. This implies that companies bear all volume risk between reviews. In contrast, under revenue caps, revenues are set and changes in demand are adjusted via prices to guarantee the allowed level of revenues. Customers bear all volume risks (through price volatility) and companies are insulated from unanticipated variations in demand.

Companies in different sectors are regulated under different price control mechanisms. Table A.2 presents an overview of the different price control mechanisms across sectors and their main features affecting the companies' exposure to demand risk. Note that this classification measures the impact of the demand on the gross level of revenues. The extent of net revenue risk companies are exposed to also depends on the companies' cost structure and how costs vary with demand.[149]

As shown in Table A.2, BAA designated airports and NATS present the highest exposure to volume risks as these companies are regulated through a price cap.[150] Gas and electricity transmission and distribution are regulated under a (hybrid) revenue cap that reduces companies' exposures to volume risk. For PR09 Ofwat will change the form of price control (from a price cap to a form of revenue cap) by introducing a mechanism that will correct for any revenue over- or under-recovery at each price review in net present value terms. Therefore, gas, electricity and water are all regulated under a revenue cap which largely protects companies from volume risk.

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148 For example, the World Bank assumes an income (GDP) elasticity of electricity demand of 0.8 in developed countries (see World Bank (2004), "Central Asia, Regional Electricity Export Potential Study", Appendix Volume, p. 15). This indicates that industrial electricity demand exhibits higher income elasticity than domestic electricity demand, which is likely to be the case also for gas and water.

149 Note that the extent of net revenue risk companies are exposed to also depends on the companies' cost structure and how costs vary with demand. If a high proportion of costs is fixed, a fixed revenue control would insulate companies from volume risk as their gross and net revenues will not be affected by changes in demand. In contrast, if a high proportion of costs is linked to the level of volume, a fixed revenue control would expose the company to earnings volatility as changes in demand will cause cost changes while revenues remain constant.

150 NATS is regulated through a hybrid form of price control under which NATS bears 50% of volume risk.

Table A.2
Price Control Mechanisms across Sectors

(Higher) — Risk Exposure — (Lower)

Sector	Type of Price Control	Comments
BAA designated airports	Price Cap (based on revenue yield approach)	▪ Full exposure to volume risk. ▪ Correction factor with a 2 year lag ensures that average revenue per passenger is equal to the allowed charge per passenger.
NATS	Hybrid Revenue/ Price Cap (revenue driver: distance travelled)	▪ 50% exposure to volume risk (allowed revenues based on a 50/50 fixed/variable split). ▪ Risk mitigant mechanism: if volumes fall below 80% of the central forecast exposure to volume risk is reduced to 20%.
Water	Revenue Cap correcting for past recoveries at next review (PR14 for the period 2010 and 2015).	▪ New price mechanism to be introduced in PR09. ▪ Revenue cap combined with a mechanism that corrects for any revenue over- or under-recovery at each price review in net present value terms. ▪ Price cap largely protects companies from demand risks. ▪ Quinquennial revision does not eliminate short term financial risk to meet demand before the price review i.e.: from actual measured demand differing from forecast and from actual meter optants (customers switching from unmeasured to measured supplies).[151] ▪ Proportion of customers outside the Tariff Basket represents approximately 6% of turnover.
Electricity Distribution	Hybrid revenue cap with revenue drivers (volume of throughput and number of connections)	▪ Largely protects companies from demand risks. ▪ Allowed revenues determined annually on the basis of last year's revenue cap, adjusting for inflation and changes in revenue drivers.
Transmission	Hybrid revenue cap with revenue drivers (capacity)	▪ Correction mechanism adjusts for over/under-recovery of revenue in previous years.
Gas Distribution	Current: revenue cap (no revenue drivers).	▪ New price mechanism introduced in GDPCR 2007-2013. ▪ Revenue Cap with no revenue drivers: insulates Gas Distribution Networks' (GDN) revenues from demand variability.

However, not all water revenues are guaranteed under the new form of price control as revenues from large industrial customers ("large users") lie outside the scope of the revenue cap.[152] In 2007 revenues from large users represented on average 6% of total revenues across the industry, varying from 2% to 14% on a company-by-company basis.[153] As 6% of the total water revenues are not covered by the revenue cap, water companies are therefore exposed to higher volume risk than the energy network operators.

In summary, (i) the higher volatility of industrial demand and its closer relationship to macroeconomic conditions, and (ii) the form of the price control imply that the water companies are more exposed to volume risk than electricity or gas network companies.

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151 Unexpected meter optants have a double impact on revenues: on the one hand, there are unforeseen costs associated with the installation of the meter; on the other hand, the company loses the difference between the average unmeasured bill and the average measured.

152 Large water users are defined as customers with an annual consumption above 50 mega litres. Charges for these customers are not restricted by the price control.

153 Some companies (e.g.: Northumbrian) have had a "substantial effects" clause in their license that allows the company to apply for an interim price revision if its revenues are severely affected by an industrial demand downturn.

Bad Debt

Companies face the risk of not being able to collect a proportion of their revenues due to customers not paying their bills. As changes in households' disposable income and economic conditions are likely to have an impact on the amount of unpaid bills, the level of bad debt is considered a beta risk factor.

Table A.3 presents a summary of the level of bad debt across sectors and the treatment of bad debt costs under the different regulatory frameworks.

Table A.3
Bad Debt Costs across Sectors

(Higher) — Risk Exposure — (Lower)

Sector	Level of Bad Debt	Comments
Water	In FY 2006-07 Household Revenue Written-off represented 1.22% of the industry revenue	▪ Higher levels of bad debt than in other sectors. ▪ Ban on disconnections reduces ability of companies to recover debts. ▪ While water companies' customer base is predominantly made of households, energy networks and air transport companies' customers are mainly other companies (energy shippers, generators and suppliers and airlines). As result, companies in other sectors might have access to credit management tools (such as commercial guarantees) that water companies cannot implement. ▪ At Price Reviews Ofwat allows companies a "bad debt expense" as part of their base operating costs allowance. ▪ Risk of outturn bad debt higher than Price Control allowance. ▪ Risk mitigant: In previous price reviews all companies have a Notified Item (NI) for costs associated with bad debt and the costs associated with bad debt management over and above the assumptions in the Price Control Review. However, at present it is not clear which of the Notified Items will be available to companies in PR09.[154]
Electricity Distribution	Bad debt related costs incurred in the period 1999-2004 represent 0.11% of the industry turnover	▪ Electricity and gas network operators are allowed to recover their bad debt from their customers provided they comply with Ofgem's best practice guidelines for credit cover. ▪ Customers Energy networks customers' are electricity generation and supply companies.
Gas Distribution	Data not available.	
Transmission	Data not available.	▪ Electricity and gas network operators are allowed to recover their bad debt from their customers provided they comply with Ofgem's best practice guidelines for credit cover. ▪ Energy networks customers' are generation and supply companies.
NATS	For the Period 2006-10 NATS has a cost allowance of 0.26% of NATS turnover	▪ At Price Reviews CAA allows NATS an annual cost allowance for bad debt related costs ▪ In addition, NATS is allowed to pass thought any bad debt amounts above that amount, hence there limited/ no risk

As Table A.3 illustrates, water companies face a higher level of risk from bad debt than companies in the other sectors considered in this report.

[154] Ofwat has argued that the list of Notified Items might be different in PR09. See Ofwat (2008) "Setting Price Limits for 2010-2015. Framework and Approach", page 12 and Ofwat (2007) "Setting Price Limits for 2010-2015: Framework and Approach – a consultation", page 14.

Water companies' bad debt has been given substantial attention by analysts over the years. Particular focus was given to this issue as bad debt (as a percentage of turnover) trended higher in the early part of this decade after Ofwat removed companies' right to disconnect customers for non-payment.[155] This trend led to Northumbrian, Anglian and United Utilities all seeking IDOKs in 2002/03. More generally, attention has focused upon the relative importance of bad debts across companies: in 2006 Merrill Lynch highlighted that United Utilities, Severn Trent and Thames accounted for almost 90% of the industry's bad debt.[156]

Table A.4 shows that, on average, the ratio of revenue written off to turnover has been fairly steady over the past four years.[157] Looking forward, however, with the economy slowing, water bills rising (in response to capex programme demands) and other utilities bills increasing due to higher energy prices, we would expect to see some upward movement in this ratio.

Further, leaving the industry trend to one side, there is considerable variation across companies; for these companies, the revenue risks are more acute. Although increasing bad debt remains a trigger for an IDOK, the overall risks from bad debt for the water industry appear set to increase over AMP5.

Table A.4
Revenue Written Off As a Percentage of Turnover

	FY 2003-04	FY 2004-05	FY 2005-06	FY 2006/07
Weighted Average	1.12%	1.38%	1.26%	1.22%
Max	3.12%	3.88%	2.10%	2.81%
Min	0.18%	0.07%	0.18%	0.38%

Source: Ofwat June Returns 2003/04 to 2006/07, Tables 6A and 23.
Note: Mid Kent excluded as has zero written off revenue

A.2.2. Operating Leverage

Operating leverage measures the degree of commitment to fixed production charges in a company's cost base. Companies with higher proportions of fixed costs will face more volatile profit margins due to market fluctuations. We compare the operating leverage across sectors using the proportion of "controllable operating costs" (total opex minus depreciation, rates, licence fees and pensions) over turnover (a measure of variable costs). Lower ratios of

155 See, for example, Merrill Lynch (2003) "UK Water: Awaiting Judgement", 30 October, p3.

156 See Merrill Lynch (2006) "UK Water Utilities: Regulatory Accounts", 4 August, pp7-8.

157 A range of measures of bad debt are available. Analysts have used doubtful debts as a proportion of turnover: see, for example, S&P (2008) "Ratings Direct: South Staffordshire PLC", 28 February, p5. Ofwat have previously used a range of measures including amount of revenue written off as a proportion of revenue billed. However, not all of this data is publicly available. Instead, we focus on the amount of revenue written off annually as a proportion of turnover. Our measure should tend to be lower than that used by analysts (as not all doubtful debt is written off). Further, the trend should lag some way behind analysts' preferred measure since there is some passage of time between when a debt is classified as doubtful and when it is finally (if at all) written off.

"controllable costs" to turnover imply *higher* operating leverage and *higher* exposure to demand shocks.[158]

Table A.5 summarises the average (forecast) controllable opex to turnover ratios across industries.

Table A.5
Average Controllable Opex across Sectors[159]

(-)— Risk Exposure —(+)

Sector	Average Controllable Opex to Turnover Ratio	Period
Gas Transmission	13%	2007-13
Electricity Transmission	15%	2007-13
Electricity Distribution	19%	2007-10
Gas Distribution	29%	2007-13
BAA designated airports (Heathrow)	29%	2008-13
Water	34%	2006-10
BAA designated airports (Gatwick)	40%	2008-13
NATS	59%	2006-11

The main conclusions to be drawn from the analysis of the proportion of "controllable costs" across sectors are:

- On average, gas and electricity transmission companies face a higher level of operating leverage than companies in other sectors.
- On average, operating leverage is higher for distribution and transmission companies than for water companies. Air transport companies face the lowest risk from operating leverage.

However, care must be applied in interpreting these ratios. First, the definition of "controllable opex" (i.e.: total opex minus depreciation, rates, licence fees and pensions) may not be entirely comparable across industries given the different nature of air transport activities in comparison to water and energy network activities.[160] Moreover, differences

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158 Note that, due to data restrictions, ratios analysed are for the periods 2006-10 for water companies, 2007-10 for ED, 2006-13 for GD, 2006-13 for transmission companies, 2006-11 for NATS and 2008-13 for BAA designated airports (Heathrow and Gatwick). These ratios are based on the different regulator's forecasts.

159 Sources: Ofwat - *Future Water and Sewerage Charge 2005-2010s: Final Determinations,* 2004; Air transport company regulatory Accounts 2004-2006; CAA – *NATS Price Control Review 2006-2010: CAA's Firm Proposals*, May 2005; CAA – *Airports Price Review – Initial Proposals for Heathrow, Gatwick and Stansted*, December 2006; CAA – *Airports Price Review – CAA recommendations to the Competition Commission for Heathrow and Gatwick Airports*, March 2007; Distribution company regulatory Accounts 2004-2006; Ofgem – *Electricity Distribution Cost Review 2004/05*, December 2005; Ofgem – *2005/06 Electricity Distribution Quality of Service Report*, 1 December 2006; Ofgem – Electricity Distribution Price Control Review – Policy Document – Summary of DNO forecasts appendix, March 2004; Ofgem – *Electricity Distribution Price Control Review: Final Proposals,* November 2004; *Ofgem – Gas Distribution Price Control Review: Initial Proposals*, 125/07, 29 May 2007; Ofgem – *Gas Distribution Price Control Review: Third Consultation appendices*, 206/06a, 27 November 2006; Transmission company regulatory accounts; Ofgem – *Transmission Price Control Review: Final Proposals*, 206/06, 4 December 2006; Ofgem – *TPCR 2007-12 – Non load related capital expenditure and operating expenditure information* (SHETL, SPT, NGET), 19 April 2006.

160 Arguably, only a small proportion of NATS labour related opex could be considered as truly "controllable" as traffic control activities are likely to be more intensive in labour.

between levels of controllable costs over turnover across companies within the same industry can be due to lack of costs standardisation.

In our discussions with companies on this risk measure, some companies argued that the majority of labour costs were not truly controllable within the business cycle (due to the essential fixed nature of the labour, and labour market rigidities). We have therefore tested how the ratios look if "employment costs" in June Returns are classified as "non-controllable". For the financial years ending 2004 to 2006, this analysis reveals that on average controllable opex represented 30% of turnover for water companies.[161] This compares with the 34% shown in Table A.5 above if "employment costs" in companies' June returns are classified as controllable. The difference between these two ratios is surprisingly small and reflects the fact that "employment costs" form only 10-15% of opex in the June Returns. We have not been able to include the labour cost component of service management contracts in this analysis, which would reduce the implied operational leverage for water further.[162]

When we repeat this analysis for the electricity distribution companies, we see similar results as for the water companies. For the financial years ending 2005 to 2006, this analysis reveals that on average controllable opex represented 14% of turnover when employment costs were classified as non-controllable.[163] This compared to 19% of turnover when employment costs were classified as controllable. Like water companies, not all labour costs are separately identified as employment costs in company regulated accounts.[164]

Overall our conclusions from this analysis are the following: the energy network companies *appear to have* higher levels of operational leverage than water companies which are higher than BAA and NATS. However, the data that underpins this analysis is not perfect, and the implied difference in risk between the sectors is not very clear. An argument can be made that the true proportions of controllable costs are low across all the utility companies due to the essential fixed nature of the labour, and labour market rigidities, that make it difficult for companies to adjust their costs in response to changes in business conditions. Hence, it is not clear whether in practice a higher level of operating leverage (using our measures) would represent a material increase in the level of beta risk.[165]

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[161] Controllable Opex defined as total operating expenditure minus Local Authority Rates, Other Business Rates, Service Charges and Employment Costs. Source: Companies' June Returns (2004, 2005 and 2006).

[162] The CAA recently noted that *"Labour costs form only 10-15% of opex in the water industry … the true figure is in excess of 50% when labour costs incurred under service management contracts are included"* CAA (2005) NATS Price Control Review 2006-2010 CAA's Firm Proposals, May 2005, page 41.

[163] Controllable Opex defined as Operating Costs minus all pensions, rates, licence fees, depreciation and employment costs (includes salaries and social security costs). Source: Regulatory Accounts (2006).

[164] EDF Energy Network DNOs (EPN, SPN, LPN), for example, do not incur in any direct labour costs as their staff is employed by EDF Energy Networks Ltd, which operates the network on the companies' behalf.

[165] We have undertaken a preliminary analysis of actual changes in labour costs of electricity distribution companies relative to changes in turnover over the period 2004-06. Our analysis shows very low correlation coefficients between turnover and operating cost changes which may suggest that very few types of costs are easy to adjust in response to changes in turnover (perhaps reflecting rigidities of local labour markets, lags in adjustments, or the fact that very little utilities' opex really is truly "controllable"). Hence it is not at all clear that, in practice, a higher operating leverage represents a material increase in level of risk.

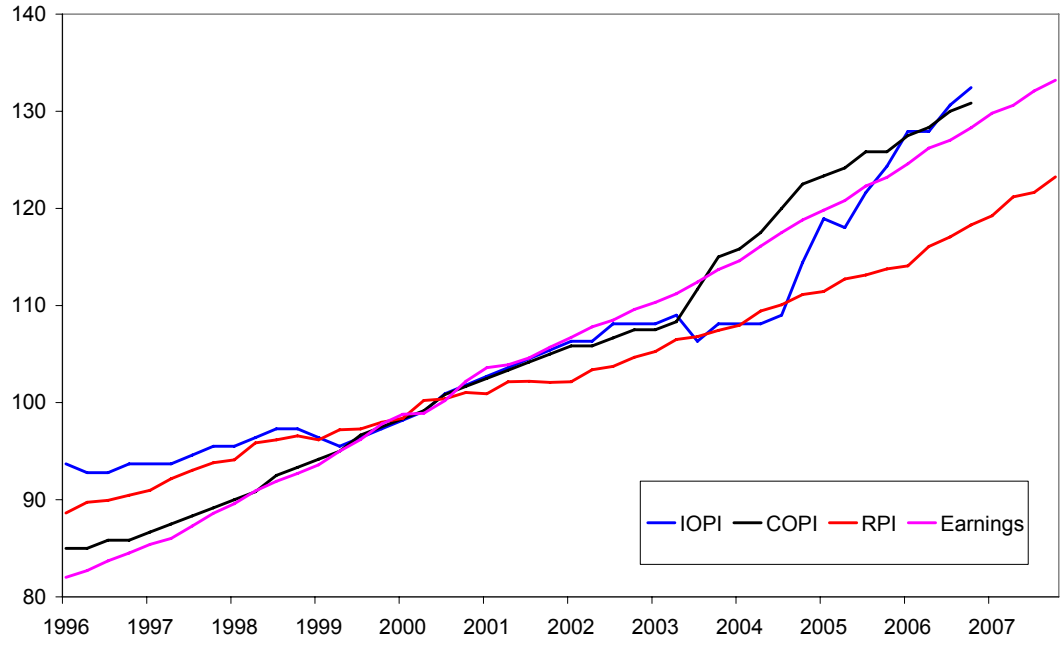
Different regulators have also noted that further work is required to better understand the proportion of fixed/variable costs in each industry. During GDPR7 Ofgem has considered alternative revenue drivers (such as the number of connections) to reflect cost changes due to changes in demand. In DPCR4 some Distribution Network Operators (DNO) argued that the volume related component of the revenue driver should be removed as it may not adequately capture changes in underlying costs. Ofgem's initial proposal for the EDPCR5 notes that the volume revenue driver will be reconsidered (page 11) in the price control review. CAA has encouraged NATS to consider how its costs vary with capacity and delay, and the responsiveness to variations in volumes over different time periods. (NATS Price Control Review 2006-2010. CAA Decision, page 43).

A.2.3. Input Price Risk

Fluctuations in the growth of input prices around RPI impact upon regulated companies' profits since revenues are typically tied to RPI and increased costs cannot usually be passed on to customers. An examination of historical capital and labour unit price changes indicate substantial disconnect between input prices and RPI: we estimate IOPI and RPI annual percentage changes to have diverged from -5 up to 9 percentage points over the period since 1996. Likewise, the divergence between IOPI and earnings growth has been from -6 up to 7.5 percentage points.

The disconnection between IOPI, RPI and earnings is highlighted by Figure A.1 below: IOPI has risen much more sharply than RPI since 2004/05, as have earnings.

Figure A.1
IOPI, COPI, RPI & Earnings (2000 = 100)



Source: DBERR and ONS.

The importance of differences between capital and labour prices and RPI will vary across sectors according to the relative intensity of labour and capital usage. To measure companies' exposure to real changes in capital prices we use the capex to turnover ratio. We proxy exposure to labour and materials prices using the opex to turnover ratio.

Table A.6 presents a summary of average capex and opex to turnover ratios by industry.

Table A.6
Summary of Capex to Turnover and Opex to Turnover Ratios across Sectors[166]

(+) — Risk Exposure — (-)

Sector	Capex to Turnover	Period
Electricity Transmission	63%	2006-12
Gas Transmission	46%	2006-12
Gas Distribution	43%	2006-13
Electricity Distribution	43%	2006-10
BAA designated airports (Heathrow)	36%	2008-13
BAA designated airports (Gatwick)	23%	2008-13
NATS	21%	2006-11
Water (WaSCs)	43% (*)	2006-10
Water (WoCs)	32% (*)	2006-10

(+) — Risk Exposure — (-)

Sector	Opex to Turnover	Period
NATS	68%	2006-11
BAA designated airports (Gatwick)	55%	2008-13
Water (WoCs)	47%	2006-10
Gas Distribution	43%	2006-13
BAA designated airports (Heathrow)	41%	2008-13
Water (WaSCs)	36%	2006-10
Gas Transmission	29%	2006-12
Electricity Distribution	29%	2006-10
Electricity Transmission	28%	2006-12

Note: (*) For PR09 Ofwat will retrospectively adjust real changes in Infrastructure Output Price Index (IOPI), reducing capex related price input risk. Ofwat currently adjust real changes using COPI.

The overall implications of this analysis on the relative risk of the sectors are not very clear. To assess the expected relative risk faced by companies from capital or labour real price changes, what really matters is expected relative deviations of actual input prices from regulatory allowances. Since Ofgem, Ofwat and the CAA have different procedures for both capex and opex allowances, the true relative exposures of the companies to input price risk are difficult to determine.

Water companies have higher ratios of capex to turnover than electricity distribution companies over the current price control period. However, as Ofwat retrospectively adjusts real changes in COPI (will use IOPI in PR09), water companies' risk from capex related input prices is mitigated to a degree. But water companies are still exposed to capital input price risks because the IOPI index is an imperfect proxy to actual water company capital costs. It is therefore hard to compare actual capital input price risks faced by water and electricity distribution companies.

A.2.4.Conclusions on Beta Risk Factors

Our analysis shows that air transport services' demand is likely to be more highly correlated with the business cycle than demand for utilities services due to a higher IED. Moreover, the

[166] Sources: *op. cit*. footnote 159.

form of price control under which BAA airports (and NATS) are regulated, does not (fully) mitigate their exposure to volume risks. As such, BAA airports and NATS appear to have greater exposure to beta risks than companies operating in the other sectors considered.

Amongst the utilities, the water sector seems to be more exposed to volume risk than electricity and gas networks. This is mainly due to two facts (i) the price control formula does not guarantee revenues from large users (on average 6% of total revenues) and (ii) the five year adjustment in water may expose companies to higher cash flow/ liquidity risks within the price review period than the energy networks which have annual adjustments. Water companies also face higher revenue risk from bad debt than energy networks whereas input price risk and operating leverage are hard to compare across sectors and their impact on beta is less clear.

Overall, it appears that water companies face a level of exposure to beta risks is higher than that faced by electricity and gas networks, but lower than the beta risk faced by BAA and NATS.

Table A.7
Summary of Beta Risks

	Demand Risk *Most relevant beta risk. Strong correlation with business cycle.*	Bad Debt *Reduces revenues; it is correlated with the business cycle.*	Operating Leverage *Comparability issues across industries due to lack of costs standardisation. Impact on Beta is less clear*	Input Price Risk *Impact on Beta is less clear (depends on input prices growth relative to RPI). Different cost structure makes comparison difficult.*
BAA designated airports	Price cap - Highest relative exposure to demand risk.	Medium/Low relative exposure to demand risk.	Average relative operating leverage (medium exposure to demand shocks).	Average relative exposure to construction and labour and material prices.
NATS	Hybrid price cap - High relative exposure to demand risk.	Medium/Low relative exposure to demand risk.	Lowest relative operating leverage (lowest exposure to demand shocks).	Lowest relative exposure to construction prices, highest relative exposure to labour and material prices.
Water	Revenue cap adjusted every 5 years + excludes demand from large users - Medium relative exposure to demand risk.	Disconnection not allowed – large number of domestic small customers - Highest relative exposure to bad debt risk.	Average relative operating leverage (medium exposure to demand shocks).	Relatively limited exposure to labour and material prices (IOPI adjustment). Average relative exposure to labour and material prices.
Electricity Distribution	Hybrid revenue cap -Low relative exposure to demand risk.	Medium/Low relative exposure to demand risk.	Highest relative operating leverage (highest exposure to demand shocks).	Average relative exposure to construction and labour and material prices.
Electricity and Gas Transmission	Hybrid revenue cap -Low relative exposure to demand risk.	Medium/Low relative exposure to demand risk.	Highest relative operating leverage (highest exposure to demand shocks).	Highest relative exposure to construction prices, lowest relative exposure to labour and material prices.
Gas Distribution	Revenue cap - Lowest relative exposure to demand risk.	Medium/Low relative exposure to demand risk.	Average relative operating leverage (medium exposure to demand shocks).	Average relative exposure to construction and labour and material prices.

(Higher) — Risk Exposure — (Lower)

A.3. Asymmetric Risks

We have considered a range of asymmetric risks, shown in Table A.8. For brevity we only present a summary of the key features of the regulator's methodologies in each sector. For each type of asymmetric risk sectors are presented in the table from highest exposure to lowest exposure. In summary this table shows the following:

- ***Opex allowances***: The methodology applied by the regulator in setting opex allowances is likely to be an asymmetric risk with greater prospect of downside impact on allowed returns (relative to an average efficient company).
  - In our view, bottom-up methods based on a detailed analysis of the costs of the company, despite being subject to regulatory risk, entail a lower degree of risk than a top-down benchmarking approach. Therefore, we consider air transport companies to be subject to less asymmetric risks than the other sectors.

  - Both Ofwat and Ofgem use econometric modelling and unit cost comparisons to determine the comparative efficiency of water and distribution companies. Any benchmarking approach introduces the risk of companies not being able to recoup actual 'efficient' costs. We consider Ofgem's approach of setting allowed opex targets for gas distribution (GD) and electricity distribution (ED) to be more risky than Ofwat's benchmarking for water due to fewer observations, limited data and a larger number of subjective and unsubstantiated adjustments by Ofgem.

- ***Unexpected costs between reviews***: Regulated companies are exposed to unexpected costs between reviews that can potentially have a significant impact on the risk profile of the company. These risks can either arise from lower than expected revenues (i.e. bad debt, negative demand shocks) or higher than expected costs (input price risks, new obligations, government charges). In broad terms, water companies appear to have more defined and codified mechanisms to deal with unforeseen events affecting costs or revenues than distribution and transmission and air transport regulated companies. Interim reviews available to distribution companies seem to be either only applicable in very specific circumstances, or broadly defined and heavily dependent on the regulator's discretion. In air transport, price control re-opener mechanisms seem to be entirely dependent on CAA's discretion. We note, however, that the level of risk reduction from these mechanisms might not be directly comparable between sectors.

- ***Capital expenditure incentive schemes***: Capital expenditure incentive mechanisms can be asymmetric risks, if the risk profiles of outturn costs are skewed relative to forecast costs. The capital triggers scheme is distinctively a source of asymmetric risks for the BAA designated airports. The "triggers" represent a downside revenue risk for BAA airports whereas rolling incentive mechanisms represent potential upside and downside risk and the asymmetry relies on the probability (frequency) of overspends relative to under-spends. At PR09 Ofwat will introduce "menu regulation" (similar to the Sliding Scale Mechanism and the Information Quality Incentive applied by Ofgem) to incentivise companies to reveal their real capex requirements. The details of the scheme are still to be confirmed by Ofwat. However, the similarities between the methodologies employed by Ofgem and Ofwat to determine the capex allowances, suggest that the risk exposure arising from these schemes are likely to be comparable.

- ***Quality of Service Incentive Schemes*** can represent an additional source of asymmetric risks if the financial rewards and penalties the companies are exposed to are not symmetric. Asymmetric revenue risks arising from quality of service penalties and reward risks are bigger for NATS and BAA designated airports than for the other regulated companies. ED companies are more exposed to revenue risk associated with quality of service incentives schemes than water companies. For electricity transmission (ET) companies, Ofgem has indicated that it may decide to move to a "penalties only" reliability incentive scheme by 2009.

- ***Competition risks***: Competition is likely to have an asymmetric downside impact on companies' revenues. We do not consider risks arising from competition for BAA designated airports to be comparable. Unlike utilities, airports do not have a "designated area" where they operate. Instead they face potential demand risk arising from

competition from other airports (existing and new entrants).[167] In our view, NATS and transmission companies do not face significant risk arising from competition.

Ofwat have stated that they will aim to encourage competition throughout the industry, excepting the water distribution network which is regarded as a natural monopoly.[168] A first step will imply accounting separation, which will involve Ofwat making a decision to split the RAV amongst different activities. The new industry structure in water may mirror that currently in place in the electricity and gas industries. The form of competition that may be promoted and eventually emerge remains uncertain, however, pending the independent review of 'competition and innovation in water markets' commissioned by the Government and being led by Professor Martin Cave of Warwick University, as well as the Ofwat consultation.[169]

The impacts of new competitive possibilities on the cost of capital, and on the relative risk of water investments, depend on the range of frameworks now being considered, and on the one which is eventually adopted. The long term financing cost impacts resulting from changed volatility of earnings may differ from the transitional financing cost impacts which arise from today's uncertainty about the proposed framework, and about how any proposed move to new structures will be handled. Specific issues include how any initial impacts on asset values and financeability will be addressed, and the potential for asset stranding, all of which may increase the option value of delaying any financial investment until more is known. Transitional impacts on the cost of capital may be partially mitigated by transparency about the options and impacts being considered and by political and regulatory commitment to protection of asset values and an appropriate phasing of change.

Some analysts have noted that the prospects for the introduction of a new competitive framework will increase revenue volatility and therefore, increase the cost of capital for water companies. It has also been commented that the published Ofwat proposals do not address the possible impact on the financing of the industry, specifically the requirements of the capital markets and the perspective of the credit rating agencies.[170] Clearly these important issues will need to be fully addressed by Ofwat and the government in reaching their views on the preferred long term structural arrangements for the E&W water sector.

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167 The Department for Transport (DfT) is currently consulting on whether Stansted and Manchester should be dedesignated; that is, whether formal price cap regulation should be abolished for these airports. The CAA supports dedesignation of both airports on the grounds that their market power is limited and that competition law, Section 41 of the Airports Act and the threat of redesignation are a sufficient basis to provide appropriate protection on pricing.

168 See Ofwat (2008) "Setting Price Limits for 2010-2015. Framework and Approach"

169 Professor Martin Cave, Director of the Centre for Management under Regulation, Warwick Business School is leading an independent review of competition and innovation in water markets commissioned by Defra. A final report is likely to be published in spring 2009. See Defra's web page for details: http://www.defra.gov.uk/environment/water/industry/cavereview/ (last visited June 2008). In May 2008, Ofwat published a consultation on competition where they recommend vertical separation of contestable markets from natural monopoly activities. This consultation is a contribution to Professor Martin Cave's review. See "Ofwat's review of competition in the water and sewerage industries: Part II", May 2008 (closing date: 29 August 2008).

170 See, for example, Merrill Lynch, Industry Overview on UK Water Utilities, 4th June 2008.

Conclusion on Asymmetric Risks

Overall, it would appear that BAA designated airports are more exposed to asymmetric risks from competition, quality of services and capex incentive mechanisms than companies in the other sectors.

For the regulated utilities considered in this study, it is hard to assess the relative magnitude and interaction of the asymmetric risks and their impact on the overall risk profile of the utilities sectors. However Ofwat's announced plans to explore competition possibilities are regarded by some analysts as a possible source of risk which could have a significant impact on the cost of capital for water companies during the AMP5 period.

Table A.8 - Asymmetric Risks

Risk Exposure (Higher) — (Lower)

Regulator's Methodology in assessing level of opex:	Mechanisms for dealing with Unexpected Costs	Capex Incentive Schemes:	Quality of Service Incentive Mechanisms	Asymmetric Risks from Competition:
1. GD - Benchmarking based on unit cost and econometric analysis - Limited no. of observations (8) - Subjective adjustments	**1. BAA** - Possibility of an interim review (no codified mechanism)	**1. BAA** - No rolling incentive mechanism - "capital expenditure triggers" reduce max. allowed level of charges (approx. 4% of airport charges).	**1. BAA** - Scheme of Standards and Rebates - Downside risk capped at 7% of airport charges. Upside (Bonus) up to 2.24%.	**1. BAA** - Competition from other London airports, new airports, Eurostar
2. ED - Limited no. of observations (14) and only 1 explanatory variable (composite scale variable)	**2. NATS** - Licence Condition number 28 – Suspension of Price Control Charges. (Outcome depends to a large extent on CAA's discretion.)	**2. Water** - PR09 – introduction of menu regulation - Rolling incentive mechanism	**2. NATS** - Service quality adjustment - Downside risk capped at 4% of total revenues (upside risk uncapped)	**2. GD** - Competition in new network extensions, connection services, metering - Potential risk from independent operators raises average costs for GDNs by 'cream-skimming'
3. Water - Benchmarking based on unit cost and econometric analysis - More observations. More disaggregated analysis	**3. ED** 1. Revenue Disapplication Clause 2. Price Control re-opener for implementation of new governmental regulations	**2. ED** - Rolling incentive mechanism: Sliding Scale Mechanism - Incentive rate between 29% and 40%	**3. ED** - Quality of Service Scheme: - Downside risk capped at 4% (upside risk uncapped) Actual adjustments: -0.2% to 2.4%.	**3. ED** - Competition in new network extensions, connection services, metering - Very little entry so far
4. ET & GT - Interrogation of Information - No objective justification for disallowing costs	**3. GD** 1. Revenue Disapplication Clause 2. Income adjusting event clause ("force majeure") 3. Price Control re-opener for implementation of new governmental regulations	**2. GD** - Rolling incentive mechanism: Information Quality Incentive - Incentive rate between 23% and 36%	**4. ET** - Reliability incentive scheme - Actual adjustments from 0.02% to 0. 23%	**4. Water** - Plan to open up to competition more broadly in near future e.g. retailing, opex contract - But limited competition so far
5. NATS & BAA - "Baseline" opex rolled forward + atypical costs - Use of multiple instruments in determining baseline mitigates risk	**3. ET & GT** 1. Revenue Disapplication Clause 2. Income adjusting event clause ("*force majeure*") 3. Safety Net Mechanism (Negative impact)	**3. ET & GT** - Rolling incentive mechanism Fixed incentive rate: 25%	**5. Water** - Overall Performance Assessment - Revenue risk capped to 0.5% of revenues on the upside and -1% on the downside. - Actual adjustments from -0.1% to +0.4%	**5. NATS & ET & GT** - Not significant risk
	4. Water 1. IDoKs – revised price limits between price reviews (RCC and NIs) 2. "Substantial Effects" (Shipwreck) clause	**4. NATS** - No rolling incentive mechanism - Allowed to keep efficiencies until next price control review	**6. GD & GT** - No Quality of Service (QoS) scheme in place.	

A.4. Regulatory Financial Framework

The regulatory financial framework can be regarded as another type of asymmetric risk: different regulatory approaches to WACC, tax and financeability can lead to significantly different financial outturns.

Table A.9 summarises the various regulators' approaches to WACC (i.e. is it set pre - or post - tax) and the treatment of taxation and the role the regulator plays in ensuring the ability of companies to maintain good financial standing. We note the following:

- A pre-tax WACC assuming the statutory corporate tax rate - such as that set by the CAA for BAA – can provide a source of upside risk to regulated companies by comparison to the use of a post-tax WACC based on forecasts of expected tax liabilities. .
- Both Ofwat and Ofgem claw back tax outperformance in the following review period. By contrast, the aviation industries are not subject to tax claw back.
- All regulators set WACC so that – in their opinion – companies will be able to maintain a solid investment grade credit rating. This is generally interpreted as A- or BBB+ using S&P's terminology. To assess whether the financeability aim will be met, the regulators all model company revenues and costs over the upcoming review period. The performance is measured with respect to a range of financial ratios including FFO, debt to RAB, FFO / interest coverage and FFO / adjusted net debt – similar to those used by ratings agencies.
- Though the assessment of financeability is broadly similar across industries, the water industry has been the greatest recipient of revenue uplift adjustments in the past. While this could be the effect of a cost of capital that was too low, it may also reflect a more interventionist bent on behalf of Ofwat. As such, despite a stated expectation that adjustments will not be needed over 2010-15, Ofwat's adjustment regime appears marginally less risky than Ofgem's.

The evidence indicates that the regulatory financial arrangements in the aviation industries are much less risky than in the energy and water sectors. The differences between the energy and water regimes appear small, suggesting the exposure to asymmetric financial regime risks are broadly the same.

Table A.9
Regulatory Financial Framework

(Higher) — Risk Exposure — (Lower)

Service	WACC	Tax	Financeability Adjustments
Electricity Transmission	Vanilla real	Separate building block – company specific allowances based on notional level of gearing and allowed cost of debt. Ex-post adjustments to reduce the tax allowance if actual gearing and actual interest expense both exceed the level assumed in the financial model.	Companies may apply for additional revenue where financial ratios breached. Limited adjustments made historically. High degree of regulatory discretion.
Gas Distribution	Vanilla real	Separate building block – company specific allowances based on notional level of gearing and allowed cost of debt. Ex-post adjustments to reduce the tax allowance if GDNs' actual gearing and actual interest expense both exceed the level assumed in the financial model.	Companies may apply for additional revenue where financial ratios breached. Limited adjustments made historically. High degree of regulatory discretion.
Gas Transmission	Vanilla real	Separate building block – company specific allowances based on notional level of gearing and allowed cost of debt. Ex-post adjustments to reduce the tax allowance if actual gearing and actual interest expense both exceed the level assumed in the financial model.	Companies may apply for additional revenue where financial ratios breached. Limited adjustments made historically. High degree of regulatory discretion.
Electricity Distribution	Vanilla real	Separate building block – ex ante tax costs allowance with an ex-post adjustment where actual gearing exceeded gearing assumption. Adopt a generic approach, rather than actual, to allocating capex to individual tax pools. Company specific allowances based on notional level of gearing; claw-back of any revenue benefit they obtain from lower tax costs where the DNO has exceeded its gearing assumption and incurred interest costs. For DPCR5 Ofgem have flagged a mechanism for ex-post adjustments for major changes to the tax system, such as the cut in the corporate tax rate and changes to capital allowances.	Companies may apply for additional revenue where financial ratios breached. For 2010-15 Ofgem expects adjustments to be largely unnecessary provided it sets an appropriate cost of capital. Has flagged the impact of the earlier accelerated depreciation as a possible trigger for financeability adjustments if not treated appropriately. However, only limited adjustments made historically and high degree of regulatory discretion.
Water	Vanilla real	Separate building block – company specific allowances based on actual level of gearing at time of review At PR14 will claw back on an NPV neutral basis the tax benefits from a company gearing up during 2010-15	Companies may apply for additional revenue where financial ratios breached. Widespread adjustments totalling about £430m at PR04. For 2010-15 Ofwat expects adjustments to be largely unnecessary, preferring new equity, retained earnings and market solutions instead. Any adjustment is to be NPV neutral. High degree of regulatory discretion.
NATS	Pre-tax real	For 2006-10 pre-tax WACC reflects modelled expected taxation payments based on the effective tax rate of 11%	For 2006-10 NATS allowed NERL to bring forward a small amount of revenue from future review periods to achieve satisfactory (to NATS) ratios
Airports	Pre-tax real	For 2008-13 pre-tax WACC reflects allowance for full statutory corporate tax rate of 28%	

A.5. Non-Systematic Regulatory Risks

Low Free Cash Flows (FCFs) increase the risk to shareholders that returns will fall short of a fair rate of return (since dividends etc can only be paid from FCFs). As an example of the importance of FCFs, for the current regulatory period, due to very high levels of investment over TPCR4, FCFs for the Scottish electricity transmission companies represent only 1% of their turnover. This has prompted rating agencies to highlight that Scottish electricity transmission faces higher levels of risk from increased capital expenditure programmes.[171]

To assess the risk to shareholders we focus on forecasts of FCFs. The table below presents average levels of FCFs across industries.

Table A.10
Summary of Free Cash Flows across Sectors [172]

(-) — Risk Exposure — (+)

Sector	Turnover minus Opex minus Capex to Turnover Ratio	Period
Electricity Transmission	9%	2006-12
NATS	11%	2006-11
Gas Distribution	12%	2006-13
Water (WoCs)	20%	2006-10
Water (WaSCs)	21%	2006-10
BAA designated airports (Gatwick)	22%	2008-13
BAA designated airports (Heathrow)	23%	2008-13
Gas Transmission	25%	2006-12
Electricity Distribution	28%	2006-10

Electricity transmission companies, NATS and gas distribution companies face the lowest levels of FCFs, while water companies and BAA airports are more exposed to regulatory risks associated with low FCFs than electricity distribution and gas transmission companies. However, these sector level assessments mask significant variation at a company level: Ranges of FCFs vary between 8% and 48% for electricity distribution companies, between 6% and 35% for water companies and between -5% and 22% for gas distribution companies.

The risks cannot fully be compared until the forward-looking investment programmes for water companies and DNOs are known over the AMP5 and DPCR5 periods respectively.

A.6. Conclusion

Based on the considerations presented above, we have ranked the different sectors according to our assessment of the overall ranking of risk across the regulated sectors.

In deriving this overall assessment of relative risk we have drawn on the following conclusions from this study:

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[171] "Crucial to most of these companies will be operating cost management and control of their significantly increased capital expenditure programmes." Fitch - 2007 Energy & Utilities Outlook, 10 January 2007.

[172] Sources: *op. cit*. footnote 159.

- Beta risks are the most relevant risk factors impacting the cost of capital. Air transport regulated companies seem to face higher systematic (beta) risk than regulated utility companies. Amongst the utilities, the water sector seems to be more exposed to volume risk than electricity and gas networks. This is mainly due to two facts (i) the price control formula does not guarantee revenues from large users (on average 6% of total revenues) and (ii) the five year adjustment in water may expose companies to higher cash flow/ liquidity risks within the price review period than the energy networks which have annual adjustments. Water companies also face higher revenue risk from bad debt than energy networks whereas input price risk and operating leverage are hard to compare across sectors and their impact on beta is less clear.

- On asymmetric risks, there are many different sources of asymmetric risks that are difficult to compare across the sectors. Overall, it would appear that BAA designated airports are more exposed to asymmetric risks from price re-opener schemes, capex incentive mechanisms and QoS incentive schemes than companies in the other sectors. Between energy and water, arguably the biggest difference is water's increased exposure to downside revenue and financing risks from competition and structural reform.

- With respect to free cash flows, the risks cannot fully be compared until the forward-looking investment programmes for water companies and DNOs are known over the AMP5 and DPCR5 periods respectively. However, electricity transmission and NATS both have low free cash flows over the current price control review periods that expose these sectors to increased regulatory risks at the current time. Water is also likely to have low forecasts free cash flows over AMP5 due to the expected heavy capital investment programme.

On the basis of this analysis, we broadly conclude that the water sector faces a lower risk than BAA designated airports and NATS, but is riskier than electricity and gas transmission and distribution activities.

However, there are also additional considerations that must be factored in when assessing the relative risk across sectors. The nature of these issues –and the fact that most of them are sector specific makes it difficult to compare their impact on the risk profiles of the different sectors.

For example, the Water UK Investor Survey 2008 indicated that electricity transmission is considered to be a low risk sector despite low forecast FCFs. This could be because investors consider the national grid as a strategic national asset and therefore regulatory decisions that could potentially jeopardize the financial viability of the transmission grids are perceived to be highly unlikely.

The respondents to the Survey also explored the difference between the water sector and the regulated energy distribution businesses. They considered that water may have been more risky due to operational risk whether through manufacturing (water resources and treatment) or disposal risk (sewerage and treatment). Others cited revenue risk, environmental focus (EU directives, prosecutions) and the significant capital programmes. On the other hand some saw gas as more risky than water because of the safety risk, greater demand sensitivities and higher investment profiles. Aviation was more risky because of terrorism. These are difficult risks to compare qualitatively across sectors.

Other factors that affect relative risk exposures but are hard to compare include:

- Potential differences on the scope for political pressure/intervention across the sectors considered.
- Impact of environmental regulation and safety/ public health regulation
- The obligation to comply with different regulatory bodies. Water has three regulators and this might restrict the flexibility of water companies' to manage their expenditure programmes. BAA and NATS are regulated by both the Civil Aviation Authority and the Competition Commission.
- Other challenges faced by different sectors such as the introduction of distributed generation and the CO_2 reduction targets for electricity distribution and transmission companies or the risk of terrorist attacks and its consequences on the air transport industry for BAA and NATS.

Overall, assessing the relative risks across different sectors is an extremely difficult and uncertain task: the analysis undertaken in this Appendix has been qualitative in nature and further quantitative modelling would need to be undertaken to track the impacts of these risk factors through to cash-flows in order to reach more robust conclusions.

Appendix B. Regulatory Precedent on the Risk-free Rate

Table B.1 Risk-free Rate – European Regulatory Precedents

Regulator	Country	Date	Company/	Nominal RFR	Real RFR
ECK	Austria	2003	Gas transmission	3.9%	
ECK	Austria	2005	Gas distribution	3.3%	
ECK	Austria	2005	Electricity distribution	4.0%	
CREG	Belgium	2003	Gas transmission	5.1%	
CREG	Belgium	2006	Gas transmission	4.2%	
CREG	Belgium	2006	Gas storage and LNG terminals	4.2%	
Ofgem	Britain	2001	Transco		2.8%
Oftel	Britain	2001	BT retail and network charges	5.1%	
Ofgem	Britain	2004	DNOs		2.8%
Ofgem	Britain	2002	Gas Transmission (IGTs)		2.8%
Ofcom	Britain	2004	Private Circuit Charging Controls	5.0%	
Ofgem	Britain	2004	Scots RO		2.8%
Ofgem	Britain	2005	Electricity transmission		2.8%
Ofgem	Britain	2006	Electricity & gas transmission		2.5%
Ofgem	Britain	2007	Gas distribution		2.5%
CAA/CC	Britain	2008	BAA		2.5%
DERA	Denmark	2005	Gas Transmission	4.9%	
EMA	Finland	2004	Gas Transmission	3.5%	
CRE	France	2005	Electricity transmission & distribution	3.6%	
CRE	France	2005	Gas distribution		2.4%
CRE	France	2006	Gas transmission		2.4%
CER	Ireland	2001	ESB Transmission		3.1%
CER	Ireland	2001	Aer Rianta		2.6%
CER	Ireland	2002	Best New Entrant Price 2002		2.6%
CER	Ireland	2003	BGT		2.5%
CER	Ireland	2003	Gas Distribution		2.5%
CER	Ireland	2004	Best New Entrant Price 2005		2.4%
CER	Ireland	2005	Best New Entrant Price 2006		2.4%
CAR	Ireland	2005	DAA		2.6%
CER	Ireland	2005	Electricity Transmission		2.4%
CER	Ireland	2005	Electricity distribution		2.4%
CER	Ireland	2007	Gas transmission and distribution		1.8% - 2.3%
AEEG	Italy	2004	Electricity Transmission	4.3%	
AEEG	Italy	2004	Electricity Distribution	4.3%	
AEEG	Italy	2005	Gas transport	4.3%	
AEEG	Italy	2005	Regasification	4.3%	
Ofreg	N.Ireland	2006	Electricity distribution		2.8%
Ofreg	N.Ireland	2006	Electricity transmission		2.8%
DTe	Netherlands	2001	Gas distribution	5.0%	
OPTA*	Netherlands	2002	TPG (Post)	5.0%	

Source: European regulatory decisions. We present a real risk-free rate when available in the regulator's decisions. Otherwise we present a nominal risk-free rate.

Appendix B. OLS Regression Estimation of Beta

In this Appendix we present the OLS regression results from our simple equation that controls for the impact of price review periods through dummy variables:

$$R_{it} = \alpha + \beta R_{mt} + \alpha_1 R_{mt} PR99 + \alpha_2 R_{mt} PR04 + \varepsilon_t$$

PR99 and PR04 are dummy variables for each of the price review periods i.e. the period between the release of the final "Setting price limits for water and sewerage services" document and the publication of the Final Determination.[173] The equation is estimated using the most available data for each company. Market returns are based on the FTSE All-share index. Table B.1 presents the coefficient estimates and their statistical significance. Both PR99 and PR04 are found to have a statistically significant negative effect at the 1% limit on beta for all four companies considered.

Table B.1
Coefficient Estimates and Statistical Significance

	Severn Trent	Pennon	Kelda	United Utilities
Market return	0.57***	0.45***	0.59***	0.69***
PR99 * Market return	-0.79***	-0.52***	-0.93***	-0.61***
PR04 * Market return	-0.5***	-0.49**	-0.64***	-0.38**

Source: NERA calculations using Bloomberg data. Uses weekly data; SVT data from 11/7/1991; UU data from 19/7/1990; KEL data from 11/7/1991, and; PEN data from 23/7/1990. End date is 31/12/2007.
****, ** and * indicate statistical significance of raw betas at 1%, 5-10% levels.*

We also expanded our equation to include a dummy for the PR94 period.[174] The OLS regression results for this model are presented in Table B.2. The estimates of beta are little changed between the two models. We also find PR99 and PR04 again both have a statistically significant negative impact on beta. On the other hand, PR94 appears to have a positive impact on beta, though this impact is not statistically significant.

Table B.2
Coefficient Estimates and Statistical Significance with PR94

	Severn Trent	Pennon	Kelda	United Utilities
Market return	0.54***	0.42***	0.58***	0.68***
PR94 * Market return	0.5*	0.47	0.19	0.25
PR99 * Market return	-0.76***	-0.49***	-0.92***	-0.6***
PR04 * Market return	-0.47**	-0.46**	-0.63***	-0.37**

Source: NERA calculations using Bloomberg data. Uses weekly data; SVT data from 11/7/1991; UU data from 19/7/1990; KEL data from 11/7/1991, and; PEN data from 23/7/1990. End date is 31/12/2007.
****, ** and * indicate statistical significance of raw betas at 1%, 5-10% levels.*

[173] For PR99 the review period is between 26 February 1998 and 25 November 1999. For PR04 the corresponding period is between 15 October 2002 and 2 December 2004.

[174] The period for PR94 is 4 November 1993 to 28 July 1994.

Appendix C. Kalman Filter Estimates of Beta

C.1. The Kalman-Filter Approach

Modern techniques for estimating beta seek to take into account the fact that the true beta of an asset can, and is likely to, change over time. There are a number of reasons why betas for UK water companies are likely to change over time:

- changes in the fundamental business riskiness of the asset (eg. increased competition risks, increased capex intensity);
- changes in the perceived riskiness of the regulatory regime;
- changes in the riskiness of the overall market portfolio (eg. "excess market volatility");
- variation in risk over the course of the business cycle.

All of these effects have been discussed in the academic literature on beta estimation.[175] The impact of regulation on beta estimates has been studied in a number of academic papers. Using UK data, Francis, Grout and Zalewska (2000) showed that a regulatory debate, i.e. a possibility of change as opposed to the change itself, affects the market perception of regulated companies. They argue that the debate initiated by the Labour Government in 1998 on whether price-cap regulation should move towards some form of profit sharing with associated lower returns reduced the utility betas (averaged for 15 utility companies) from a level of 0.8 to 0.4. In contrast, the values of betas calculated for a sample of 21 old-economy non-regulated stocks were unaffected (remaining on average close to one) over the same period of time.

There is also a significant academic literature that shows that beta estimates vary in accordance with the ERP. This effect is related to the discussion above regarding the impact of excess volatility on beta estimates, since periods of excess volatility would be expected to be associated with an increased ERP to compensate investors for greater uncertainty regarding returns. Likewise a significant literature shows that beta estimates vary over the course of the business cycle: betas can have very different values in bull and bear markets.[176]

The emergence of literature that shows evidence that beta varies over time has led to the development of more sophisticated techniques to measure the time-varying nature of beta. An important technique that has been used to estimate beta for UK regulated stocks is the Kalman Filter technique.[177] The Kalman Filter technique is a regression technique in which the explanatory variables as well as the parameters are functions of time. To obtain these time-varying coefficients an algorithm calculates *predictions* and then *smoothes* them.

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[175] The CAPM assumes that the relationship between risk and return is constant over time. A number of academic papers such as Jagannathan and Wang (1993), Harvey (1989) and Chordia and Shivakumar (2002) discuss the time varying nature of risk and return measures. Harvey (1989) finds strong evidence that the risk return relationship is time varying.

[176] For example, Granger and Silvapulle (2001) have concentrated on the instability of beta during bull and bear markets and have found evidence to suggest that the portfolio beta generally increases when the market is bearish and decreases when the market is bullish. The authors found that 21 stocks out of a sample of 30 satisfied this conclusion, whereas 9 stocks experienced betas decreasing during bear markets and increasing in bull markets.

[177] See Buckland and Fraser (2001) and Francis, Grout and Zalewska (2000).

Predictions are obtained when a series of a parameter values is calculated, starting from time zero and extrapolated into the future as new information arrives, i.e. on a daily basis if using daily observations.[178]

The Kalman Filter has a number of advantages over standard OLS techniques as a way to estimate beta coefficients:

- Through its ability to calculate time-varying parameters, the Kalman Filter gives greater sensitivity of the beta estimates to recent news coming to the market meaning that the beta estimate is more forward-looking than the OLS beta estimate.
- By allowing the beta estimate to be time-varying the impact of one-off regulatory and industry specific events on the estimated beta can be better analysed at the time they occur.[179] This is important in order to be able to adjust the beta for factors such as price reviews, sector financial restructurings and other industry specific factors that have affected water share price behaviour.
- Since the Kalman Filter allows the regression coefficients to change over time, it also eliminates the need to determine the appropriate length of the window required for the beta estimation, and reduces averaging bias.

A final advantage of the Kalman Filter technique is that because the estimation of time–varying parameters is obtained recursively using information about the errors of the estimates, there is no need for a Bayesian adjustment.

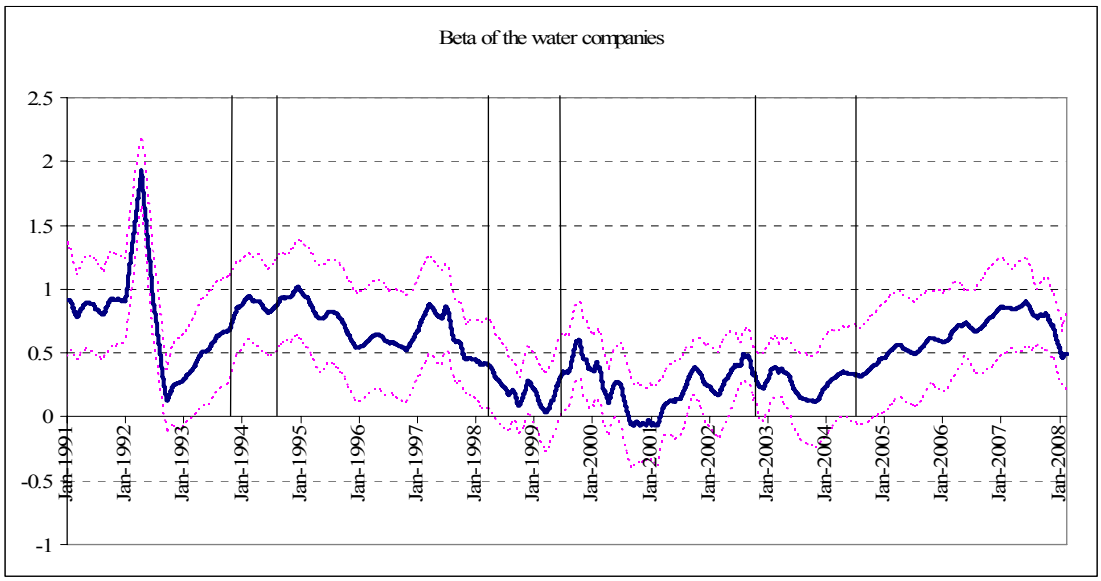
C.2. Results and Analysis

Figure C.1 presents the Kalman Filter estimate of beta for listed UK water companies relative to the FTSE All-share index since 1991, based on daily data. These initial results indicate that the three regulatory review periods have not had a clearly distinguishable effect upon beta compared to the rest of the sample period. That is, the 1993-1994 period beta is not low, the 1998-1999 is not lower than the beta estimated for 2001, and the last review period is not lower than the 2001 beta.

[178] The application of the Kalman Filter to estimation of time varying coefficients is outlined, for example, in Zalewska-Mitura and Hall (1999).

[179] The OLS moving window technique estimates beta time series using overlapping periods and so when an event occurs that affects market or company returns, the effect on beta is diffused over many periods.

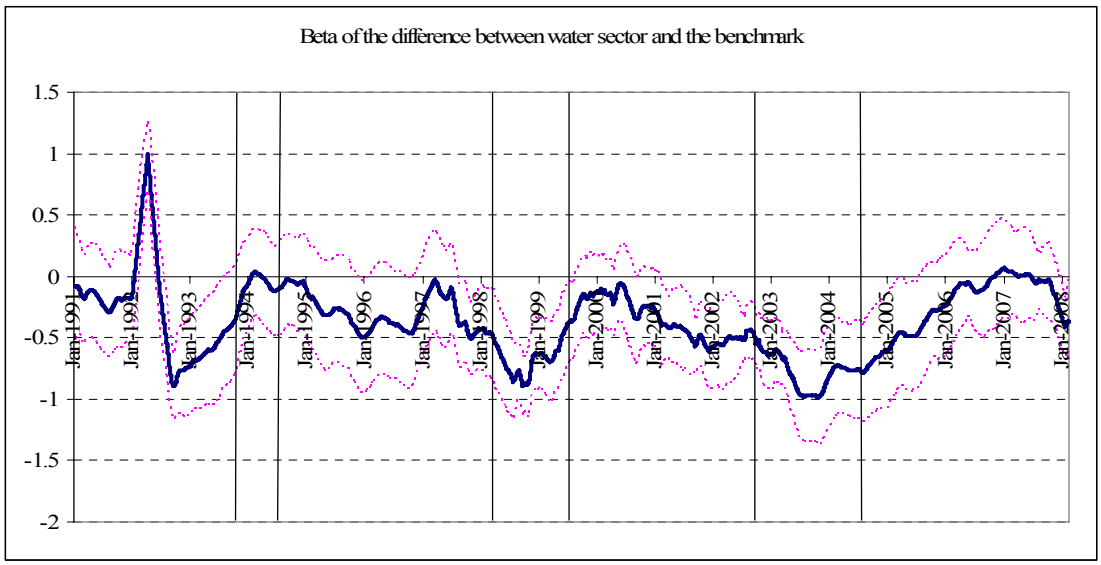
Figure C.1
Kalman Filter Beta Estimates for UK Water



However, these preliminary results are still susceptible to random correlation (or non-correlation) between UK water companies and the broad stock index. For instance, beta may increase even where the fundamental relationship between water returns and market returns is unchanged. For example, the infrastructure bubble of recent years has increased beta since PR04, even though the underlying relationship should probably be little changed.

Therefore, the Kalman Filter approach may better capture the impact of regulatory review periods through comparison with a 'control' group that shares many similar characteristics to water companies, but which is not regulated. Importantly, the benchmark needs to also have been subject to whatever random, or idiosyncratic, factors that have affected the water sector. For this purpose, a group of old-economy mainly industrial stocks is selected based on the group used in Zalewska (2000). Figure C.2 presents beta based on the comparison with the benchmark (or 'control' group). PR99 and PR04 now appear to have a negative, and statistically significant, impact upon beta. Beta appears little changed during the PR94 period, suggesting some fundamental difference between the earliest review period and the two subsequent periods. This could be due to, for example, differences between the perceived impacts upon water company profits of these reviews.

Figure C.2
Comparison to Benchmark



It is also possible to estimate the relationship between the Kalman-filter betas for the water sector and the benchmark. Simple OLS regressions are sufficient for this purpose. A number of dummy variables are included to capture the effects of regulatory periods. In particular, two approaches are attempted: (i) a single common dummy variable for all regulatory periods, and (ii) separate dummy variables for each of the review periods. These results are presented in Table C.1. 'Difference' refers to the regression in which the difference in betas between the water sector and the beta of the benchmark is calculated. 'Water' refers to the regression in which the beta of the water sector is estimated. T-stats are in brackets.

The 'outlier' nature of the first regulatory review is confirmed – the coefficient is (significantly) positive, but less so for the difference equation than for the levels equation. However, if just one dummy is used to capture all three regulatory reviews the coefficient for the difference is very strongly negative. None of these regressions include a dummy for PR09, but the decline in the KF beta in recent months, for both the levels and the difference equations, strongly suggests that once the fourth dummy is introduced the result will be even stronger.

Table C.1
Estimated Impact of Regulatory Review Periods

		Regulatory Reviews Dummies						
	Constant	All reg reviews	1993-1994	1998 - 1999	2002-2004	Beta	R-squared	Adj R-squared
Difference	0.000	-0.316				-0.319	0.092	0.092
	(1.514)	(-6.901)				(-13.219)		
Water	0.000	-0.198				0.511	0.116	0.116
	(1.709)	(-4.562)				(22.286)		
Difference	0.000		0.271	-0.380	-0.375	-0.319	0.097	0.097
	(1.541)		(2.113)	(-5.928)	(-6.141)	(-13.253)		
Water	0.000		0.414	-0.324	-0.207	0.511	0.122	0.122
	(1.737)		(3.397)	(-5.335)	(-3.571)	(22.361)		

Source: NERA analysis

In conclusion, the Kalman-filter approach reveals:

- A statistically significant negative impact of the two most recent regulatory review periods upon water company beta, relative to either historic water company beta or to a benchmark of old economy stocks, and;
- A likely decrease in beta during the upcoming PR09 review period.

Appendix D. Regulatory Precedent on the ERP

Table D.1
Equity Risk Premium – European Regulatory Precedents

Regulator	Country	Date	Company/Activity	ERP
ECK	Austria	2003	Gas transmission	5.0%
ECK*	Austria	2005	Gas distribution	5.0%
ECK*	Austria	2005	Electricity distribution	5.0%
CREG	Belgium	2003	Gas transmission	3.5%
CREG*	Belgium	2006	Gas transmission	3.5%
CREG*	Belgium	2006	Gas storage and LNG terminals	4.3%
DERA	Denmark	2005	Gas transmission	3.7%
Ofgem	Britain	2001	Transco	3.5%
Oftel	Britain	2001	BT retail and network charges	5.0%
Ofgem	Britain	2004	DNOs	4.8%
Ofcom	Britain	2004	Private Circuit Charging Controls	5.0%
Ofgem	Britain	2002	Gas transmission (IGTs)	3.5%
Ofgem	Britain	2004	Scots RO	4.8%
Ofgem	Britain	2005	Electricity transmission	4.8%
Ofgem	Britain	2006	Electricity transmission	5.2%
CC/CAA	Britain	2007	British Airports Association	2.5%-4.5% (point estimate close to 4.5%)
EMA	Finland	2004	Gas Transmission	5.0%
CRE*	France	2005	Electricity transmission & distribution	4.5%
CRE	France	2005	Gas distribution	4.5%
CRE	France	2006	Gas transmission	4.5%
CER	Ireland	2001	ESB Transmission	5.4%
CAR	Ireland	2001	Aer Rianta	6.0%
CER	Ireland	2002	Best New Entrant Price 2002	5.3%
CER	Ireland	2003	BGT	5.0%
CER	Ireland	2003	Gas distribution	5.0%
CER	Ireland	2004	Best New Entrant Price 2005	5.3%
CER	Ireland	2005	Best New Entrant Price 2006	5.5%
CAR	Ireland	2005	DAA	6.0%
CER	Ireland	2005	Electricity transmission	5.3%
CER	Ireland	2005	Electricity distribution	5.3%
CER	Ireland	2007	Gas transmission and distribution	4.0%-5.0%
AEEG	Italy	2004	Electricity transmission	4.0%
AEEG	Italy	2004	Electricity distribution	4.0%
AEEG*	Italy	2005	Gas transport	4.0%
AEEG*	Italy	2005	Regasification	4.0%
Ofreg	N.Ireland	2006	Electricity distribution	4.8%
Ofreg	N.Ireland	2006	Electricity transmission	4.8%
DTe	Netherlands	2001	Gas distribution	5.5%
OPTA	Netherlands	2002	TPG (Post)	6.0%

Source: NERA analysis of European regulatory precedents. We note that the 2007 CER decisions for gas transmission and distribution presented ERPs in a range (4.0% - 5.0%), and the final cost of capital determined was at the upper end of a range, and it is unclear where in the range for ERP the regulator's final decision lies. We therefore do not include this range in the average ERP for European regulators. Similarly, we do not include the CC/CAA decision for BAA, because no point estimate for the ERP was stated or can be derived from the final cost of capital. We also do not include Ofgem (2007) decision on gas distribution as it did not break down the cost of equity into CAPM components.

Appendix E. Technical Issues in Estimating the ERP

An issue that was recently raised in the cost of capital debate for BAA airports is the relevance of historic data for the prospective ERP. In their recommendations to the CAA, the CC stated that (para 63) that "*ex post estimates of the ERP overstate the expected future ERP*".

The CC further states that:

> "*(M)any academics believe that past equity returns are far too high to represent rationally expected returns in the future*".

There is a worrying lack of recent evidence presented in the CC's report to justify the above assertions. The CC refers in particular to an outdated Mehra and Prescott paper (1985) which suggested that relative risk aversion would have to be extraordinarily high in order to justify observed past returns given that aggregate consumption growth does not exhibit that much volatility. This apparent disparity between observed parameters was termed the "*equity risk premium puzzle*".

Following the Mehra and Prescott papers a number of papers were written that put forward rational explanations for high observed ERPs. Such explanations included tax effects, liquidity effects, and explanations related to myopic loss aversion and habit formation.[180] More recently, further explanations of the so-called "equity risk premium puzzle" have put forward alternative theoretical frameworks for analysis of expected returns based on habit formation and borrowing constraints.[181] Subsequently in 2003 Mehra reviewed the literature since his original article and came to the following conclusion:

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[180] Benartzi and Thaler (1995) use prospect theory to argue that the puzzle can be explained by relaxing assumptions made about risk aversion characteristics. Benartzi and Thaler argue that investors are more sensitive to losses than gains. "Myopic Loss Aversion and the Equity Premium Puzzle", The Quarterly Journal of Economics. For investors' demand for liquidity see Holmstrom and Tirole (1998) and for a consideration of tax see McGrattan and Prescott (2001). On the topic of habit formation see Constantinides (1990) "Habit Formation: A Resolution of the Equity Risk Premium Puzzle", The Journal of Political Economy. Constantinides argues that when the standard assumption of time separability of consumption is dropped the ERP puzzle can be explained by allowing for complementarity of consumption in consecutive time periods. This "habit persistence" drives a wedge between the relative risk aversion of the representative agent and the intertemporal elasticity of substitution in consumption. This essentially appears to mean that consumers do not change their consumption in response to changes in conditions as much as their risk aversion would suggest, because they are constrained by habits.

[181] One idea to explain the puzzle is to weaken the assumptions of continuous optimisation and to replace them with assumptions of consumer satisficing (rather than maximising utility). This change creates a similar constraint on consumption with respect to true risk aversion as the arguments about habit formation. Ben-Haim (2006) develops an "info-gap robust satisficing" model, which implies that investors seek to maximise the robustness of an investment to uncertainty, for any given (minimum) level of reservation utility. He concludes that investors do not maximise utility as under the traditional model but "robust-satisfice". Ben-Haim (2006) "Info-Gap Decision Theory: Decisions Under Severe Uncertainty". Another explanation is advanced by Mehra, Donaldson and Constantinides (2002) who argue that in an overlapping generations model, the borrowing constraint means that young people are unable to borrow and invest in equity as they would wish. They argue that this combined with older people's preference for saving in a diversified portfolio including bonds explains lower interest rates and higher equity premia than would be observed if the borrowing constraint did not exist. Mehra, Donaldson and Constantinides "Junior Can't Borrow: A New Perspective on The Equity Premium Puzzle," Quarterly Journal of Economics, 2002.

> *"Before the equity premium is dismissed, not only do researchers need to understand the observed phenomena, but they also need a plausible explanation as to why the future is likely to be any different from the past. In the absence of this explanation, and on the basis of what is currently known, I make the following claim: over the long term, the equity premium is likely to be similar to what it has been in the past and returns to investment in equity will continue to substantially dominate returns to investment in T-bills for investors with a long planning horizon"*

This statement refutes any attempt to attribute to Mehra the view that past values of the ERP overstate future values.

Goyal and Welch (2006) also conclude that when forecasting the ERP one cannot do better than to project the historical average equity premium into the future. Their study could not identify a single predictive variable that would have been of robust use for forecasting the equity premium, and recommended "*assuming that the equity premium is 'like it always has been'"*.

An adjustment that is sometimes made to ex post data to derive an ex ante ERP is to assume that markets will be less volatile in the future than in the past. However, the "Smithers" paper commissioned by the UK joint regulators (Wright, Mason and Miles (2003)) [182] for example argues that there is no evidence of a decline in stock market volatility to justify a conclusion that the prospective ERP is lower than the historical ERP:

> *"There is indeed a reasonable amount of evidence that macroeconomic aggregates like GDP became more stable in the second half of the twentieth century. But, at least in mature markets, the evidence that stock markets, as opposed to the rest of the economy, have got much safer, is distinctly weaker. In economies that escaped major disruption, such as the UK or the US, there is little or no evidence of a decline in stock return volatility."* (p. 39)

Smithers' analysis of historic returns shows that the arithmetic average cost of equity lies in the range of 5.5% (geometric) and 6.5%-7.5% (arithmetic).

Overall, the CC's conclusion that ex post returns overstate future expected returns is not consistent with a large amount of academic literature. Many academics, including Mehra (2003), cited by the CC as one of the inaugurating authors of the debate on the "equity risk premium puzzle", argue that the prospective ERP is likely to be similar to the past.

Based on the majority of academic opinion, regulators must avoid making subjective adjustments to historical data and should follow Goyal and Welch's (2006) conclusions that for forecasting the ERP one cannot do better than to project the historical average equity premium into the future.

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[182] Wright, Mason, Miles (2003), "A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK", Smithers and Co Ltd.

Appendix F. Competition Commission on the ERP in the BAA Price Control (2007)

On the ERP, the CC concludes on a range of 2.5-4.5%. The CC states that the lower end of the range is consistent with *ex ante* estimates by Dimson et al (2002, 2007) and Gregory (2007), and that the upper end of this range is consistent with *ex post* estimates by Dimson et al (2007).

The CC's conclusions on the ERP range appear to be inconsistent with the evidence that it has presented. In fact, the ex post estimates of Dimson et al (2007) shown in Appendix F17 Table 3 show an ERP over bonds of 4.2-5.4% and the ex ante estimates of Gregory (2007) and Dimson et al (2002, 2007) summarised in paragraphs F66 and F67 show an ERP of 1.5-3.9%.[183,184] Hence the CC's own evidence shows a range for the ERP of 1.5-5.4%.

In deciding what weight to attach to ex post and ex ante estimates of the ERP, the CC makes the following statements:

- on the geometric versus arithmetic averaging debate, the CC states (para F58) that "*there is evidence that stock markets revert to a mean return*" and use this as a basis for concluding that the "*arithmetic average of historic returns probably overstates the expected future returns*";
- on the interpretation of historical evidence on the ERP, the CC states (para F63) that "*ex post estimates of the ERP overstate the expected future ERP*".

However, no academic papers are referred to in support of the CC's position on the arithmetic versus geometric debate. Moreover, the CC refers to two outdated and contentious academic papers by Mehra and Prescott (1985) and Shiller (1981) to support their assertion that ex post estimates of the ERP overstate future expected returns. Below, we set out a summary of recent academic papers on these issues that reach the opposite conclusions to the CC on the above issues. As we have already shown in Section 4, the balance of recent academic opinion does not support the CC's view on the above issues.[185]

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[183] In para F62, the CC state that the ex post estimate of the ERP should be based on the premia over bonds (gilts) as gilts are used as the basis for the risk-free rate. However, the ERP over bonds is shown in Table 3 to be 4.2% (geometric) to 5.4% (arithmetic) based on Dimson (2007). The CC's conclusion in paragraph F72 that its upper end of the ERP of 4.5% is consistent with Dimson (2007) is not correct. The upper end of the range indicated by the ex post evidence is clearly 5.4%.

[184] In para F67 the CC state that Dimson et al (2002) estimated the ex ante UK premium over Treasury Bills to be 2.4% (geometric average) and that in 2007 Dimson et al (2007) their forward world premium is 3.0-3.5%.

[185] Even the CC's own economic advisors do not support their conclusions on the use of geometric averages: "*We also would tend to agree that the cost of capital in the context of five year price cap regulation should be based on arithmetic mean returns, rather than geometric mean returns. Arithmetic mean returns give a measure relevant to the opportunity cost of capital. If there is serial correlation — by this we assume the Commission means mean reversion — then using geometric means can become better, because doing so captures the underlying process behind the historical returns, as opposed to the annual observations of return captured by arithmetic mean. However, in our view it is too much to suggest that there is powerful evidence of mean reversion in stock markets. Indeed, our understanding is that the considerable bulk of academic evidence suggests that markets are weakly efficient over any significant timescale, and thus that, say, annual returns certainly do not exhibit mean reversion*". Para 2.35 Advice to CAA on Aspects of Cost of Capital for the Final Q5 Price Control Decisions, Europe Economics (2008).

Since the CC relies strongly on evidence presented by Dimson et al on the ERP, we start with a summary of what Dimson et al actually say in their reports. The CC states that:

> "*(I)n 2007 Dimson et al updated their forward world premium from 3.0 per cent (2002) to 3.0 to 3.5 per cent (2007)*".

This appears to be a misrepresentation of the evidence presented by Dimson et al (2007). In fact, Dimson et al (2007) state:

> *"(F)rom 1900–2006, the annualised (geometric) equity risk premium relative to bills was 5.6% for the US, 4.5% for the UK, and 4.8% for the world index—somewhat lower than was previously believed".*
>
> *"Based on new research this year which decomposes historical returns into four components, namely the historical dividend yield, dividend growth, re-rating, and real currency movements, the authors estimate that a plausible, forward-looking risk premium for the world's major markets would be of the order of 3–3½% relative to bills on a geometric mean basis, while the corresponding arithmetic mean risk premium would be around 5%."*

The CC's statement that Dimson (2007) conclude the prospective ERP is 3.0-3.5% is selective since it only takes Dimson's results on the geometric mean basis and ignores the ex ante ERP based on arithmetic means.

The CC (para. F.69) states that it has considered evidence from the Dividend Growth model (DGM) in its assessment of the ERP. The CC attempts to derive an estimate of the ERP based on current dividend yields in the market and "a growth assumption" but its choice of growth assumptions (either historical dividend growth or real GDP/capita growth) is subjective and may be contradicted by analysts' forecasts. The CC also appears to have made a number of errors in its application of the DGM that leads to underestimation of the ERP.

In summary, our analysis shows that the CC's conclusions on the ERP range are flawed because they are inconsistent with the conclusions from the academic papers that they have cited and the overall range of 2.5-4.5% is a highly selective and biased representation of the true range of estimates for the ERP.

A number of similar comments about the CC's conclusions on the ERP have been made by leading finance academics. In particular, Myers (2008) argues that: "*(f)orecasted ERPs below 3.5% or 4% should attract extreme scepticism".* Instead Myers argues for a range of 4-6%. Schaefer (2007) of the LBS estimates an ERP range of 2.5-6.5% while arguing that the CC's central estimate of 3.5% and its range for the ERP are very low.

Finally we note that the latest consensus view from 400 finance professors that the equity premium is about 5% as of year-end 2007 is also inconsistent with the CC's estimates of the ERP:

"A sample of about 400 finance professors estimates the 1-year equity premium and the 30-year geometric equity premium to be about 5%, as of year-end 2007. The sample interquartile range is 4-6%. The typical range recommended in their classes is a little higher (from 4-7%, with a mean of 6%). Since 2001, participants have become more bearish (by about 0.5%).

The participants estimate the 30-year arithmetic equity premium estimate to be about 75 basis points higher than its geometric equivalent; and they estimate the 30-year geometric expected rate of return on the stock market to be about 9%."[186]

[186] http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1084918

Appendix G. De-Levering DGM Cost of Equity Estimates

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

(G.1) $$\beta_{equity} = \beta_{asset} \cdot (1 + (D / E))$$

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

(G.2) $$CoE = \beta_{equity} \cdot ERP + RFR$$

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

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

Our re-levering methodology based on the risk-free rate and ERP assumptions is:

(G.3) $$CoE_{notional} = [\beta_{asset} \cdot (1 + (D / E)_{notional}) \cdot ERP] + RFR$$

Where;

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

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

(G.4) $$CoE_{observed} = [\beta_{asset} \cdot (1 + (D / E)_{actual}) \cdot ERP] + RFR$$

Where:

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

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

Appendix H. Cost of Debt Supporting Information

This Appendix contains various detailed supporting information on the cost of debt.

Table H.1 sets out the different sources of debt used by UK water, at different levels of aggregation.

Table H.1
Sources of Funding by Levels of Aggregation

Disaggregated		Aggregated	
Finance leases	11%	Finance leases	11%
Bank overdrafts	3%		
Loans	5%	Bank loans	7%
EIB loans	4%	EIB loans	4%
GBP IL bonds	16%		
EUR IL bonds	1%	IL bonds	17%
GBP Nominal bonds	30%	GBP Nominal bonds	30%
EUR Nominal bonds	27%		
USD Nominal bonds	3%		
Other bonds	1%	Non- GBP Nominal bonds	30%
Total	100%	Total	100%

Source: NERA calculations based on water and sewerage company 2007 Annual Reports and Bloomberg data. The proportion of debt represented by all bonds is based on Annual Reports. The composition of bonds according to currency and indexation is based on amount issued converted into GBP using exchange rates at close on 30th March 2007, sourced from Bloomberg. All bonds for WoCs and WaSCs with available issue and maturity date data have been used in the calculations.

Table H.2 sets the proportion of new debt and old debt in the sector's capital structure by 2015.

Table H.2
Proportion of Current and Long-run Cost of Debt

		Unit	Value	Assumption/Source/Calculation:
a	AMP5	GBP, Bn	21.4	2.2% higher than AMP4 (in real terms)
b	Gearing ratio at PR09:	%	60%	NERA assumption
c	**New debt required for AMP5**	**GBP, Bn**	**12.8**	**= a * b**
d	RCV at March 2007:	GBP, Bn	45.0	RD0907; indexed to reflect Dec-2007
e	Assumed gearing:	%	55%	Ofwat PR04 gearing assumption
f	Debt on issue at March 2007:	GBP, Bn	24.7	= d * e
g	Refinancing	%	37%	=23%*0.75 + 77%*0.25 (*)
h	**New debt for refinancing**	**GBP, Bn**	**9.2**	**=g * f**
i	Total new debt	**GBP, Bn**	22.0	= c + h
j	Old debt	**GBP, Bn**	15.6	= f * (1 - g)
k	**Total debt (at 2015)**	**GBP, Bn**	**37.6**	= i + j
l	**Share of debt at "current cost of debt"**	**%**	**59%**	= i / k
m	**Share of debt at "long run cost of debt"**	**%**	**41%**	= j / k

Source: NERA analysis. (*) 23% of the sector's debt is short-term of which 75% will need to be refinanced prior to 2015; 77% of the sector's debt is long-term of which 25% will need to be refinanced prior to 2015.[187] *This means 37% of existing total debt will need to be refinanced.*

Table H.3 presents averages of the trailing historic yield to maturity of Sterling denominated UK water bonds issued since PR04. We selected only those bonds with fixed coupons and bullet maturities which were not subordinated or structured.

Table H.3
Sterling UK Water Bonds

Company	Issue Date	Maturity	Rating	Coupon (%)	Average Yield to Maturity since Issue (%)
Anglian*	24/02/2005	30/10/2015	A-	5.25	5.47
United Utilities	28/02/2005	28/02/2035	A-	5.00	5.27
Yorkshire	29/05/2007	28/05/2027	A-	5.50	5.80
Wessex*	10/03/2005	10/03/2028	BBB+	5.38	5.42
Thames	30/06/2005	30/06/2010	BBB+	4.75	5.73
Thames	30/06/2005	30/06/2020	BBB+	5.05	5.68
Thames	11/09/2006	20/04/2021	BBB+	6.59	5.96
Thames	28/09/2006	30/06/2015	BBB+	4.90	5.74
Thames	28/09/2006	28/09/2037	BBB+	5.13	5.49
Veolia	29/10/2007	29/10/2037	BBB+	6.13	6.21

*Source: NERA analysis of Bloomberg data; * indicates bond is callable.*

[187] In particular, we note 70% of EIB loans outstanding at March 2007 will mature before 2015 and we assume that a higher percentage of finance leases and bank loans will also mature.

Table H.4 presents data on UK IL bonds.

Table H.4
IL Bond Yields UK Water and Utilities

	Issue Date	Maturity	Coupon (%)	Yield to Maturity (Avg since issue)	Yield to Maturity (Current)
National Grid A-	27/07/2001	27/07/2030	3.59	2.75	2.39
National Grid A-	27/07/2001	27/07/2020	3.81	2.88	2.58
Thames Water BBB+	21/02/2002	21/07/2021	3.38	2.76	2.57
United Utilities A-	04/12/2002	04/12/2032	3.38	2.26	2.39
Yorkshire Water A-	21/02/2003	29/07/2033	3.05	2.35	2.11
National Grid A-	31/08/2005	28/08/2035	2.08	1.96	1.78
National Grid A-	17/10/2005	17/10/2035	1.99	1.96	1.78
National Grid A-	23/11/2005	23/11/2035	1.82	1.71	1.78
Electricity North West BBB+	06/04/2006	06/04/2046	1.47	2.22	2.28
National Grid A-	07/04/2006	07/04/2036	1.67	1.71	1.78
National Grid A-	11/05/2006	11/05/2056	1.82	1.88	2.14
National Grid A-	26/05/2006	26/05/2056	1.82	2.04	2.15
Anglian Water A-	03/07/2006	03/07/2056	1.72	1.77	2.08
Yorkshire Water A-	01/06/2007	01/02/2054	1.76	1.60	1.54
Average All			**2.38**	**2.13**	**2.10**
Average UK Water			**2.65**	**2.15**	**2.14**

Source: Bloomberg

Table H.5 shows historic data on floating rate bank loans.

Table H.5
Floating Rate Bank Loans

Issuer	Issue Date	Maturity Date	Interest rate (bps)
SEVERN TRENT PLC	04/06/2000	04/12/2002	Libor + 50
SEVERN TRENT PLC	04/06/2000	04/06/2005	Libor + 75
GLAS CYMRU	06/05/2001	06/05/2006	Libor + 57.5
NORTHUMBRIAN	30/07/2003	28/07/2004	Libor + 75
NORTHUMBRIAN	30/07/2003	30/07/2005	Libor + 125
NORTHUMBRIAN	30/07/2003	30/07/2005	Libor + 75
NORTHUMBRIAN	30/07/2003	30/07/2005	Libor + 75
NORTHUMBRIAN	30/07/2003	30/07/2005	Libor + 125
SEVERN TRENT PLC	08/04/2004	07/04/2005	Libor + 30
SEVERN TRENT PLC	08/04/2004	08/04/2009	Libor + 35
ANGLIAN	03/12/2004	03/12/2007	Libor + 50
WELSH WATER	09/05/2005	09/05/2010	Libor + 30
Average			**Libor + 67**

Source: Bloomberg

Table H.6 presents average interest rates for a range of types of debt for financial years.

Table H.6
Interest Rates on Amounts Outstanding for Existing Sources of Debt

		Other Debt	
	Bank loans	**Finance leases**	**EIB loans**
FY ending	%	%	%
2007	6.31	5.08	4.86
2006	5.71	4.47	4.29
2005	5.30	4.31	4.57
2004	5.69	5.25	4.32
2003	4.51	5.58	4.22
2002	4.59	5.62	7.03
2001	5.18	5.26	7.23
2000	--	5.57	8.41
1999	--	6.08	8.40
1998	--	8.70	8.49
Average	**5.33**	**5.59**	**6.18**
Avg (real)	**2.45**	**2.74**	**3.32**

Source: NERA calculations. Bank loans data is sourced from Bloomberg. All other data is from WoC and WaSC Annual Reports. Interest costs for finance leases and EIB loans reflect the cost of funding at the financial year end.Interest rates on bank loans are Libor plus margin. Libor for each loan is calculated as the average within each financial year of the 3 month Libor prevailing at 3 monthly intervals from the date of loan issue (provided the loan has not already matured).

Table H.7 presents transaction costs of conventional bond issues.

Table H.7
Transaction Costs Conventional Bond Issue

Cost	Conventional WaSC (max)
Assumed issue size	£100m
Upfront costs	
Total upfront costs (assume all fixed)[1]	£0.33m - £0.94m
Upfront costs as % issue size	0.33% - 0.94%
Upfront costs as % issue size, annualised over 30 years	0.01% - 0.03%
Annual/ongoing costs	
Source	Company information on generic WaSC bond
Total annual/ongoing costs	£0.04m
Annual costs as % issue size	0.04%
Total transactions costs	
Total annual transactions costs as % issue size	0.05% - 0.07%

Source: Company confidential information supplied to NERA. (1) Based on actual total upfront costs associated with different sizes of loan.

Appendix I. Analysts' Opex and Capex Outperformance Assumptions

Table I.1
Analysts' Opex Outperformance Assumptions

	Analyst	Date	AMP3	AMP4	AMP5
Severn Trent	UBS	08/10/2002		0%	
	Merrill Lynch	09/02/2007		0%	
	Citigroup	06/06/2007		3%	
	Morgan Stanley	11/01/2008		3%	
United Utilities	Credit Suisse	14/06/2007		1%	
Kelda	Commerzbank	08/04/2003	6.4%		
	Lehman Brothers	10/06/2003	8%		
	Citigroup	27/05/2004	9.2%		
	Citigroup	26/05/2005		5%	
	Citigroup	07/06/2007		5%	5%
Pennon	Lehman Brothers	11/10/2001	10%		
	Commerzbank	28/11/2003	0%		
	Deutsche Bank	06/08/2004		0%	
	Smith Barney Citigroup	26/05/2005		0%	
	Citigroup	29/01/2007			0%
Northumbrian	DKW	23/05/2003	0%		
	UBS	22/10/2003		0%	
Anglian	DKW	14/10/2002	0%		
	UBS	17/12/2002		0%	
	Smith Barney Citigroup	03/06/2005		2.5%	
Average			**4.8%**	**1.6%**	**2.5%**
Range			**0% - 10%**	**0% - 5%**	**0% - 5%**

Source: NERA analysis of analyst reports.

Table I.2
Analysts' Capex Outperformance Assumptions

	Analyst	Date	AMP3	AMP4	AMP5
Severn Trent	UBS	08/10/2002		0%	
	Smith Barney Citigroup	07/06/2005		2.5%	
	Merrill Lynch	09/02/2007		0%	
	Citigroup	06/06/2007		6%	
	HSBC	05/12/2007		6%	
	Morgan Stanley	11/01/2008		6%	
United Utilities	Schroder Salomon Smith Barney	04/11/2002	14%		
	Commerzbank	08/04/2003	15%		
	Commerzbank	19/08/2003	10-12%		
	Smith Barney Citigroup	06/06/2005		5%	
	Credit Suisse	14/06/2007		5%	
Kelda	Lehman Brothers	05/06/2002	7-10%		
	Commerzbank	08/04/2003	10-15%		
	Morgan Stanley	27/05/2004	10-12%		
	Citigroup	27/05/2004	10-12%		
	Citigroup	26/05/2005		5%	
	Citigroup	07/06/2007		10%	5%
Pennon	Lehman Brothers	11/10/2001	10%		
	Commerzbank	28/11/2003	10%		
	Deutsche Bank	06/08/2004		0%	
	Smith Barney Citigroup	26/05/2005		2.5%	
	Citigroup	29/01/2007		5%	5%
	Goldman Sachs	16/02/2007		5%	
	Morgan Stanley	11/01/2008		5%	
Northumbrian	DKW	23/05/2003	0%		
	UBS	22/10/2003		0%	
	Goldman Sachs	16/02/2007		5%	
Anglian	DKW	14/10/2002	6.7%		
	UBS	17/12/2002		0%	
	UBS	24/07/2003	15%		
	Cazenove	26/11/2003	15%		
	Morgan Stanley	01/12/2003	10%		
	Smith Barney Citigroup	03/06/2005		5%	
Average			**10.7%**	**3.8%**	**5%**
Range			**0% - 15%**	**0% - 10%**	**5%**

Source: NERA analysis of analyst reports.

Table I.3
Company Statements of Outperformance

Capex outperformance		**Source**
Severn Trent	6% over remaining two years of AMP4	Morgan Stanley "UK Water Utilities", 11/01/08
Kelda	7.5% by end of AMP4 (expected)	AR 2007, p2
Anglian	>10% by end of AMP3	AR 2005, p3
United Utilities	10% by end of AMP3 (for quality capex)	AR 2004, p1
Kelda	12% by end of AMP3	AR 2004, p1
Opex outperformance		
Severn Trent	3% for remaining two years of AMP4	Morgan Stanley "UK Water Utilities", January 11 2008
Anglian	>2% in 2006/7, albeit "significant upward operating cost pressures"	AR 2007, p11
Kelda	£2m (~0.8%) in 2006/7, albeit energy prices are significantly higher than assumed in FD	AR 2007, p2
Kelda	£115m target over AMP3 (~11% p.a.)	AR 2004, p1
Kelda	£100m target over AMP3 (~10% p.a.)	AR 2003, p1

Appendix J. Analysts' Non-Regulated Asset Valuations

Table J.1
Analysts' Non-Regulated Asset Valuations

Company	Analyst	Date	Value (£m)
Anglian	Deutsche Bank	08/12/2003	247
	JP Morgan	11/05/2004	453
	JP Morgan	02/06/2004	345
	Deutsche Bank	04/06/2004	188
	Morgan Stanley	02/02/2005	247
	Smith Barney Citigroup	03/06/2005	250
	Deutsche Bank	09/12/2005	245
	Deutsche Bank	31/05/2006	215
	Deutsche Bank	14/07/2006	215
	Lehman Brothers	08/09/2006	381
Severn Trent	Lehman Brothers	08/12/2003	1154
	JP Morgan	11/05/2004	1335
	Morgan Stanley	02/02/2005	1288
	Smith Barney Citigroup	07/06/2005	1194
	Merrill Lynch	09/02/2007	175
	Goldman Sachs	16/02/2007	182
	Merrill Lynch	07/03/2007	175
	Deutsche Bank	30/11/2007	234
	HSBC	05/12/2007	282
	Morgan Stanley	11/01/2008	179
	UBS	11/02/2008	197
SouthWest Water	Commerzbank Securities	28/11/2003	275
	JP Morgan	11/05/2004	263
	Morgan Stanley	04/06/2004	312
	JPMorgan	01/07/2004	302
	DB	06/08/2004	166
	Morgan Stanley	02/02/2005	341
	Smith Barney Citigroup	26/05/2005	403
	Citigroup	29/01/2007	857
	Goldman Sachs	16/02/2007	609
	Merrill Lynch	18/04/2007	611
	JP Morgan	31/05/2007	960
	Credit Suisse	25/06/2007	1127
	Merrill Lynch	07/01/2008	815
	Morgan Stanley	11/01/2008	980
	UBS	11/02/2008	1015
United Utilities	ING	17/11/2003	2198
	Lehman Brothers	04/12/2003	1795
	Citigroup Smith Barney	31/03/2004	1839
	DB	01/04/2004	1648
	JPMorgan	11/05/2004	3034
	UBS	22/07/2004	1897
	ABN Amro	06/08/2004	2345
	Morgan Stanley	02/02/2005	2759
	Smith Barney Citigroup	06/06/2005	2621
	Deutsche Bank	30/11/2007	2891
	Morgan Stanley	11/01/2008	647
	UBS	11/02/2008	750
Kelda	ING	05/12/2003	436
	JP Morgan	11/05/2004	605
	Morgan Stanley	27/05/2004	376
	Morgan Stanley	02/02/2005	456
	Smith Barney Citigroup	26/05/2005	514
	Merrill Lynch	07/03/2007	610
	Merrill Lynch	24/04/2007	610
	Merrill Lynch	18/06/2007	155
Northumbrian	Deutsche Bank	06/11/2003	181
	Goldman Sachs	16/02/2007	360
	Deutsche Bank	20/06/2007	478
	Morgan Stanley	11/01/2008	486
	UBS	11/02/2008	491
	Merrill Lynch	15/02/2008	312

Appendix K. Regulated Utilities' Transaction Premiums

Table K.1
Utilities Transactions: RAV Premiums

Company / Transaction	Buyer	Date	UK WaSCs	UK WoCs	UK Other	Inter-national	Source
Norweb	Consortium of Commonwealth Bank and JP Morgan	Dec-07			35%		GS
Kelda	Consortium featuring HSBC, Prudential and Citigroup	Nov-07	31%				GS
Southern	Consortia of JP Morgan and Australian Infrastructure fund Challenger	Oct-07	28%				GS
South Staffordshire	Alinda Infrastructure Fund	Oct-07		38%			GS
DirectLink	Australian Pipeline Trust	Dec-06				44%	Factiva
South East	Hastings Fund Management	Nov-06		26%			GS
AWG	Consortia of Canadian Pension Plan Investment Board, Colonial First State Global Asset Management etc	Oct-06	27%				Factiva
Allgas	Australian Pipeline Trust	Oct-06				70%	Factiva
Viridian	Arcapita	Jul-06			23%		Factiva
Thames	Macquarie	Jun-06	27%				GS
BAA	Grupo Ferrovial SA	May-06			20%		Factiva
Bristol Water	Aguas de Barcelona	Apr-06		18%			GS
AGL's infrastructure assets	Alinta	Apr-06				45%	Factiva
Sutton and East Surrey	Deutsche Bank (by Terra Firma)	Dec-05		30%			Factiva
Mid Kent	Hastings Fund Management	Feb-05		20%			Factiva
MOL Rt's gas division	E.ON Ruhrgas AG	Dec-04				75%	Factiva
South Staffs	First Islamic Bank	Oct-04		14%			GS
Scotland & South	SSE	Oct-04			12%		GS
Distrigaz Sud (Romania)	Gaz de France	Oct-04				49%	Factiva
National Grid Transco (North of England GDN)	United Utilities & Cheung Kong Infrastructure	Aug-04			12%		Factiva
National Grid (Wales & the West GDN)	Macqurie European Infrastructure Fund	Aug-04			10%		Factiva
Dampier to Bunbury Natural Gas Pipeline	Alinta	Aug-04				19%	Factiva
Cambridge	CKI	Apr-04		16%			Factiva
South East	Macquarie	Oct-03		-4%			Factiva
Northumbrian	Aquavit	May-03	0%				Factiva
Southern	Vivendi Environnement	Feb-03	-5%				CEPA
WPD (SWA & SWB)	PPL	Aug-02			18%		GS
Citipower	CKI and Origin Energy	Jul-02				65%	Factiva
Midlands Electricity		Jun-02			15%		Factiva
See Board	EdF	May-02			19%		
Southern	RBOS/Veolia	May-02	-2%				Factiva
Wessex	YTL	May-02	-4%				GS
Southern	First Aqua	Mar-02	-1%				Factiva
Brockhampton Holdings	MBO	Oct-01		10%			Factiva
Eastern	EdF	Oct-01			20%		GS
Midlands	Utillcorp	Sep-01			25%		GS
Kelda	Mid American	Jul-01			14%		GS
Mid Kent	Swan Capital	Mar-01		-9%			Factiva
Dwr Cymru	Glas Cymru	Nov-00	-7%				Factiva
Thames	RWE	Sep-00	18%				GS
Welsh	PPL Corp	May-00	-2%				CEPA
Cambridge	Union Fenosa	Dec-99		29%			GS
Wessex	Enron	Jul-98	27%				GS
Southern	Scottish Power	May-96	24%				CEPA
Northumbrian	Lyonaise des Eaux	Nov-95	-16%				CEPA

Source: NERA analysis of media reports and press releases, Goldman Sachs "United Kingdom: Utilities: Water", February 11, 2008, and CEPA (2003) "Market evidence on the cost of equity", extract from "Extended briefing final version", October.

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