The Weighted Average Cost of Capital for Ofgem's Future Price Control

Phase III Report by Europe Economics

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1 INTRODUCTION

1.1 This report follows the publication of Europe Economics' Phase I report on the high level estimates of the cost of capital inputs and methodologies for transmission system operators and gas distribution networks, in the context of the RIIO model.[1]

1.2 Stakeholders have now had a chance to comment on our report as part of broader Ofgem consultations on the strategy for the next gas distribution price control (RIIO – GD1) and the next transmission price control (RIIO-T1).[2]

1.3 This report represents Phase III of our study. This has two key components:

(a) Moving on from the broad ranges, focused upon market data, identified in our Phase 1 Report to narrower ranges in which we identify what we believe to be the range within which reasonable regulatory discretion might lie.[3] We consider this in Section 2.

(b) Responding to specific issues raised by stakeholders, and considering certain other issues raised through the consultation at a very high level. We consider this in Section 3.

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1 http://www.ofgem.gov.uk/NETWORKS/GASDISTR/RIIO-GD1/CONRES/Documents1/Europe%20Economics%20Final%20Report%20-%20011210.pdf

2 http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=251&refer=NETWORKS/GASDISTR/RIIO-GD1/CONRES
http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=28&refer=Networks/Trans/PriceControls/RIIO-T1/ConRes

3 The data cut-off date for this phase is 31 January 2011, unless otherwise stated.

2 RECOMMENDED RANGES OF REGULATORY DISCRETION

2.1 In this section we reconsider our Phase 1 Report ranges in the light of the evolution of market data since that time, and also seek to narrow our ranges, moving on from specifying a broad interpretation to a specific recommendations concerning what we regard as the reasonable range of regulatory discretion. We emphasise that we do not offer point estimates for any parameters.

Risk-Free Rate

2.2 In our Phase I report, we set out our initial broad range for the risk-free rate as 1-2 per cent. As there is no reliable precise mechanical method by which to calculate the risk-free rate, some element of judgement was required in arriving at this estimate. Thus, in arriving at this preferred range, we considered evidence on the following:

(a) Spot and longer term trends in index-linked UK government bonds (as a market proxy for the risk-free rate) focusing mainly on bonds with a maturity of 10 years.

(b) Spot and longer term trends in nominal UK government bonds focusing mainly on bonds with a maturity of 10 years – deflated by expected RPI over the same period.

(c) International trends in the risk-free rate (focusing on developments in French and German government bonds).

(d) Previous regulatory decisions on the risk-free rate.

2.3 Overall, data on index-linked yields over the 10 year period to 31st September 2010 indicated a steady downward trend in yields on bonds of 5, 10 and 20 years, a trend that did not appear to have been materially affected by the period of turbulence that characterised financial markets towards the latter part of 2008 (during which yields on 10 year index-linked gilts rose from one per cent in September 2008 to 2.75 per cent in November 2008).

2.4 We noted, in our earlier report, that during September 2010, yields on all three gilts fell to historic lows (coupled with the divergence in yields on shorter and longer term gilts increasing markedly from historic trends) with spot data suggesting that yields on 10 year gilts – our main area of focus – (which were as low as 0.4 per cent as of 30 September 2010) were still approximately 50 bps below their long term trend. Further, and more interestingly, yields on 5 year index-linked gilts had turned negative (implying that investors were, in effect, *paying* to hold UK government bonds). We noted at the time that the depression in yields may, in part, have been increased both by speculation that the Bank of England was going to expand its programme of quantitative easing and by larger than previously anticipated cuts in government spending.

2.5 However, we also noted at the time that we did not believe that negative values for five year bonds could properly be taken as indicative that risk-free rates had become negative. Indeed, we noted that ten year government bonds were likely to be downwards

biased by up to 100 basis points by quantitative easing (as estimated by the Bank of England)[4] [5], and that there was also likely to be an element of inflation risk hedging in five-year index-linked gilt yields. Thus, focusing upon the 10-year benchmark, a 100 basis points adjustment suggested a spot rate of around 1.4 per cent. This figure was also closely in line with longer term 5 year averages for 10 year index-linked yields (which at the time was 1.38 per cent).

2.6 As yields on index-linked gilts should be equal to the yields on nominal gilts less inflation expectations and an inflation risk premium, we therefore used data on nominal yields to cross-check the risk-free rate as implied by the yields on index-linked gilts by stripping away inflation expectations.[6] Overall, our estimations of the risk-free rate based on nominal gilts stripped of inflation expectations differed notably from the estimates implied by index-linked gilts yields. We noted at the time that this variance may, in part be attributed to inflation risk premiums (which are difficult to observe in market data) that were not accounted for by independent inflation forecasts or that market expectations (as indicated by index-lined gilt yields) were at odds with independent forecasts of inflation.

2.7 In addition to analysing developments in market proxies for the risk-free rate in the UK, we also considered data on French and German government bonds which showed that reductions in yields on index-linked government bonds had not been confined to the UK, with similar patterns in the risk-free rate observed internationally. Indeed, yields on index-linked bonds had also fallen to historic lows in France and Germany in the 12 months to 30th September 2010 with spot rates on 10 year German bonds falling from just under 1.8 per cent in June 2009 to approximately 0.64 per cent on 30 September 2010 and yields on 10 year index-linked French bonds falling from just over 1.30 per cent in January 2010 to just under 0.65 by the end of September 2010.

2.8 In arriving at our preferred range, we also considered previous regulatory decisions on the risk-free rate over the 10 years up to September 2010. Over this period, we noted that in most cases, regulators had set the risk-free rate at a level above real yields on 10 year gilts (in some cases by over 100bps). When considering the period as a whole, however, we noted that, on average, the range set by regulators in the UK had come down from approximately 2.5-3 per cent in the first half of the decade to 2 per cent or less by the end of the decade. In considering regulatory precedents, we took particular note of the most recent regulatory precedent at the time, the Competition Commission's choice of a 1-2 per cent range in the Bristol Water judgement which, we observed, encompassed the 1.4 per cent estimate for (quantitative-easing-adjusted) 10 year index-linked bonds.

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[4] "New Instruments of Monetary Policy: The Challenges", Speech by Spencer Dale, Executive Director and Chief Economist at the Bank of England, *Remarks at the CIMF and MMF Conference, Cambridge* (12 March 2010), available at: http://www.bankofengland.co.uk/publications/news/2010/027.htm

[5] "The financial market impacts of quantitative easing ", Joyce. M et al. (July 2010, revised August 2010), Bank of England, *Working Paper. 393,* available at: http://www.bankofengland.co.uk/publications/workingpapers/wp393.pdf

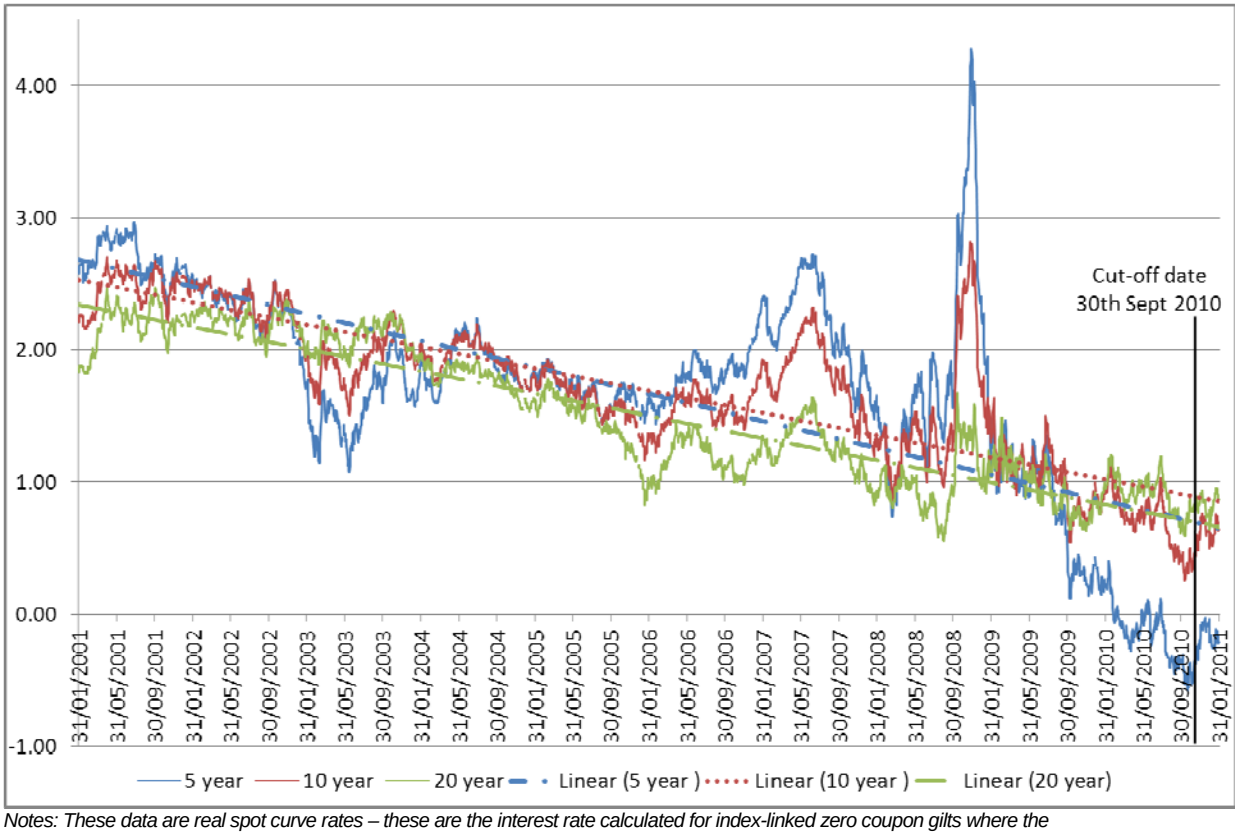
[6] As we have noted, an inflation risk premium as well as inflation expectations should be deducted from nominal yields. We do not, however, carry out this step given the difficulties in calculating the inflation risk premium and the fact that we are using nominal yields only as a cross-check for the risk-free rate.

Developments since our Phase I report

2.9 In light of recent developments in market data and in regulatory precedents since our Phase I report (i.e. since 30th September 2010) we set out a narrower range than presented in our Phase I report.

2.10 Overall, market proxies for the risk-free rate have been on a sustained underlying downward trend for the past ten years and developments in market data between 30 September 2010 and 31st January 2011 do not alter this overall trend. Since reaching historic lows in October 2010, yields on bonds (both nominal and in index-linked) of all three maturities have increased (see below).

Figure 2.1: UK ILG Yields for the 10 years to 31st January 2011



Notes: These data are real spot curve rates – these are the interest rate calculated for index-linked zero coupon gilts where the principal is indexed to the RPI index. Source: Bank of England

2.11 Spot rates as of 31 January 2011 were 0.64 per cent on 10 year index-linked bonds (up 21bps from 30th September 2010), -0.21 per cent on 5 year bonds (up 14bps since September 2010) and 0.87 per cent on 20 year bonds (up 23bps from September 2010). Apart from 5 year averages in yields on 5 year index-linked bonds, which increased slightly (by 13bps) since our Phase I report, 5 year averages on 10 and 20 year bonds have remained more or less constant since our Phase I report, calculated as 1.32 per cent and 1.06 per cent respectively. Further, index-linked yields on 10 year gilts (i.e. 1.64

- after adjusting for quantitative easing) and the inflation-adjusted 10 year nominal bond yield – see Table 2.1–(i.e. 1.96 – after adjusting for quantitative easing) both lie within the top end of our September range for the risk free rate.

Table 2.1: Comparison using nominal ILG and inflation forecast – 10 years

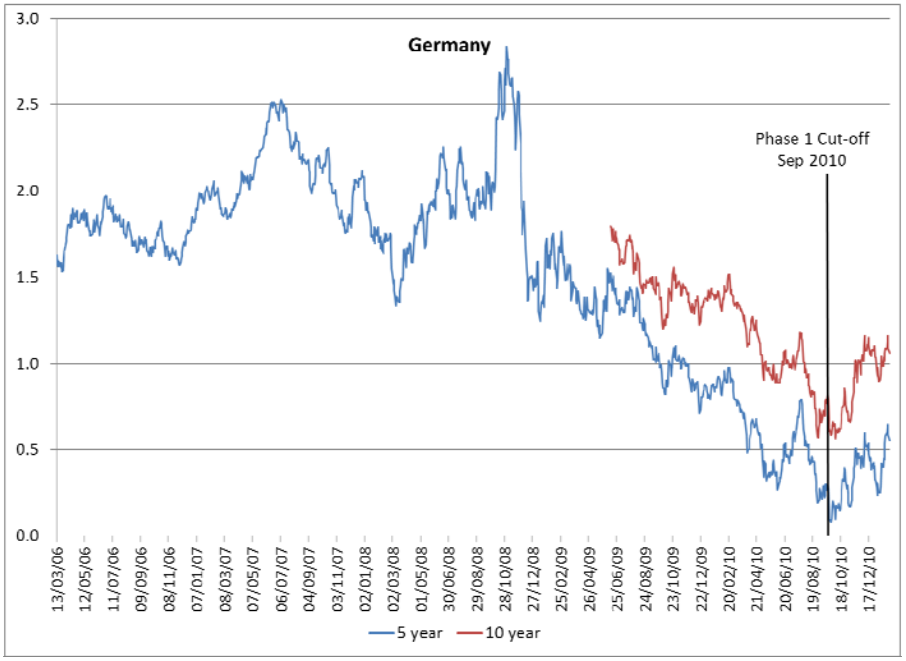
	Yield (%)
10 year average RPI (using the average of "independent forecasts" over the next 5 years)	2.9
Spot rate (31st January 2011) nominal 10 year guilt	3.88
Calculated risk-free rate (nominal spot - inflation expectations)	0.96
Spot rate (31st January 2011) index linked 10 year guilt	0.64

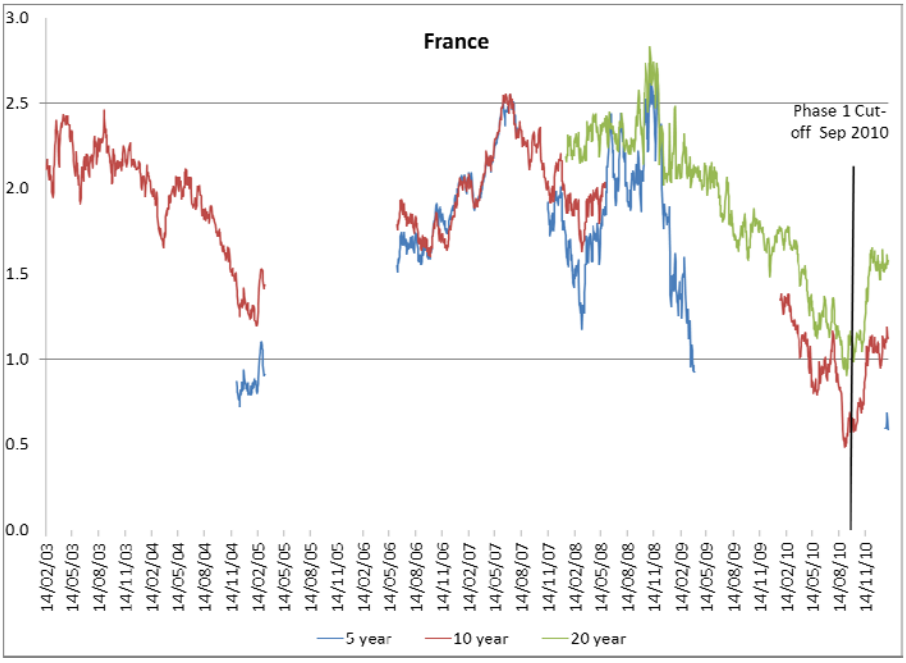
Source: EE calculations with Bank of England and Treasury collected data on independent forecasts

2.12 With regard to international developments in the risk-free rate, recent data shows that since September 2010 yields (both nominal and index-linked) on French and German government bonds with maturities of 5, 10 and 20 years have, like the UK, risen (See (a) and (c) in Figure 2.2 for developments in German and French inflation linked bond yields and (b) and (d) for developments in German and French real bonds). Index-linked gilts on 10 year German and French government bonds, for example, have increased by 42bps and by 48bps respectively.[7] Further, like the UK, current index-linked yields (as well as nominal yields deflated by expected inflation) on 5 and 10 year bonds in Germany and France also remain below 2 per cent.

[7] Data for 10 year IGLS in France between May 2008 and January 2010 and data on yields on 5 year IGLs beyond March 2010 is not available.

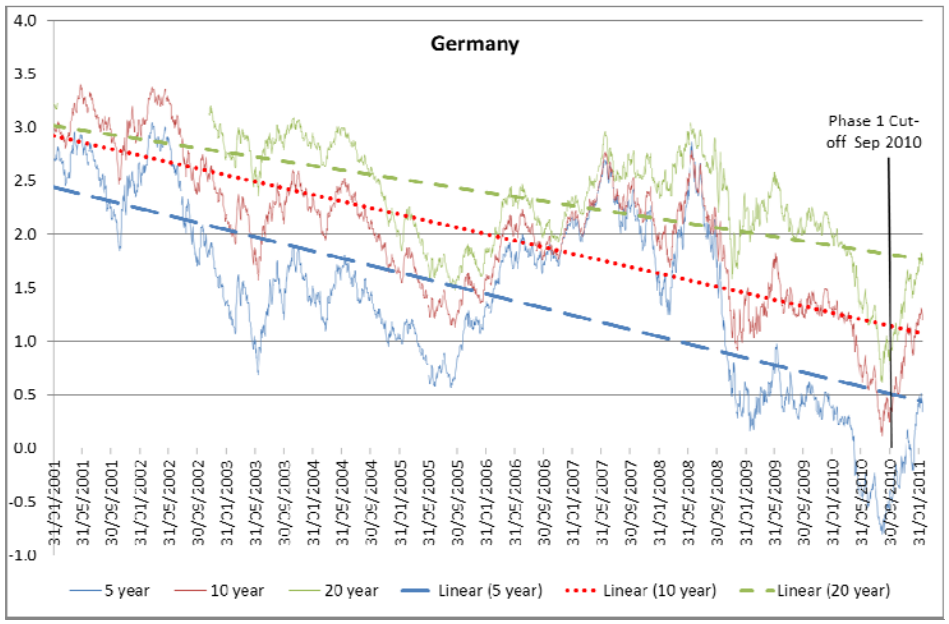
Figure 2.2: Inflation-linked bond yields on German and French government bonds (to 31 January 2011)

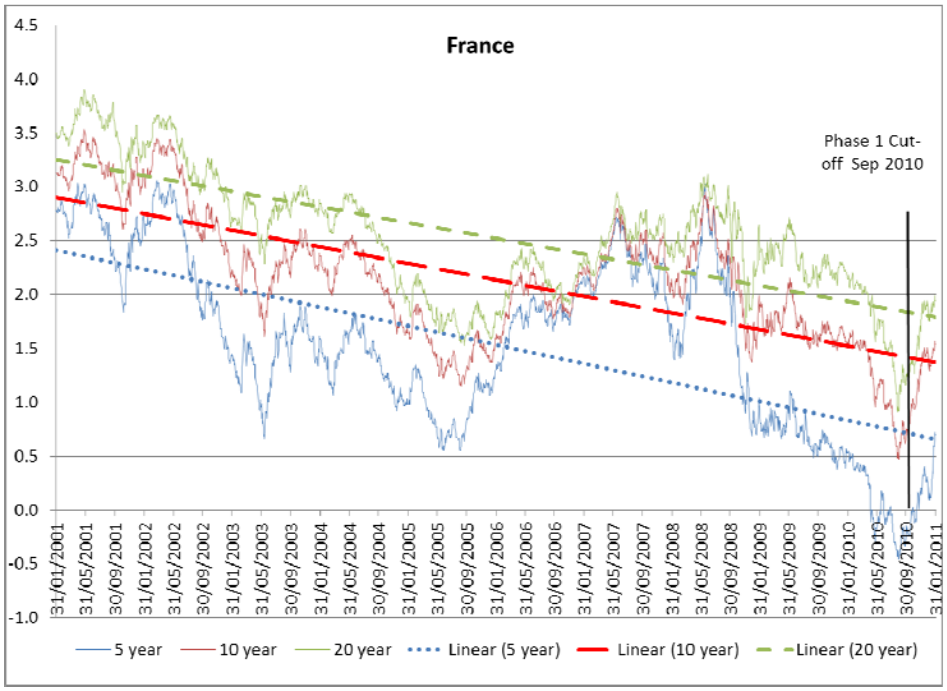




Source: Bloomberg

Figure 2.3: Real yields on German and French Nominal Government Bonds (to 31 January 2011)





Source: Bloomberg

2.13 With regard to regulatory judgements, the only significant additional case is the consultation launched by Ofcom from January 2011 regarding the cost of capital for Openreach. Ofcom is consulting on a risk-free rate of 1.5.

2.14 We note that we continue to believe that the single most relevant regulatory precedent remains the CC Bristol Water judgement.[8] The CC recommends a risk-free rate range of 1.0-2.0. Then, because the CC chooses a total cost of capital for Bristol Water of 5.0 per cent (Annex N Paragraph 156), at the very top of its 3.8-5.0 per cent range, it produces a table (Table 12, Annex N page N46) in which it quotes a "projected" risk-free rate of 2.0. That "projected" risk-free rate is, however, simply a mathematical implication of the CC's choosing a total WACC at the very top of its recommended range, not a separate recommendation as to the correct risk-free rate. The CC Bristol Water recommendation for the risk-free rate is 1-2 per cent.

Recommended range of regulatory discretion

2.15 We believe that the range within which regulatory judgements might be defensible is **1.3-1.8 per cent**. The 1.3 lower bound reflects the 5 year averages for 10-year ILGs. Use of this figure would imply that the regulator placed high weight upon market data relative to recent regulatory precedent. The 1.8 at the upper bound encompasses the most recent determination (1.75 per cent for NATS 2010). Use of this figure would imply that the regulator placed low weight upon market data relative to recent regulatory precedent.

Equity Beta Estimation

Introduction

2.16 In November 2010 we carried out an estimation of the equity beta for the energy (gas distribution and transmission) sector industry equity based on market data covering the period 01/January/2000— 13/October/2010. Based on that analysis, we concluded that raw equity beta for the energy lay within the rage 0.55—0.83, and we observed that such a range was consistent with past regulatory precedent on the asset beta for the energy sector, assuming reasonable gearing assumptions.

Market data analysis update

2.17 The new point estimates of the energy sector beta, based on the last 12 months and the last 24 months of data, are reported below (standard errors are in parentheses).

[8] See http://www.competition-commission.org.uk/rep_pub/reports/2010/fulltext/558_appendices.pdf

Table 2.2: Equity beta's point estimate of the energy sector (12 months window, 31/01/2010-31/01/2011)

Estimation method	Beta estimate	p-value	95% confidence interval
OLS	0.52 *(0.051)*	0.000	[0.42—0.62]
Newey-West autocorrelation correction	0.52 *(0.054)*	0.000	[0.41—0.63]
White heteroskedasticity correction	0.52 *(0.056)*	0.000	[0.41—0.63]

Table 2.3: Equity beta's point estimate of the energy sector (24 months window, 31/01/2009-31/01/2011)

Estimation method	Beta estimate	p-value	95% confidence interval
OLS	0.45 *(0.037)*	0.000	[0.38—0.52]
Newey-West autocorrelation correction	0.45 *(0.044)*	0.000	[0.36—0.54]
White heteroskedasticity correction	0.45 *(0.048)*	0.000	[0.36—0.54]

2.18 The figures below that report energy sector's rolling betas based on, both, 12 months and 24 months rolling windows.

Figure 2.4: Rolling beta of the energy sector (12 months rolling window)

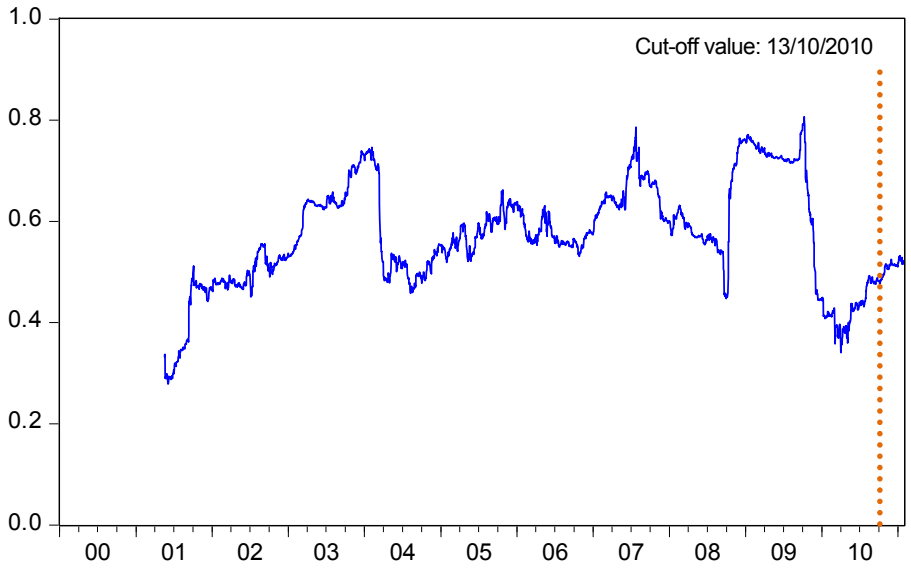
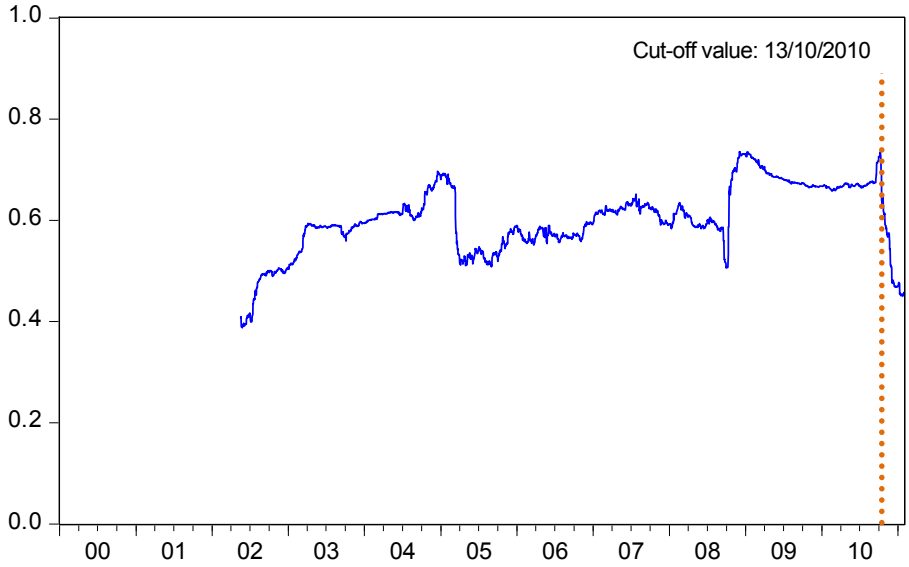


Figure 2.5: Rolling beta of the energy sector (24 months rolling window)



2.19 Compared to the analysis carried out in November, it should be noted that:

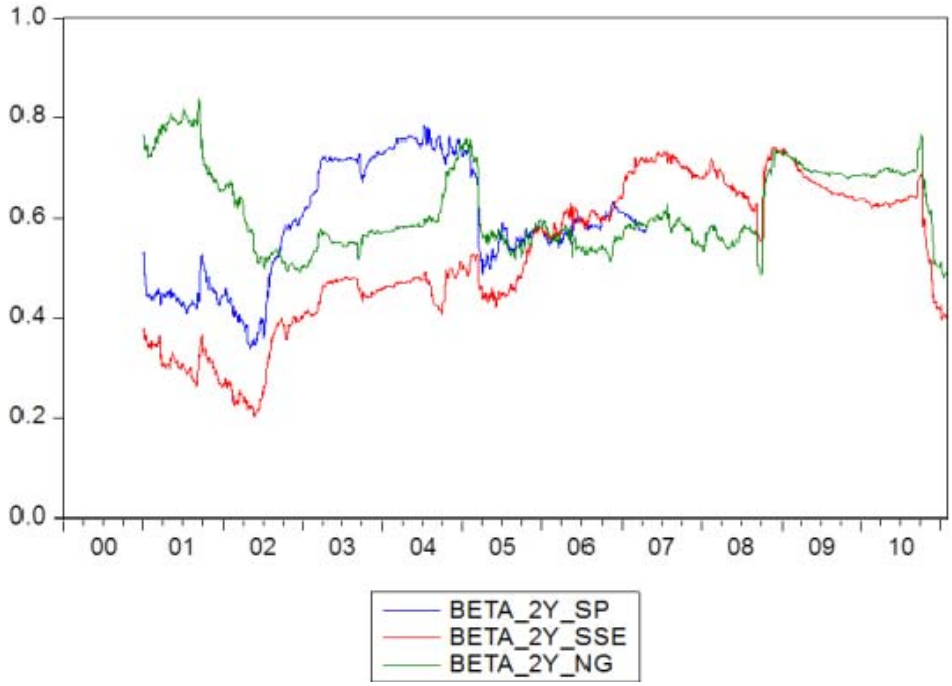
(a) The equity beta's point estimate based on 12 months windows has slightly increased (i.e. from 0.49 to 0.52)

(b) The equity beta's point estimate based on 24 months windows has decreased significantly (i.e. from 0.69 to 0.45). This decrease coincides with the marked drop observed between the end 2010 and the beginning 2011 in Figure 2.5.

2.20 Therefore, whilst the 12 month rolling betas series is qualitatively similar to that produced in November 2010 (the beta has continued increasing also in the last two months of 2010 and the first month of 2011), the 24 months rolling beta series displays now two sharp breaks. The first (which could already be observed in our November 2010 analysis) is the sudden increase in the industry beta of late 2008. The second is a pronounced decline between the end of 2010 and the beginning of 2011.

2.21 The sharp decline in the energy sector's 24 month beta from late 2010 to early 2011 is mirrored in sharp declines in the individual companies' 24 month betas over the same period.

Figure 2.6: Rolling beta of energy companies (24 months rolling window)



2.22 With regard to the sudden increase of late 2008, we argued in our Phase 1 report that this might be associated with some combination of the oil price spike of 2007/8 and the period of financial turbulence following the US government's quasi-nationalisation of the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation in September 2008, most famously including the bankruptcy of Lehman Brothers.

2.23 With regard to the drop observed at the end of 2010, too little time has lapsed from such decline in order for us to be in a position of providing an explanation. It is, for example, unclear from observing the two-year beta series alone whether this should be seen as a downward spike of the sort observed in mid-2008 (which was followed by an even larger sudden up-spike) or as a more sustained phenomenon reflecting some enduring change in the risk perception of energy sector companies (e.g. their faring better during the financial crisis and recession, relative to other companies, than might have been expected before the recession began), or as a simple "dropping out of the data" of an elevated period from late 2008, such that the two-year equity beta might be seen as returning to a continuation of the downward tendency observed from mid-2007 to late 2008, interrupted by the events of late 2008.

2.24 The drop in the beta since our Phase 1 report takes it outside the 95 percent confidence interval range that we quoted at that time. Indeed, it takes us to the lowest value observed for the two-year rolling beta since 2002. We see two periods of considerable previous instability in the two-year beta: in late 2004/early 2005 (a period in which data may have been affected by some combination of the end of the 2002/3 bear market and

the dropping out of the data series of the instability in energy market expectations at the time of the Iraq war) and in late 2008/early 2009.

2.25 We thus face an issue of what significance to attach to this sudden fall in the two-year equity beta (which is the standard benchmark). Does it mean that the equity beta should now be regarded as materially lower than thought at the time of our Phase 1 report? Does the instability in the series indicate that less weight should be placed on the point estimate of the two-year equity beta relative to other measures of equity beta? Does this instability indicate that less weight should be placed on market data relative to regulatory precedent, comparators or other bases for beta estimation? Could there be some other factor, such as gearing changes, that accounts for the instability?

Gearing

2.26 The equity betas considered above are "raw" betas for the industry and for the companies concerned. Ofgem takes a notional gearing approach, and places only indicative weight on the gearing levels quoted by the companies, since they are typically owned by holding companies, broader than the regulatory entities, that have some discretion over the allocation of their debts. For this reason, at the Phase 1 Report, we focused upon raw equity data, ignoring ways in which gearing levels for the companies involved might have changed over time.

2.27 The instability in our two-year benchmark has forced us to review this approach. In Appendix 1 we have therefore considered to what extent, if at all, the instability in the raw equity betas might be accounted for by sudden changes in company gearing. The key conclusions we draw there are:

(a) There is a sharp drop in betas after our Phase 1 report, even when gearing is taken into account.

(b) The relevered equity beta, taking account of gearing changes, was in late 2008 at approximately the same level it had been in mid-2007, but fell back through 2009, during a period in which the "raw" equity beta showed considerably stability.

2.28 In other words, adjusting for gearing does not eliminate the downwards spike in late 2010/early 2011, but does suggest that beta might have been falling for longer than the raw equity beta numbers might imply alone.

Interquartile ranges

2.29 Returning to raw equity betas (i.e. not adjusting for changes in quoted gearing), in order to further explore the potential instability issue, we have reported below rolling betas (calculated on 24 months, 12 months, and also 6 months rolling windows) and the corresponding interquartile range, for the last five years of available data. (The interquartile range excludes the highest 25 per cent and lowest 25 per cent of data points.)

Figure 2.7: Rolling beta of the energy sector (6 months rolling window), and its interquartile range: 0.50—0.64

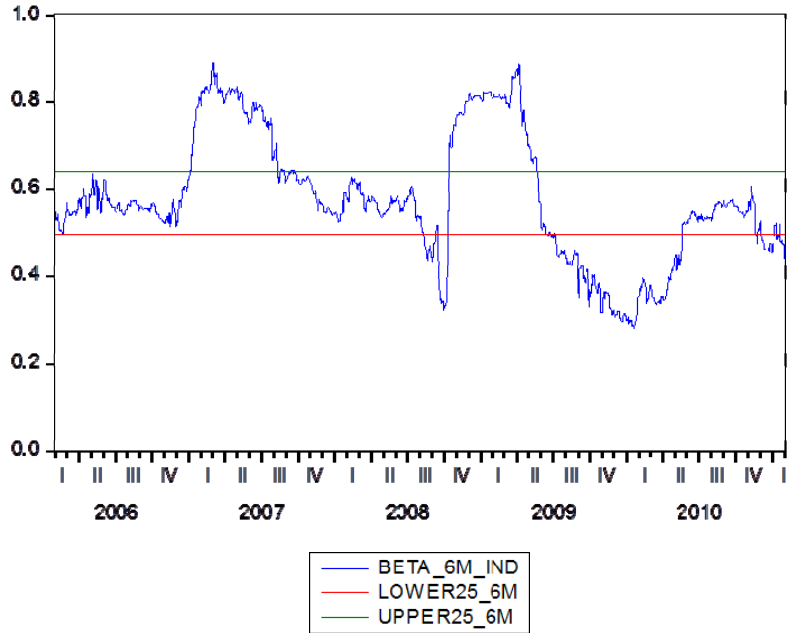


Figure 2.8: Rolling beta of the energy sector (12 months rolling window), and its interquartile range: 0.53—0.68

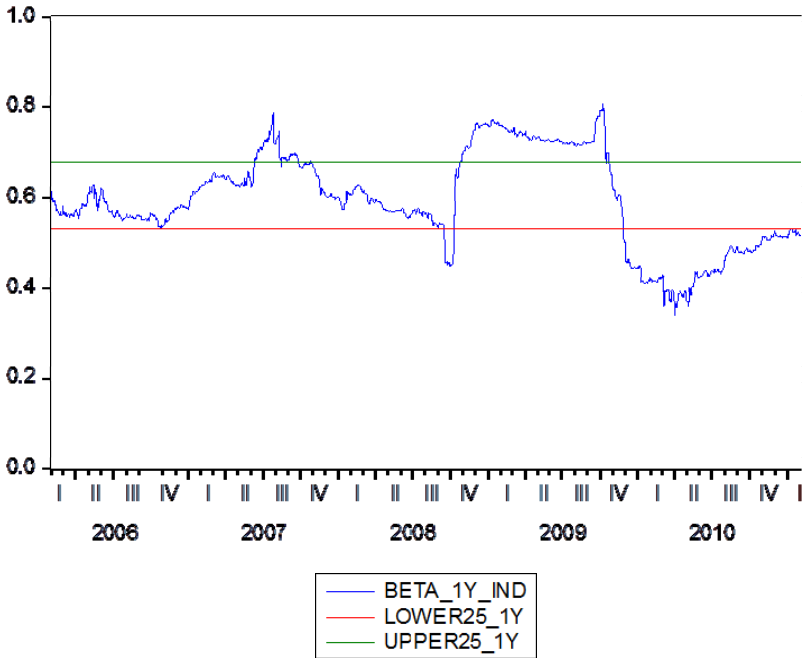
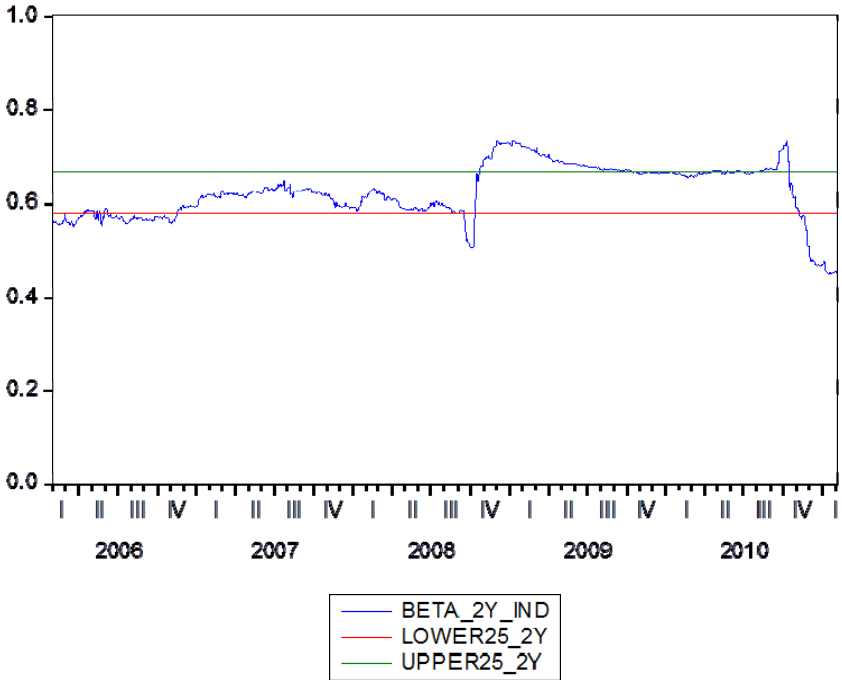


Figure 2.9: Rolling beta of the energy sector (24 months rolling window), and its interquartile range: 0.58—0.67



2.30 From Figure 2.7 to Figure 2.9 above, we note the following:

(a) Over the last three years industry betas have consistently taken values above or below the interquartile rage, with the exception of the two transition periods of late 2008 (i.e. where a sudden rise in beta is observed) and end 2010 (when betas have declined sharply). This is true to a lesser extent for the series calculated on six months rolling windows, as the series falls within the interquartile range also in the second, third, and fourth quarter of 2010. It is also worth observing that whilst the 12 months rolling beta has been rising since early 2010, the six-months beta fell from the last quarter of 2010, suggesting that it would not be safe to assume that the rise in the 12 month rolling beta will be sustained for long enough eventually to "drag up" the 24 month rolling beta.

(b) Across the three series depicted above, the upper quartile appears to be more stable than the lower quartile. In fact, the former takes values ranging between 0.64—0.68, while the latter ranges between 0.50—0.58.

(c) Whilst the most recent value of 24 months rolling beta series (i.e. 0.45 as per Table 2.3 is still far below the lower quartile, the latest 12 months rolling beta estimate (i.e. 0.52, as per Table 2.2) falls almost within the interquartile range. Moreover, during the whole 2010, the 12 months rolling beta series appears to revert to its interquartile range.

(d) Even if the beta estimates based on 24 months rolling windows are typically preferable to those based on 12 months rolling windows, in this occasion, the point estimate based on the last 12 months of data (i.e. 0.52 as set out in Table 2.2) might be preferable as it is more consistent with values belonging to the interquartile range.

2.31 The 10-year and five years average of the energy sector's rolling betas (calculated on 12 months and 24 months rolling windows) are reported in the table below.

Figure 2.10: Five and 10-year average rolling beta of the energy sector

Rolling window used for the estimation	5-year average (2005-2010)	10-year average (2000-2010)
12 months	0.59	0.57
24 months	0.63	0.60

2.32 In light of the additional analysis illustrated above, we have reasons to suspect both that there is an issue of instability in the equity beta but also that the equity beta has in fact fallen since early 2009.

2.33 Focusing purely on the market, a range of reasonable discretion might be 0.53—0.68. This is defined by taking the smallest lower-quartile value observed for the rolling six-month, one-year, and two-year betas (i.e. 0.53), and the largest upper-quartile value for the same beta estimation bases (i.e. 0.68). It is very close to the lower half of the 0.55-0.83 market data range quoted in our Phase 1 report. The implication is that we are suggesting that it would be difficult to defend mechanically adopting the most recent values for the benchmark two-year equity beta (i.e. a figure below our Phase 1 report's 95 per cent confidence interval), given that

(a) this change has occurred very recently;

(b) it is unclear how long it will last;

(c) in 2008 there was a sudden drop almost immediately followed by a sudden large rise; and

(d) it the lowest observations since 2002

but that there is some basis for believing that the equity beta has fallen over the past two years.

Comparator analysis

2.34 The Table below, reproduced from our Phase 1 Report, provides 5 and 10-year averages for the equity betas for each of the two comparator groups the choice of which as relevant comparators was explained there.

Table 2.4: Five and 10-year averages for comparators' equity betas

	5-year average (2006-2011)	10-year average (2001-2011)
KEL	0.66	0.36
NWG	0.66	0.61
PNN	0.58	0.36
SVT	0.64	0.49
UU	0.63	0.55
Average for the UK water companies' group	**0.63**	**0.47**
CNA	0.64	0.68
ENEL	0.66	0.64
GSZ	0.88	0.88
IPR	0.99	0.91
REE	0.55	0.45
RWE	0.66	0.77
TRN	0.36	0.34
VRD	0.50	0.24
Average for the European energy utilities' group	**0.66**	**0.61**

Source: EE calculations using Bloomberg data. Note: due to unavailability of data over the whole of the period for some companies the averages for those companies refer to the average of the data available within that period.

2.35 This suggests that equity betas broadly in the range 0.5-0.65 might be chosen on the basis of comparators. We noted at the time of our Phase 1 Report that most of this range lay within the broad raw equity beta range we then quoted. We note now that this range is similar to the range implied by our analysis of the market data. Indeed, the comparator data at the time of our Phase 1 report lay in the lower half of our broad raw equity beta range.

Regulatory precedents

Asset beta estimates used in recent regulatory reviews

2.36 The Table below shows equity betas, gearing levels, and asset betas used in recent regulatory reviews for the energy sector.

Table 2.5: Previous regulatory decisions on asset betas

Regulator	Case	Equity beta	Gearing (%)	Notional Asset beta for calculation purposes (as constructed by EE)
Ofgem	Electricity distribution (2009)	0.69-0.97 [0.9]	[65]	0.24-0.34
Ofgem	Gas Distribution (2007)	[1]	[62.5]	[0.375]
Ofgem	Transmission (2006)	[1]	[60]	[0.4]
Ofgem	Electricity distribution (2004)	[1]	57.5	[0.425]

Regulator	Case	Equity beta	Gearing (%)	Notional Asset beta for calculation purposes (as constructed by EE)
CC	Bristol Water (2010), estimate for Bristol Water	0.64 to 0.92	60	0.32 to 0.43
CC	Bristol Water (2010), estimate for Water and Sewerage Companies			0.27 to 0.36 (debt beta of 0.1), 0.21 to 0.31 (debt beta of zero)
Ofwat	Water and sewerage (2004)	[1.0]	[55]	*0.45*
Ofwat	Water and sewerage (2009)	[0.9]	55-65 [57.5]	[0.4]
CC	Stansted (2008)	1.0-1.24	[50]	0.55-0.67 [0.61]
CAA	Heathrow (2008)	0.9-1.15	[50]	0.55-0.67 [0.61]
CAA	Gatwick (2008)	1.0-1.3	[60]	0.40-0.52
CC	London Airports (2007), estimated range for "Utilities" (including gas, electricity and water)			0.3-0.45
Ofcom	General approach – applied to BT (2005)	1.14-1.23	30-35	0.74-0.86
Ofcom	Openreach / BT's other activities (2009)	0.76 / 0.96	35	0.49 to 0.62
Postcomm	Royal Mail (2005)	0.81-0.94	[20]	0.65-0.75

Source: Regulatory determinations. Note: point estimates are shown in square brackets; asset betas shown in italics were calculated from equity betas and gearing assuming debt beta=0.

2.37 The most recent Ofgem determination, for electricity distribution in 2009, concluded for an equity beta of 0.9 at a gearing level of 65 per cent. If we assume a debt beta of zero, then consider Ofgem's current preferred levels of gearing of 62.5 per cent for gas distribution and 60 per cent for transmission, simply repeating the 2009 determination would imply an equity beta of 0.84 for gas distribution and 0.79 for transmission.

2.38 The most relevant other recent judgement was in the Bristol Water case. The CC stated that "*electricity and gas transmission and distribution companies already benefited from revenue correction (since they had revenue, rather than price, caps) and were often thought to have systematic risk not dissimilar to water companies.*" Its recommended

ranges for water and sewerage companies, of 0.27-0.36 (with debt beta of 0.1) and 0.21 to 0.31 (with debt beta of 0), are therefore relevant.[9] We observe:

(a) At 60 per cent gearing, an asset beta of 0.27 to 0.36, with debt beta of 0.1, is equivalent to an equity beta of 0.525 to 0.75, whilst an asset beta of 0.21 to 0.31, with debt beta of 0, is equivalent to an equity beta of an equity beta of 0.525 to 0.775.

(b) At 62.5 per cent gearing, an asset beta of 0.27 to 0.36, with debt beta of 0.1, is equivalent to an equity beta of 0.55 to 0.8, whilst an asset beta of 0.21 to 0.31, with debt beta of 0, is equivalent to an equity beta of an equity beta of 0.56 to 0.83.

2.39 We note the very close similarity between the equity beta ranges implied by the CC Bristol Water judgement (0.53 to 0.83) and our Phase 1 range (0.55 to 0.83).

Recommended range

2.40 Bearing in mind the market data and the comparator data, our recommendation is **0.55-0.65** (for gearing of 60-62.5 per cent). This range is based on our interpretation of (albeit somewhat unstable) market data, which we have argued implies a range of approximately 0.53-0.68 (discounting the most recent benchmark two-year equity beta, which is below our recommended range, but accepting that the market data imply that the equity beta has indeed fallen since early 2009) and the comparator data, which suggest a range of 0.5-0.65.

2.41 We note that we believe that it is clear that betas have fallen since the time of Ofgem's previous regulatory decision in 2009. That previous judgement was, in 2009, for an equity beta of 0.9 at a gearing of 65 per cent. Observing that, as an implication of the Modigliani-Miller theorem, betas are defined only in combination with a level of gearing (i.e. one has an equity beta of X at a gearing of G), an equity beta of 0.9 at 65 per cent gearing is equivalent to an equity beta of 0.84 at 62.5 per cent gearing and 0.79 at 60 per cent gearing. We observe that a value of 0.84 is almost precisely the very top of the broad market data range (0.55-0.83) which we quoted in Phase 1, as indeed is the top of the range in the Bristol Water judgement. Thus a natural interpretation is that our Phase 1 range ran up to the level of the DPCR5 judgement and the top of the Bristol Water range, but our advice now is to narrow to a portion in the lower half of that range. We believe that the clear message of the market data is that the beta range is currently markedly lower than that determined in 2009.

2.42 An equity beta of 0.55-0.65 at 60-62.5 per cent, with a debt beta of 0, equates to an asset beta of 0.21 to 0.26. We observe that this is the lower half of the Bristol Water judgement asset beta range.

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[9] See Annex N, paragraph 119, page N33. We note, as ever, that although the CC chose a cost of capital at the very top of its range, that does not imply a CC recommendation of Bristol Water's asset beta being at the top of the range.

Equity Risk Premium

2.43 In Phase I Europe Economics examined the latest and historical estimates of the Equity Risk Premium (ERP) as well as regulatory precedents and recommended a range of 4.0 to 5.5 based on the latest range of DMS estimates.

Developments since Phase 1 Report

2.44 Since the Phase 1 Report, financial markets were relatively stable up until the volatility of February 2011 associated with uncertainty arising from the revolutions in multiple North African and Gulf states. Early GDP estimates for the UK for the final quarter of 2010 indicated a contraction of 0.5 per cent, but this was not interpreted by markets as indicating a high probability of the UK entering a further significant phase of recession or a high likelihood of a further phase of credit markets disruption.

Regulatory precedents

2.45 We summarise recent regulatory precedents on the ERP below.

Table 2.6: UK Regulatory precedents of ERP estimates

	Year	Sector/company	ERP %
Ofcom (consultation)	2011	Openreach	5.0
Competition Commission	2010	Bristol Water	4.0 to 5.0
CAA	2010	NATS	5.25
Ofwat	2009	Water	5.4
Ofcom	2009	Openreach (BT's other activities)	5.0
NIAUR	2008	SONI	4.5
Ofgem	2009	Electricity distribution	5.25
CEPA for Office of Rail Regulation	2008	Network Rail	3.0 to 5.0 but may be as high as 7
Civil Aviation Authority	2008	Heathrow and Gatwick (BAA)	4.5
Competition Commission	2007	Heathrow and Gatwick (BAA)	2.5 to 4.5
Ofgem	2007	Gas Distribution	4.75
Ofgem	2006	Transmission	4.50
Smithers & Co for Ofgem	2006	Four electricity and gas licensees	higher end of 2.5 to 4.5
Ofcom	2005	BT	4.0 to 5.0
Postcomm	2005	Royal Mail	3.5 to 4.0
Ofwat	2004	Water (WaSCs and WoCs)	4.0 to 5.0
Ofgem	2004	Electricity Distribution	4.75

Sources: Respective regulator reports.

2.46 The only significant additional regulatory exercise since the Phase 1 Report has been Ofcom's 2011 consultation paper, in which it argued for an ERP of 5.0.

2.47 We note that Ofcom interprets the Competition Commission in the Bristol Water judgement as adopting a risk-free rate of 5.0. We believe that this over-interprets the Competition Commission's findings. The Competition Commission recommends a total market return of 5.0-7.0 and a risk-free rate range of 1.0-2.0, which it states can be interpreted as indicating an "implied range" (Annex N, paragraph 100) for the ERP of 4.0-5.0 (though it places greater weight upon the total market return estimate than upon the ERP estimate in isolation). Then, because the CC chooses a total cost of capital for Bristol Water of 5.0 per cent (Annex N Paragraph 156), at the very top of its 3.8-5.0 per cent range, it produces a table (Table 12, Annex N page N46) in which it quotes a "projected" ERP of 5.0. Just as with the risk-free rate, that "projected" ERP is simply a mathematical implication of the CC's choosing a total WACC at the very top of its recommended range, not a separate recommendation as to the correct ERP.[10]

Recommended range of regulatory discretion

2.48 We believe that the range of regulatory discretion for the ERP is **4.5-5.0**. Choice of the upper part of this range would imply some combination of belief that

(a) markets exhibit little or no mean reversion, such that arithmetic mean estimates of the ERP (which are higher) are to be preferred;

(b) the degree of lognormality in market returns is low (indicating that the downwards adjustment to the arithmetic mean estimate is small);

(c) for a given total market return (the sum of the ERP and risk-free rate), regarded as more stable than the individual components thereof, a low-end estimate of the risk-free rate is preferred (implying a relatively higher ERP);

(d) the disruption to equity markets of 2008/9 can now be regarded as past, such that no upwards adjustment to the longer-term "normal times" ERP is required;

2.49 Conversely, choice of the lower part of this range would indicate some combination of beliefs in the oppose of (a) to (d).

Conclusions on the Cost of Equity

2.50 We now draw the material of previous sections together into an overall range of regulatory discretion for the cost of equity.

2.51 Our recommendations for the overall cost of equity range at a gearing range of 60-62.5 per cent (noting once again that a cost of equity is only defined at a given level of gearing), alongside a reference estimate (the use of which we do *not* recommend) and the values at the DPCR5 regulatory decision (at 65 per cent gearing), appear in Table 2.7.

[10] See http://www.competition-commission.org.uk/rep_pub/reports/2010/fulltext/558_appendices.pdf

Table 2.7: Overall Cost of Equity

	Europe Economics recommendation (at 60-62.5% gearing)*		Reference estimate (gearing unspecified) (Note that we do *not* recommend this)	*DPCR5 Regulatory Decision (at 65% gearing)*
Risk-free rate (%)	**1.3**	**1.8**	1.8	*2.0*
ERP (%)	**4.5**	**5.0**	5.0	*5.25*
Equity beta	**0.55**	**0.65**	0.9	*0.9*
Cost of equity (before re-levering) (%)	**3.8**	**5.1**	6.3	*6.725*

*Notes: * This is our overall recommendation, taking account of market data, of comparators, and of regulatory precedent. It should not be regarded, for example, as simply a "market data" range — the values recommended lie well above the current market data in respect of both the risk-free rate and the equity beta.*

2.52 We note that we believe that our recommended range allows enough flexibility to encompass gearing levels of 60 per cent or 62.5 per cent. If a gearing level outside that range were to be chosen, the cost of equity range would need to be re-levered.

2.53 In the third column we note, for reference purposes, that if the equity beta of 0.9 chosen at DPCR5 were maintained, but our recommended upper bounds for the risk free rate and ERP were applied, the cost of equity would be 6.3 per cent. A determination along these lines would accept that there had been changes to the risk-free rate and ERP since 2009, but maintain the same equity beta as was then chosen with a 65 per cent gearing level. Ofgem's view is that, given the value associated with consistent regulatory determinations over time and the issues created if changes in the WACC are very steep from one determination to the next, a conservative estimate of the cost of equity might place greater weight on this reference estimate.

3 RESPONSES TO CONSULTATION FEEDBACK AND OTHER ISSUES

Cost of Debt Indexation Mechanism

3.1 Our Phase I report explored the various methodological options in designing a cost of debt index and recommended:

(a) Indexing the total cost of debt rather than the premium or the risk fee rate;

(b) A broad non-financial bond index (not specific to the utilities sector);

(c) Adjusting for inflation using the implied inflation data from Bank of England gilts data;

(d) Use of standard 10-year bond index;

(e) Use on an average of yields on A rated and BBB rated indices;

(f) Eight-year trailing window;

(g) Simple average rather than a weighted one due to data constraints.

3.2 Some consultation respondees appear to have misunderstood one important aspect of our Phase 1 Report, namely the choice of tenor.[11] Our recommendation is stated in paragraphs 7.76 ("*we recommend that a baseline cost of debt be calculated, and then adjusted proportionately to changes in an index based on 10 year bonds*") and 7.78 ("*a baseline value for the index is re-calculated at each price review based on a weighted basket of actual tenors, and the evolution of the index during price control periods is based on changes in the trailing average for 10 year bonds*").

3.3 For example, Electricity North West, in its response[12], characterises our proposal thus (p4): "*Ofgem should set the Cost of Debt start point following traditional complex analysis and then use the index to flex assumptions within the price control is a much better approach.*"

3.4 Europe Economics was not asked to consider an alternative to the index-based approach of RIIO[13], and stated explicitly in our Phase 1 report (paragraph 7.78): "*We emphasise that [our recommendation] should be interpreted in the light of RIIO and such that it is compatible with it....It is simply a mechanism for calculating the index.*" We were thus not asked to consider approaches such as calculating "*a Cost of Debt start point following*

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11 http://www.ofgem.gov.uk/NETWORKS/GASDISTR/RIIO-GD1/CONRES/Documents1/Europe%20Economics%20Final%20Report%20-%20011210.pdf

12 http://www.ofgem.gov.uk/Networks/GasDistr/RIIO-GD1/ConRes/Documents1/Electricity_North_West.pdf

13 Ofgem (2010) 'RIIO: A new way to regulate energy networks final decision', 4 October 2010

traditional complex analysis" and have made no recommendation for or against such an approach.

3.5 There also appears to be some confusion regarding our proposals in respect of use of a 10-year bond benchmark. Electricity North West, for example, states: "*In the context of this recommendation Europe Economics recommends use of a 10-year index as what it considers the "standard financial market benchmark". We find this conclusion surprising since the analysis in the Europe Economics report very clearly shows that the tenor of bonds at the time of issue by the network companies are very significantly weighted towards maturities of 20 years and longer with a very large proportion over 30 years.*"

3.6 It might help, to clarify our recommendation, to consider the following table.

Approach	**Pure 10 year bonds basket**: Construct an index based on 10 year bonds	**Mixed approach**: Construct an initial startpoint for an index based on actual bond tenors, then have the index evolve between price controls on the basis of 10-year bonds, then correct at each subsequent price control	**Pure actual tenors basket**: Construct an index based on actual bond tenors
Advantages	Simple to calculate	Uses actual bond weightings to determine startpoint, is simple to calculate during price controls, and since movements in bond prices of different tenors closely mirror one another, is likely to closely mirror evolution of an index based on actual bond tenors, but without the computational complexity	Mirrors actual weightings of bond tenors
Disadvantages	Actual bond portfolios may be weighted to other tenors, of which 10 year bonds may be an imperfect proxy	Slightly more complicated to calculate than simple 10 year bond index, and slightly less reflective of actual weightings than index based on actual bond tenors	At any point in time, analysis would be required to determine the weighting of companies' actual bond portfolios

3.7 The Europe Economics recommendation in our Phase 1 report was intended to be intermediate between the options of simply constructing an index based purely on 10 year bonds and the more computationally complex option of constructing an index based purely on actual bond tenors. Our recommendation was that basing the initial value of the index on actual bond tenors would allow the index to better reflect the actual tenor mix of firms, but that 10 year bonds tended to have movements over time that were proportionately very similar to the movements in bonds of longer tenors, and hence that the added gain from continuously gathering-and-calculating the exact actual portfolio weights of differing tenors would add very little to simply using proportionate changes in the 10 year bond.

3.8 Thus, to repeat what was said in our Phase 1 report: we were asked to propose mechanisms for calculating the index, not to reconsider whether basing the cost of debt upon an indexation mechanism was appropriate, and our proposal was simply a mixed means for calculating an index.

Duration of Cash Flows

3.9 In our Phase 1 Report we noted the debate between CEPA and Oxera concerning whether an NPV-neutral change in cash-flow duration should be expected to change the cost of capital. CEPA had argued that it should not; Oxera than it should. We offered some comments on this debate (paragraph 7.17), in particular questioning whether, even if there were some basis for believing that a change in cash-flow duration did change the cost of capital, there were any strong basis to believe there is a systematic direction for such a change (e.g. that a lengthening of cash-flow durations always increases the cost of capital, rather than decreasing it).

3.10 We moved on to explore whether there might be any strong empirical basis for believing that NPV-neutral changes to cash-flow durations change the cost of capital. We considered oil industry capital allowances and accelerated depreciation in electricity distribution in DPCR3.

3.11 In its consultation response, ENA suggests that we have misunderstood certain key features of the DPCR3 and oil industry examples. In the case of DPCR3 their contention is that

> there was a general expectation that Ofgem would act to mitigate the impact of the ending of depreciation revenue in respect of pre-privatisation assets, i.e. a general expectation that Ofgem would, in effect, act to maintain the status quo in terms of expected cash flows…This was indeed what Ofgem did and the lack of market reaction was exactly what would have been expected as a result of the status quo being maintained.

3.12 In the case of the North Sea ENA's contention is that

> UK government changes in the North Sea tax regime have typically been designed to make future (i.e. marginal) investment more financially attractive…As such, the changes

had little or no impact on the NPV of cash flows from past investment which would make up the bulk of the foreseeable cash flows for most companies.

3.13 Our response is as follows:

(a) The Ofgem DPCR3 example of shortening asset lives is the direct opposite of Ofgem's current proposals to extend asset lives. Even if there was a "general expectation" that Ofgem would change make adjustments to address the cashflow issues, prior to any announcement, financial markets would not have priced in such a change in regulatory policy as though it were certain. Hence, even if Ofgem's announcements merely increased the certainty that financial markets attached to a change in policy to address the cash-flow issue, one would expect to observe an effect in betas (if it were true that the cashflow profile affects the cost of capital).

(b) We do not dispute that there are limitations on the applicability of both the DPCR3 and oil industry cases to Ofgem's current proposals. However, we emphasize again our conclusion from our Phase 1 Report (paragraph 7.45):

> This statistical study is not in itself decisive, and if there were good theoretical grounds for supposing that betas are, in fact, affected by duration then a more extensive statistical analysis might be warranted. However, since there are, on the contrary, strong theoretical grounds for supposing that cash flow durations have little, if any effects on betas (and that if they do it will not be in any clear systematic direction) we believe that this brief statistical review is sufficient to illustrate that the theoretical case for no effect is not clearly at variance with the statistical evidence.

Thus, our task was not to *prove*, using our empirical examples, that NPV-neutral changes in cash-flow duration do *not* affect the cost of capital. Rather, our task was to investigate whether the opposite case (namely that NPV-neutral changes in cash flow duration *do* affect the cast of capital) was supported by case studies. Our conclusion was that it was not.

"Hedging" and Fixing the Cost of Debt

3.14 Some respondents have suggested to Ofgem that the cost of debt indexation mechanism that Ofgem has committed to under RIIO would reduce the capacity of companies to "hedge" the cost of debt. We do not attempt to provide a comprehensive analysis of this point here, but, rather, to make the following high-level observations.

3.15 We shall organise our remarks in the following way. First we shall consider what hedging, in the financial markets (rather than economic theory) sense of the term, is done by regulated utilities. We shall see that this is unaffected by the use of a debt indexation mechanism. Then we shall move on to consider a broader sense in which firms could more straightforwardly "hedge" (in the economic theory sense of the term) a fixed cost of debt than an indexation mechanism, and reflect briefly upon whether this matters.

"Hedging" in the financial markets sense of the term

3.16 First, we consider what form of "hedging" firms engage in, in the sense of purchasing specific forms of derivative instrument. There appear to be two main categories of hedging undertaken by companies:

(a) Hedging in respect of issuance of a specific tranche of debt. A typical scenario here might be that a company wishes to issue debt, and company staff in charge of such issuance secure approval from the company's senior management/board to proceed with such an issuance at or below some given coupon rate. Such debt is typically priced as a number of basis points spread above some reference gilt yield. At the point the decision to issue is taken, the company insures itself against adverse movements in the price of the underlying gilt (which could otherwise threaten the company's ability to execute the gilt issuance in accordance with the approval (e.g. because the movement in the underlying gilt was sufficiently adverse that the coupon rate required at issuance would be above that approved by the board) by hedging against movements in that gilt — through some combination of gilt locks and interest rate swaps. Such operations will typically range from one day to one year in the duration of the hedge. (Note that our understanding is that companies rarely hedge against movements in spreads over gilt rate as doing so would be prohibitively expensive.)

(b) Hedging as part of general risk management (e.g. using interest-rate swaps).

3.17 Neither of these forms of hedging directly involves Ofgem's determined cost of debt, and thus neither is directly threatened by changes in the way Ofgem calculates its cost of debt allowance. For example, when a company engages in a pre-issuance hedge (a hedge of form (a) above), it will typically be hedging against absolute movements in its own required coupon, not in changes between its required coupon and Ofgem's determined cost of debt.

3.18 In principle, with a fixed cost of debt allowance (i.e. absent an indexation mechanism), companies could choose, on the opening day of a price control period, to hedge against all subsequent movements in the cost of debt from that day on until the end of the price control period . Our understanding is that no company, in fact does this. And even if a company were to do that, the cost of debt available for hedging against on that day would be most unlikely to be Ofgem's determined cost of debt (since that is a rate to apply over a period, not a forecast of the cost on the first day).

"Hedging" in the economic theory sense of the term

3.19 Our understanding of the industry's actual concern is not about the use of derivative instruments as such. Rather, it is that with a fixed cost of debt firms could take out fixed rate debt at the start of the price control period and, given a particular deal at or below the allowed WACC, firms could then be secured in having allowed revenues sufficient to cover their interest payments. In the economic theory sense of the term, this could (very broadly) be thought of as a form of "hedging". With an indexed cost of debt the future

path of the index is uncertain so this cannot be done in the same straightforward way. Firms could perhaps replicate the index by taking out small amounts of debt each year of the same kind as the index, but the transactions costs involved in financing oneself this way would make it inefficient — and perhaps infeasible for smaller firms given minimum funding amounts that bond markets may require for a bond issue.

An indexation mechanism as itself a form of insurance?

3.20 A natural question is whether the cost of debt indexation mechanism in some sense replaces the need to hedge by providing its own insurance. A case can be made that it should not be conceived as a form of additional insurance for investors — if the regulated utilities wished to insure investors against movements in the cost of debt relative to the Ofgem determination they already could do so, and a definitive Ofgem cost of debt determination provides a benchmark against which to hedge, whilst a cost of debt indexation mechanism increases nominal uncertainty.

3.21 On the other hand, an indexation mechanism, might reduce uncertainty (and thus constitute a form of insurance) regarding the difference between the cost of debt at any one point in the price control and the Ofgem allowance for cost of debt. However, it is not clear that such insurance would actually reduce the fundamental systematic riskiness of the businesses. All insurance that did not reduce systematic risk would do is to re-apportion risk between consumers and investors.

3.22 (One may question whether setting a fixed cost of debt with some "headroom" would represent a fair price for consumers to pay for allocating risk away from consumers. Analysis contained Ofgem's December paper showed that the annual movements in the trailing average would have minimal impact on allowed revenues — no more than 0.8 per cent movement in the most volatile year.[14])

Ability to hedge against movements in the cost of debt index

3.23 In principle, companies could choose to hedge completely against movements in their cost of debt, relative to Ofgem's determined level, over the price control. They are also able to form clear internal performance indicators in respect of out-performance of the Ofgem cost of debt benchmark. With the cost of debt indexation mechanism, it will be less straightforward to predict this. Instead, companies and their investors would, as part of their general risk management (form (b) hedging above) need to form some view as to the likely path of the cost of debt index and then (if they so chose) hedge against these movements. We see no particular difficulty in achieving some degree of hedging in this respect — there is little more to this than hedging against movements in gilt rates of different maturities — but we do believe that perfect hedging (in the sense of

[14] Ofgem (2010) 'Consultation on strategy for the next transmission and gas distribution price controls - RIIO-T1 and GD1 Financial issues' p34

guaranteeing a certain nominal or real return or coupon in respect of underlying gilts) would be less straightforward, if feasible at all.[15]

3.24 We do not, however, see great significance in the difference between firms being able to hedge perfectly against movements in underlying gilt rates, whilst not hedging perfectly against movements in credit spreads, and being able to do so imperfectly. We highlight the following points:

(a) There would be no effect upon firms' practical ability to engage in pre-issuance hedging, since that hedges against (an aspect of) actual costs of debt, not costs of debt relative to an Ofgem benchmark.

(b) It is not a standard practice to hedge, at the commencement of a price control, against all movements in the cost of debt or to obtain debt for the full price control period at the initial price (then hold cash until investments are made), and thus even if some firms would prefer to do this in the next price control, we do not believe it can be regarded as an essential component of the business funding model in the sector.

(c) Even with perfect hedging of underlying gilts relative to an Ofgem reference, firms would not have perfect hedges of their total cost of debt relative to an Ofgem reference. And they *could* hedge, albeit imperfectly, against movements in a debt index. So the comparison is not between perfect hedging with a standard fixed cost of debt and no hedging with a cost of debt indexation mechanism. Rather, it is between imperfect hedging in each case.

(d) We do consider it plausible that the imperfection of hedges might be greater with a cost of debt indexation mechanism. But we are not convinced, without deeper empirical analysis, that the imperfection involved would increase systematic, as opposed to idiosyncratic, risk. If only idiosyncratic risk is increased, then provided that companies still meet financeability thresholds, there should be no negative effect on the overall cost of capital.

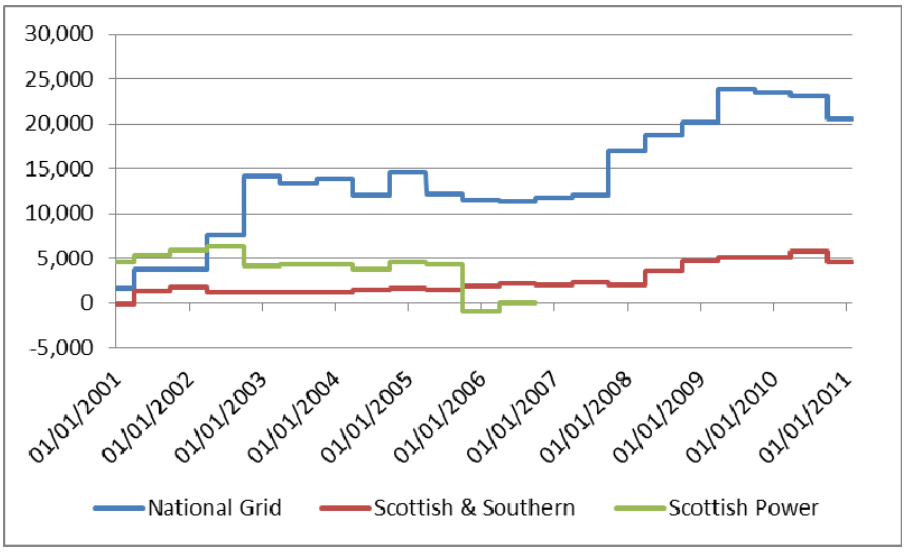
(e) Furthermore, even if there were an overall effect on the cost of capital, it is plausible (perhaps even likely) that the increase would be lower than the reduction in "headroom" that Ofgem felt able to accept as a consequence of the indexation mechanism.

[15] It has been suggested to us that it would be more feasible to hedge against movements in an iBoxx (or even, via swaps, an iTraxx index) than against movements in Bloomberg indices. This may be true, but hardly seems to be a decisive objection to the concept. Furthermore, given that there must be some correlation between movements in iBoxx or Bloomberg, given that these are both indices of bonds, hedges against movements in iBoxx would surely provide a partial hedge against movements in the Bloomberg indices. And, as we emphasize repeatedly above, there is no perfect hedging done anyway — it is all a matter of comparison between imperfect hedges.

APPENDIX 1: CONSIDERATION OF GEARING CHANGES AS EXPLANATION OF INSTABILITY IN EQUITY BETA

A1.1 In this appendix we consider to what extent gearing changes are a factor in the instability in our two-year beta estimates. Ofgem takes a notional gearing approach to the regulated entities. However, the quoted entities are broader companies than the regulated entities. Their net debt[16] can be seen below.

Figure A1.1: Net Debt (£m) of Listed Companies



Effects of gearing on beta

A1.2 According to the famous Modigliani-Miller capital structure irrelevance theorem, the asset beta for a company should be (under certain assumptions) invariant to the company's level of gearing. As gearing changes, the debt and equity betas change in such a way that the asset beta remains invariant. In particular, as the level of gearing rises both the debt and equity betas rise.

A1.3 With relatively small changes in gearing and relatively modest gearing levels, it is typically safe to assume no change in debt beta. If gearing changes are large or levels of gearing very high, the effects of debt beta cannot be ignored. A further factor arises when changes to the level of gearing arise as a consequence of large falls in quoted equity prices. If the falls in quoted equity prices arise because of a changed perceived risk of default by the company, one is not safe to assume that changes in equity beta occur independently of changes in debt beta.

[16] Net debt is defined as short-term borrowings PLUS long-term borrowings MINUS cash & near cash items MINUS marketable securities MINUS collaterals

Rolling Asset Betas for the Energy Sector

A1.4 To examine this issue further, asset betas were constructed using rolling two-year equity betas, rolling two year average debt betas and rolling two-year averages of companies' actual gearing. Relevered equity betas were then calculated on the basis of 60 per cent notional gearing.

A1.5 Debt betas for the industry were calculated using market data on debt premia, making assumptions (explained below) about the risks and costs associated with defaults on bonds. More specifically, estimates for debt beta were produced by decomposing the debt premium into two key components

(a) adjustment to the expected value to take account of the risk of default and loss given default; [17]

(b) the debt beta.[18]

A1.6 Note that our exercise here is not to produce precise estimates of the debt beta or asset beta or equity risk premium. We are focused on the question of whether taking account of changes in gearing would eliminate the instability in the two-year equity beta. We therefore use an illustrative range of values for the ERP, probability of default, and loss given default.

A1.7 Industry averages for market rates of debt and market debt premiums were used, alongside an illustrative equity risk premium of 4.5 per cent.[19]

A1.8 The period from 2007-onwards involved a large rise in observed market debt premia. For our purposes here it is necessary to formulate some assumption as to what component of the rise in observed debt premia was a rise in perceived risk of default or loss given default, and what component was a rise in debt beta (in perceived correlation of default or loss given default with wider losses across the economy). For our illustrative purpose we focused upon two extreme assumptions:

(a) that all of the rise in debt premia was the consequence of increased perceived risk of loss or loss given default (i.e. there was no change in debt beta);

(b) that all of the rise in debt premia was the consequence of an increase in debt beta (i.e. there was no change in perceived risk of loss given default).

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[17] The "cost of debt" that appears in the Capital Asset Pricing Model is the *expected* return on debt, not the *promised* return. The promised return is the market cost of debt — the amount that must be promised to a bondholder. The expected return is the market return adjusted downwards for the expected probability of default and expected loss given default.

[18] The debt beta is simply the premium of the expected cost of debt (after adjustment for risk of default and expected loss given default) over the risk-free rate, divided by the Equity Risk Premium.

[19] Note again that we require some assumption about the ERP to calculate our debt beta from the debt premium.

A1.9 If our exercise involved actual estimation of debt betas, we would need to explore this point in more detail, perhaps by considering direct estimation of debt betas from correlations between movements in bond prices and in the equity market index, and could not simply rely upon these extreme assumptions. But we emphasize again that our purpose is to investigate the potential for gearing changes to be behind the instability in the equity beta, not to estimate specific effects.[20]

A1.10 For the probability of default and the cost of bankruptcy as a proportion of debt principal, a best case scenario was used, in which the probability of default was 0.5 per cent, with a seventy per cent recovery rate, alongside a worst case scenario in which the default probability is one per cent and all of the value of the bond is lost. These are summarised below:

	Best Case	Worst Case
Default Probability	0.5%	1.0%
Default Loss	0.3	1
ERP	4.5%	4.5%

A1.11 "Actual gearing" figures were calculated using the ratio of net debt to net debt and total market capitalisation. Two year rolling averages of the gearing and debt beta figures were then calculated, and combined with the rolling two year beta estimates to give two year rolling asset betas for the industry.

A1.12 These asset betas were then relevered under an indicative assumption of notional gearing of 60 per cent. Under each scenario we also considered the alternative in which debt betas were held constant from 2008 onwards.

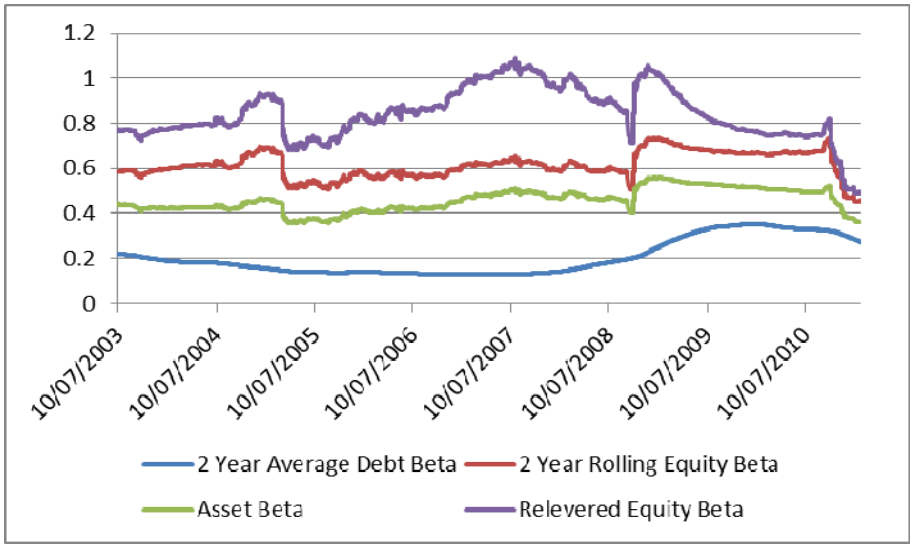
"Best Case" Scenario

A1.13 Under this scenario, the rolling two year debt beta gradually decreases from mid-2003 from a high of 0.22 to less than 0.13, before climbing from mid-2007 and increasing more sharply between mid-2008 and mid-2009, reaching 0.35 by the beginning of 2010, declining slightly thereafter. The asset beta closely tracks changes in the equity beta, though is less volatile — as would be expected given that the debt beta is less volatile than the equity beta.

[20] It should be noted, in passing, that one could not simply assume a zero debt beta for our purpose here, as changes in debt beta are central to the exercise.

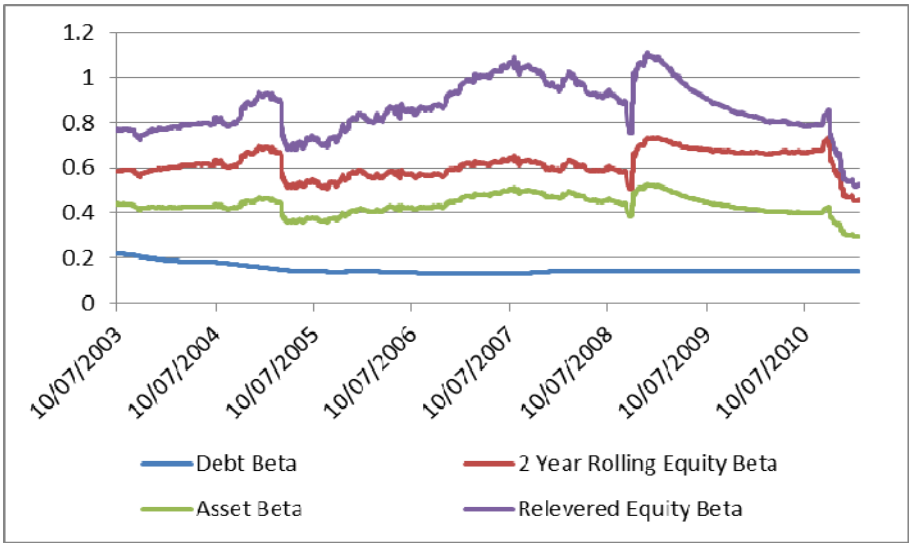
A1.14 The relevered equity beta is consistently higher than the equity beta calculated on a rolling two-year basis, and tracks it to some extent. It does, however, increase significantly between 2005 and mid-2007, while the unlevered equity beta is relatively constant. The mid-2008 increase in the relevered equity beta is more significant than in the unlevered equity beta, though the relevered equity beta declines thereafter, in contrast to the unlevered equity beta, which plateaus up to the end of 2010.

Figure A1.2: Industry betas under the "best case" scenario with a variable debt beta



A1.15 Under the alternative of a constant debt beta beyond 2008, the asset beta tracks the unlevered equity beta less closely than is the case for a variable debt beta. In particular the plateau in the unlevered equity beta after mid-2008 is matched with a decline in the asset beta over this period, as higher gearing is combined with an invariant (and lower) debt beta. On the other hand, the relevered equity beta behaves much the same as is the case with a variable debt beta, with a significant increase in mid-2008 and a steady decline thereafter, in contrast to the unlevered equity beta's increase and subsequent plateau. The relevered equity beta also matches the unlevered equity beta's significant decline from the end of 2010, as is the case for a variable debt beta.

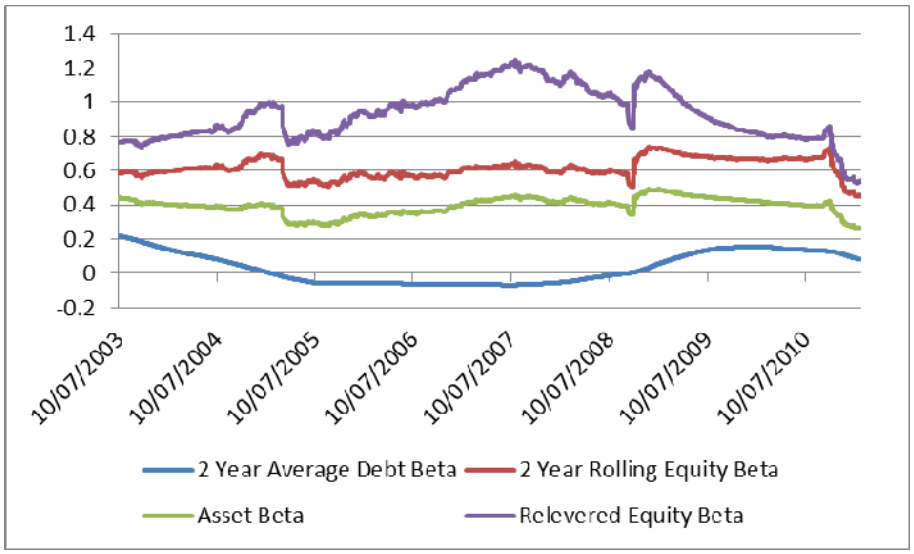
Figure A1.3: Industry betas under the "best case" scenario with a constant debt beta from 2008



"Worst Case" Scenario

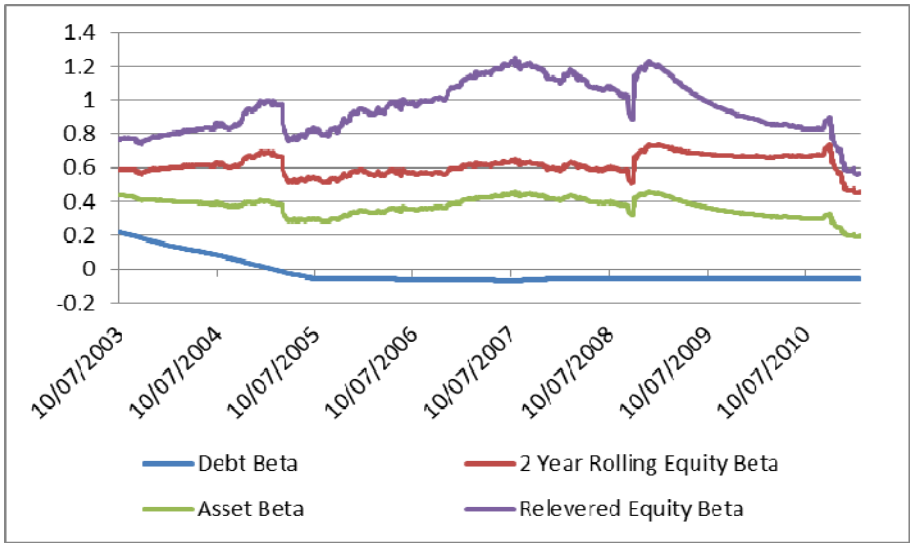
A1.16 Under the "worst case" scenario, the behaviour of the debt beta over time is broadly similar to its behaviour in the "best case" scenario, particularly with respect to the increase after mid-2008, though its absolute level is consistently lower. Again, the asset beta tracks the unlevered equity beta, though is less volatile. The behaviour of the relevered equity beta over time is almost identical to its behaviour under the "best case" scenario, though its absolute level is consistently higher.

Figure A1.4: Industry betas under the "worst case" scenario with a variable debt beta



A1.17 Holding the debt beta constant after 2008 under the "worst case" scenario gives broadly similar results as under the "best case" scenario. In particular, the decline in the asset beta (alongside a relatively constant unlevered equity beta) from mid-2008 is also seen here. The behaviour of the relevered equity beta here is also similar to its behaviour under other scenarios, though it is again consistently higher than is the case under the "best case" scenario.

Figure A1.5: Industry betas under the "worst case" scenario with a constant debt beta from 2008



Conclusion

A1.18 Given that the sharp downward drop in rolling two-year equity betas appears in the relevered equity betas under a variety of different scenarios and assumptions concerning debt betas, it does not appear that regearing is a plausible candidate explanation.

A1.19 However, there is one other point worth drawing from this exercise: that the relevered equity beta, taking account of gearing changes, was in late 2008 at approximately the same level it had had in mid-2007, but fell back through 2009, during a period in which the "raw" equity beta showed considerably stability.