Annex B BT's comments on the cost of capital

Contents

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B.1 Executive Summary

B.1.1 Overview[1]

BT attaches very high importance both to the methodology used and to the value set for Weighted Average Cost of Capital (WACC) and is disappointed that Ofcom should contemplate any reduction from the 2005 determined values.

The investment environment since 2005 has changed radically such that an increase to BT's WACC, rather than a reduction, should be expected. This Response to Ofcom's Consultation presents substantive evidence to support this statement. Ofcom's draft proposals may reduce the prospects of BT and other industry players from securing substantive investments in NGA-based infrastructure over the coming years and are likely to delay such network upgrades.

BT has a number of comments and reservations of a technical economic nature on Ofcom's analysis of WACC which are summarised below (details including references are in the main body of this Annex):

- The central estimate of the WACC is too low. A number of the parameters in the CAPM framework appear to be inconsistently estimated and/or not up-to-date, including in particular the beta factor, the risk free rate and the equity risk premium; each being too low, by varying degrees. More plausible estimates using the methodology which Ofcom itself has adopted would raise the central estimate of the BT Group WACC by approximately 1%. Current values for key parameters including beta and the risk free rate are either already at, or even above, the upper levels of Ofcom's ranges.

- The range for WACC is not calibrated in a consistent fashion and Ofcom does not provide any rationale for its adopted approach. It is generally accepted that the future WACC is uncertain. However, Ofcom's approach to the assessment of the range does not appear to be consistent with the methodology it adopted in 2005 nor with other regulatory approaches to the construction of the ranges. This is a particularly critical matter given the turbulence in financial markets which is not expected to abate in the short to medium term.

BT also considers that Ofcom has given insufficient consideration to the relationship between its chosen methodology to construct a range for the WACC, the choice of a WACC value and investment incentives (with the consequential impact on consumers). By contrast, the Competition Competition/Civil Aviation Authority ("CAA") recently adopted a quite different approach for airports and BT considers this to be a more appropriate way of accounting for asymmetries in welfare loss arising from under/over-estimation of regulatory WACC.

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[1] The views in this Annex B are those of BT Group. However, the views and analysis contained within this Annex are supported by Openreach, a line of business within BT.

In this context, it should be stressed that the implications for investment extend considerably beyond NGA fibre to all players in the marketplace across the totality of their investments which are affected by the regulated services of BT's entire portfolio.

B.1.2 BT's Estimates for WACC

BT has provided alternative central estimates of the WACC. These central estimates have a wide range of uncertainty dependant on the range of parameters used. They could be higher than the values quoted below, as, for instance, measures of the risk-free rate continue to rise (see Annex C Figures 2.5 and 2.6). A range (confidence interval) has been calculated which increases the central estimate by about 1.5% at the 90th percentile. Accordingly Openreach's cost of capital should be set towards the upper limit of this range, at 12.1% or more.

A summary of the relevant parameters underpinning WACC and a comparison of BT and Ofcom is shown in the two Tables below which respectively give detail on the computation of the central estimates and the ranges.[2]

Table B.1 Comparison of Ofcom and BT views on regulatory WACC (taking midpoint of parameter values)

	Ofcom			BT			
	Openreach	**RoBT**	**BT Group**	**Openreach**	**RoBT**	**BT Group**	**BT Range**
Risk-free rate (%) nominal	4.4%	4.4%	4.4%	4.6%	4.6%	4.6%	4.4-4.8%
Equity risk premium (%)	4.6%	4.6%	4.6%	5.0%	5.0%	5.0%	4.0-6.0%
Tax rate (%)	28%	28%	28%	28%	28%	28%	
Gearing (%)	35%	35%	35%	35%	35%	35%	
Equity beta	0.75	0.95	0.85	0.90	1.10	1.00	0.85-1.05
Pre-tax cost of equity (%) nominal	10.9%	12.2%	11.6%	12.6%	14.%	13.3%	
Post-tax cost of equity (%) nominal	7.9%	8.8%	8.3%	9.1%	10.1%	9.6%	
Cost of debt pretax (%) nominal	6.9%	6.9%	6.9%	7.1%	7.1%	7.1%	

[2] Table B.2 presents percentiles for the WACC, based on a Monte Carlo simulation methodology. Notice that this indicates a higher midpoint value and wider confidence interval than in the Ofcom assessment.

Debt premium (%)	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.0-3.0%
Pre-tax WACC (%) nominal	9.5%	10.4%	9.9%	10.7%	11.6%	11.2%	

Table B.2 Mid point and percentile values for WACC

BT	**Ofcom**			**BT**		
	Mid point	75th Percen.	90th Percen.	Mid point	75th Percen.	90th Percen.
Openreach	9.5	10.4	11.0	10.7	11.5	12.1
RoBT	10.4	11.4	12.1	11.6	12.5	13.3
Group	9.9	11.0	11.5	11.2	12.1	12.8

B.1.3 Comparison with other sectors

Ofcom's proposals could mean that BT is being given a lower WACC than settlements for other telecom companies in other EU countries and indeed other sectors of the UK economy on a like-for-like basis.

The CAA recently awarded British Airports Authority (BAA) a WACC which disaggregated Heathrow and Gatwick for variation in systematic risk. The former had a higher WACC almost 1% than the mid-point of the range Ofcom is proposing for Openreach and the latter, a WACC 0.8% higher than the mid-point of Ofcom's range for BT Group as a whole.

Recent regulatory settlements by the French communications regulator, ARCEP, and the Irish communications regulator, ComReg, provided for higher settlements than the mid-points that Ofcom is proposing for BT. Indeed, even if Ofcom adopted the top end of its range for BT Group, this would be less than ComReg awarded the incumbent Eircom in Ireland.

B.1.4 Incentives to invest

BT has substantive concerns about Ofcom's methodology for constructing the range for the WACC, as we believe this in itself has a material impact on incentives to invest. The choice of range – and the means of its construction – directly impact on the extent to which Ofcom may wish to err on the side of caution to ensure that worthwhile investment is not artificially depressed.

Ofcom suggests that 'uplift' to WACC can be given on a service or project – specific basis with BT having the burden of proof to justify the increase. BT has major difficulties with this approach and considers that absent much more detailed explanation, it would probably be unworkable in practice, unpredictable in its consequences, and give investors no comfort whatsoever that BT would be able to earn a proper rate of return. It would reduce

investment incentives and might prevent BT from being able to secure necessary funding.

BT is attracted to the methodology of incentivising investment proposed by the Competition Commission and accepted by the CAA in the recent airports determination which made allowance for asymmetry in welfare losses from under-rewarding investment. Using this methodology could easily raise the BT central estimate of WACC by the order of 1.5%.

BT considers this is a completely reasonable and proportionate stance given the current telecom environment, the state of financial markets, and given that BT and other operators are contemplating significant high risk investment over the coming review period. This level of WACC is further supported by a wide range of financial analysts and institutions as demonstrated in the accompanying reports to this submission.

B.2 The central estimate of the WACC

B.2.1 Approach

BT has a number of detailed comments to make on the analysis underpinning the central estimates and ranges of the parameters which comprise the WACC. These are provided below and the following Section gives consideration to the construction of an appropriate range for the WACC.

There is a substantial highly technical literature on alternative ways of estimating the CAPM parameters which BT does not address: our comments are essentially based on the methodology which Ofcom itself has adopted.

B.2.2 The Equity Risk Premium (ERP)

Ofcom proposes a very narrow range for the ERP, of 4.5%–4.75%, and while the lower value is above the equivalent of 2005, at 3%, the upper value is actually also below the equivalent in 2005, of 5%. The Ofcom midpoint estimate for the ERP is about 4.6%.

The ERP range is significantly different from what might be expected; most commentators believe that the level of ERP is highly uncertain, and advocate *at least* a 2 percent range. Given the increased volatility in financial markets, which can be expected to persist for some time, this is certainly not a period in which the range for ERP can be assumed to be narrowing.[3] In addition, regulatory determinations in the past have adopted significantly higher ranges, as shown below in Table 3.

[3] See the accompany report by Oxera.

Table B.3 Equity Risk Premium ranges

Source	Range	
	Low	*High*
Ofcom [2005]	4.0%	5.0%
Myers [2008]	4.0%	6.0%
Schaeffer [2008]	2.5%	6.5%
Oxera [2008]	>3.5%	>5.0%
Europe Economics [2008]	3.5%	5.0%
ComReg	4.8%	6%
ARCEP	5%	5%
NERA [2008][4]	4.2	5.4
Ofcom [2008]	4.5%	4.75%

The recent determination for airports, of 2.5–4.5%, as adopted by the CAA [2008], was explicitly quoted by Ofcom. However as noted by Ofcom, this range attracted significant criticism from the leading academics such as Professors Schaefer and Myers as well as from other sources. It could be argued that the methodology which the CAA adopted implicitly sidestepped this range and took a value for the ERP which was at the upper bound of this range (assuming the adopted beta estimate was close to the middle of the range). It is therefore misleading to quote this range in evidence for the setting of a WACC using Ofcom's methodology.[5]

Myers [2008] suggests a range or 4–6% with (implicitly) a midpoint of 5%. He suggests there are some problems associated with the adjustments used in Dimson et al [2007] which may have been the primary influence on the range adopted by the CAA. He also argued that the observed historical values should have some influence over the top end of the range.

Schaefer [2008] gives a *central estimate* of 4.5%. He also remarks the standard deviation of historical returns is 2% but discusses whether this is a relevant measure of the likely level of uncertainty in the 'consensus view' of what the ERP is. He notes "there is no established way to proceed" given the "inescapable element of subjectivity in arriving at a view" on an appropriate

[4] This is not a true range as explained in the accompanying text.

[5] Indeed the advisors to the CAA Europe Economics specifically countenanced against presenting the range of the ERP in this way. Ofcom at Footnote 36 recognises that the range quoted (but not directly used) by the CAA was widely dismissed.

range of estimates.[6] However, he then proposes the above range and a standard deviation of 1%.

The Europe Economics [2008] commentary is rather unspecific on numbers but they remark that 4.5% is probably too low for the upper level for the ERP:

> … we have sympathy with the thought that the 4.5 per cent higher end estimate is a rather low "top of the range", if the range is conceived as expressing the full set of statistically plausible possibilities. For example, the error bounds exhibited by Smithers & Co suggest that, statistically speaking, the range of plausible values might extend higher as well as lower than 4.5.[7]

One could reasonably infer from this to mean that the upper level 'for regulatory purposes' is *at least* 5% for and something more than this for a confidence interval (perhaps 5.5% or 6%).

Oxera [2008] examines the evidence for increasing volatility arising out of recent and ongoing financial turbulence – and computes implied volatilities using options pricing data. This can give estimates of market expectations concerning volatility up to 1 year forward (given that this is the maximum maturity date for these traded options — maturities are 3 month, 6 month, 9 month and 12 month). They show evidence of rising volatility — indeed, their analysis shows that the average implied volatility has nearly doubled since 2006. This implies a higher ERP.

Oxera also refers to the considerable body of academic literature which elaborates upon the relationship between ERP and the variance of portfolio returns. Most of that literature shows that there is a significant positive relationship between the variance of the returns and the ERP (e.g. French, Schwert and Stambaugh [1987], Harvey [1989], Turner, Startz and Nelson [1989], and Baillie and DeGennaro [1990].[8]

NERA [2008] propose a range for ERP of 4.2–5.4%, although this should not be interpreted as a confidence interval. The range merely reflects the difference between the estimate based on geometric mean and arithmetic mean. A confidence interval would be wider and they quote a survey with a range of 4%–7% with a mid-point of 6%.

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6 Schaefer, S. (2008), 'BAA Quinquennial Review: The Cost of Capital for Heathrow and Gatwick', pp10

7 Europe Economics (2008), 'Supporting paper I: Advice to CAA on Aspects of Cost of Capital for the Final Price Control Decisions', p 14.

8 French, K., Schwert, G.W. and Stambaugh, R.F. 1987, 'Expected Stock Returns and Variance', Journal of Financial Economics, 19, 3–19. Harvey, C., 1989, 'Time-varying Conditional Covariances in Tests of Asset Pricing Models, Journal of Financial Economics, 24, 289–317. Turner, C., Startz, R. and Nelson, C. ,,1989, 'A Markov model of heteorskedasticity, risk, and learning in the stock market', Journal of Financial Economics, 25, 3–22. Baillie, R.T. and DeGennaro, R.P., 1990, 'Stock Returns and Volatility', Journal of Financial and Quantitative Analysis, 25, 203–14.

NERA [2008] also strongly criticises the range used by CAA [2008] and forcefully argues that the weight of evidence from academic work points strongly to the use of the historic data as the appropriate source for the forward looking ERP (and against ad hoc downward adjustments such as those proposed in Dimson et al [2007]).

Welch [2008] reports on his survey of academics views on the ERP and notes the average across the sample for a central estimate of the geometric mean ERP is around 5% with an inter-quartile range of 4%–6%. This agrees with BT's assessment of the mean and range for ERP.

Ofcom (A10.36) appears to dismiss this study arguing that it is not up-to-date. However, exactly the same criticism could be made of the ranges quoted by Ofcom in its Figure 2 – most of the sources quoted by Ofcom are even more out-of-date.

Comreg [2008] took a range of 4.8–6.0% for the ERP in the recent review of Eircom's WACC and ARCEP retained the ERP at 5%.

The 2008 Q1 Bank of England Quarterly Bulletin provides evidence to suggest that recent market conditions have impacted on the returns required by equity investors. According to the Bank of England:

> Accompanying the overall fall in UK equity indices, share prices became more volatile over recent months. Realised volatility of daily movements in the FTSE 100 index picked up further from around 20% to close to 27%. And implied uncertainty about future equity prices, inferred from options, indicated that market participants expected volatility to remain at these elevated levels. … Increased uncertainty about the macroeconomic environment could have prompted a rise in the risk compensation required by equity investors. According to a simple dividend discount model, recent price moves indicated a significant rise in the implied equity risk premium.[9]

Although some of these conclusions are qualified in the 2008 Q2 Bulletin, the latter nevertheless acknowledges that equity volatility remains high.

In summary, there is substantial support for a central estimate of *at least* 4.6% from both market evidence and academic studies. BT's central estimate of the ERP is 5%. There is little support for a central estimate below Ofcom's value of 4.6%, but there is significant support for a central estimate rather higher than this and certainly a range for the ERP which extends considerably above Ofcom's upper value.

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[9] Bank of England, 2008, 'Quarterly Bulletin', 2008 Q1, p. 8.

B.2.3 Equity Beta

(i) The Brattle Group analysis

Ofcom's proposed range for BT Group equity beta is 0.8–0.9 based on work undertaken by the Brattle Group [2008] which recommends a range of 0.7–0.9. However, "given the relative volatility and turmoil in credit (and to a lesser extent equity) markets" (Ofcom [2008] (para A10.52), proposes using the upper part of the Brattle range, from 0.8–0.9.

BT considers that the Brattle Group work is a useful starting point for considering the level to set for beta but that the analysis presented is incomplete: the analysis fails to identify a clear rising trend in BT's beta; it does not consider the impact of estimating beta using alternative market indices and does not purport to provide a forward looking estimate.

Nevertheless, it is reassuring that Brattle find that the simple OLS approach to estimation of beta, based on daily data and a 2 year data window, seems reasonably reliable. In particular they find that:

- There is no need to adjust for thin trading (a potential problem, given that daily data are being used).
- Heteroskedasticity and autocorrelation do not undermine the key results.
- Latest estimates (at least on a 2 year window) are not significantly influenced by outliers.

BT therefore supports the statistical methodology which Brattle has employed but disagrees on aspects of interpretation. In particular, the Brattle Group does not provide any explanation of how their range for beta is derived.

In essence there are three reasons which support a higher mid-point and range for beta which are examined below:

- The use of a World index or a weighted index would imply a higher beta.
- BT's beta has been rising from a historically very low level in 2006 and this recent evidence should be given weight.
- There are good theoretical reasons why the beta will regress to unity.

(ii) Choice of benchmark for index

The Brattle Group reports results for BT's equity beta against the usual FTSE All Share Index, but also against the FTSE all world index. There is however no discussion of the relative merits of using alternative market indices and the Brattle conclusions merely focus on equity beta estimated against the FTSE all share index. Ofcom [2008] also does not discuss the issue of 'choice of index'.

However, the choice of market index for use in the market model used here to estimate beta remains an open question. For stocks that are not well known

outside a country, there is arguably a case to use the appropriate country index. For stocks that are more heavily traded and internationally known to investors, it can be argued that this increases the rationale for using a world index.

Wright et al [2003] (see p. 104) discuss this in some detail. According to Wright, for large UK companies, the representative stockholder has an international portfolio, albeit one with a fair degree of 'home bias' in the portfolio. For this reason, Wright et al [2003] propose using a composite index (70% weighting on FTSE all share and 30% weighting on FTSE all world excluding UK index, for example). [10]

This is of some importance. BT group equity beta estimated against the Wright et al weighted index was fairly similar to that estimated on the FTSE all share index up to around 2005, but has risen significantly above it in 2007 and 2008, and the gap appears to be widening. The latest estimate of beta against this index is not statistically different from unity. This provides a further argument for choosing a central estimate for equity beta closer to unity.

Ofcom's [2005, para 6.95] preferred estimation window is 2 years. Table B.4 and Figure B.1 report on results for BT-group beta using the 2 year data window, against the FTSE all share, the FTSE all world, and the weighted composite index (with 70% and 30% weightings, as suggested by Wright et al [2003][11]).

[10] Wright et al suggests that 'One pragmatic approach is to take the CAPM as a guide and use as the market portfolio of risky assets a portfolio which reflects the composition of assets held by the dominant owners of the stocks in question' They propose that this might comprise a variety of UK and international assets.

[11] The results below use the FTSE all share and the FTSE all world excluding UK indices.

Table B.4 Trends in Beta estimates

Betas–2 year window			
End date	**FTSE all share**	**Weighted index**	**FTSE World**
06/06/2008	0.872	0.979	0.842
06/03/2008	0.777	0.867	0.760
07/01/2008	0.758	0.835	0.744
06/09/2007	0.747	0.806	0.629
06/06/2007	0.659	0.678	0.457
Betas – 1 year window			
End date	**FTSE all share**	**Weighted Index**	**FTSE World**
06/06/2008	0.877	0.995	0.893
06/03/2008	0.846	0.962	0.889
07/01/2008	0.860	0.967	0.960
06/09/2007	0.915	1.032	0.974
06/06/2007	0.788	0.831	0.626

Figure B.1 Rolling 2 year Beta

Figures B.2 and B.3 also report the results for rolling beta using shorter data windows (12 months and 6 months) which are included for completeness; there is greater inter-temporal instability in betas estimated over shorter time horizons although they are of interest in that they can be viewed as 'marginal' betas, relative to the 'average' beta estimated on the 2-year window.

While the Brattle Group starts its analysis in the period of the dotcom bubble, it ends in February 2008; a further 4 months data are now available. There is some evidence of rising beta over time in the original Brattle data, but the trend in beta becomes much clearer with the addition of the latest available data.

Figure B.2 Rolling 1 year Betas

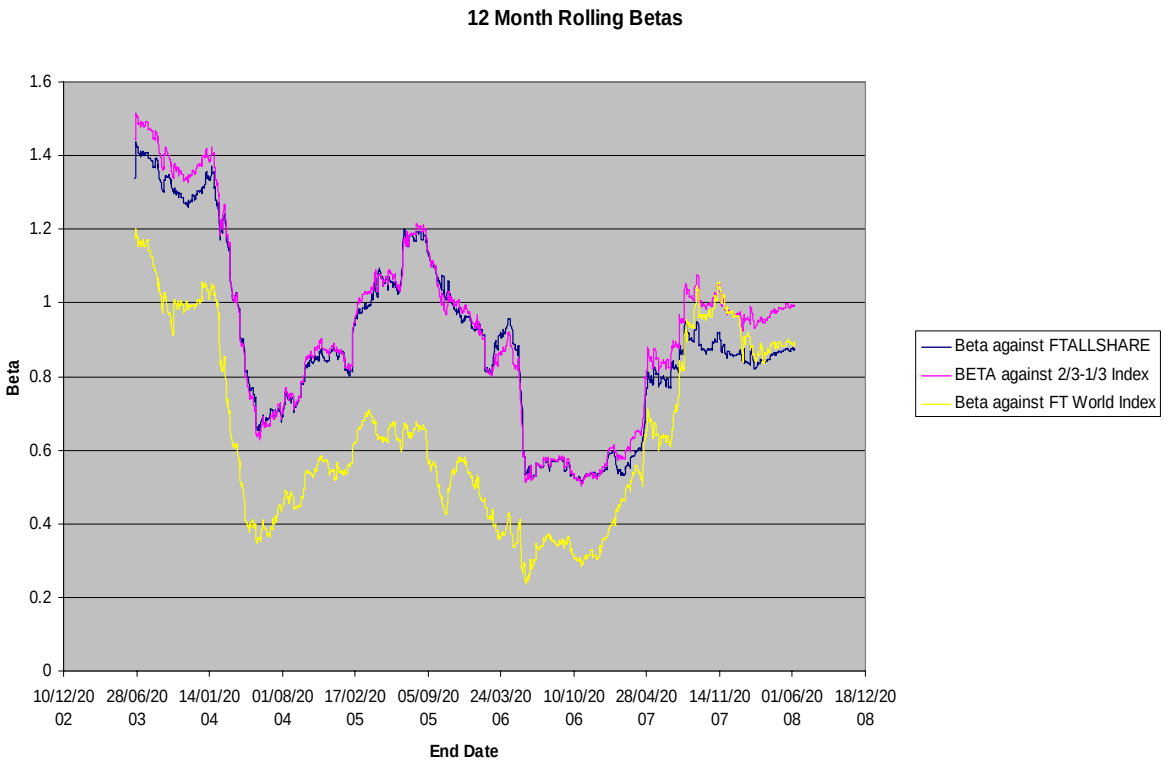
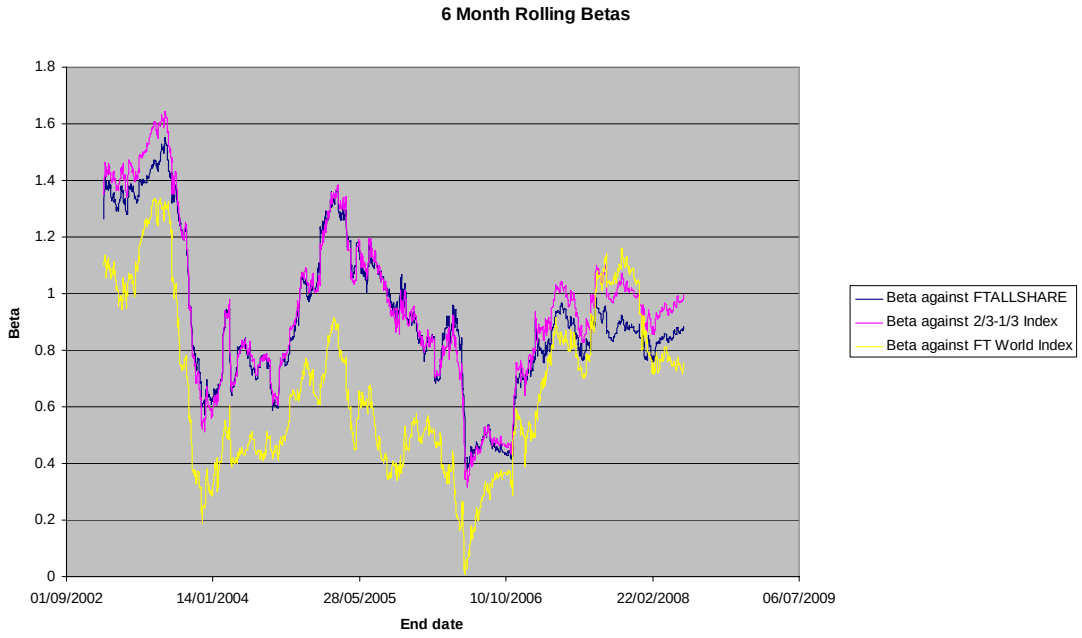


Figure B.3 Rolling 6 month Betas



(iii) Trends in beta

A further factor to consider is the period of unprecedently low beta during 2006. BT considers that it is strongly arguable that the creation of Openreach following the Telecoms Strategic Review in late 2005 led to a temporary reappraisal by the market of the likely stability in BT revenues and this temporarily depressed beta. It is reasonable to deduce that the market anticipated that BT would be subject to lower earnings volatility arising from the TSR including the ability of Openreach to earn its WACC on a consistent basis from the service provider of services associated with enduring bottlenecks. (The current review and concerns on BT's financial position reflect a very different perspective.)

It can be demonstrated mathematically that the beta factor can be expressed as the combination of two components: (a) the *relative* volatility of BT shares *vis a vis* the market; and (b) the correlation coefficient between the two sets of returns. BT's beta measured against the FTSE All Share (daily rate, 6 month data window) is presented in Figure B.4 along with the series of these two components. This analysis uses a 6 month rolling data window which is better suited to identify contemporaneous effects which are not observable using a longer window.

As seen in Figure B.4, subsequent to the TSR and creation of Openreach in the period of 05/2006 – 11/2006, the BT Group beta fell very sharply to below 0.5. This reduction can be traced to the sharp fall in the *relative* volatility of the share price of BT to the market as a whole (upper series in blue). In fact, at its lowest point the ratio of the volatilities was about 1.2 - an historical precedent.[12]

During late 2006, the series showing the relative volatility of returns climbed back up to a more typical ratio of about 2 and along with the rising correlation of returns (series in red), the beta (yellow series) climbed back to very close to unity for a period. Since 03/2007, the relative volatility series once more fell to a ratio below 1.5 which arose from the high volatility of stocks in general.[13] For much of 2008, this series has been rising so that it is now above 1.5 and with comparative stability in the correlation series (in yellow), the beta is rising to close to unity.

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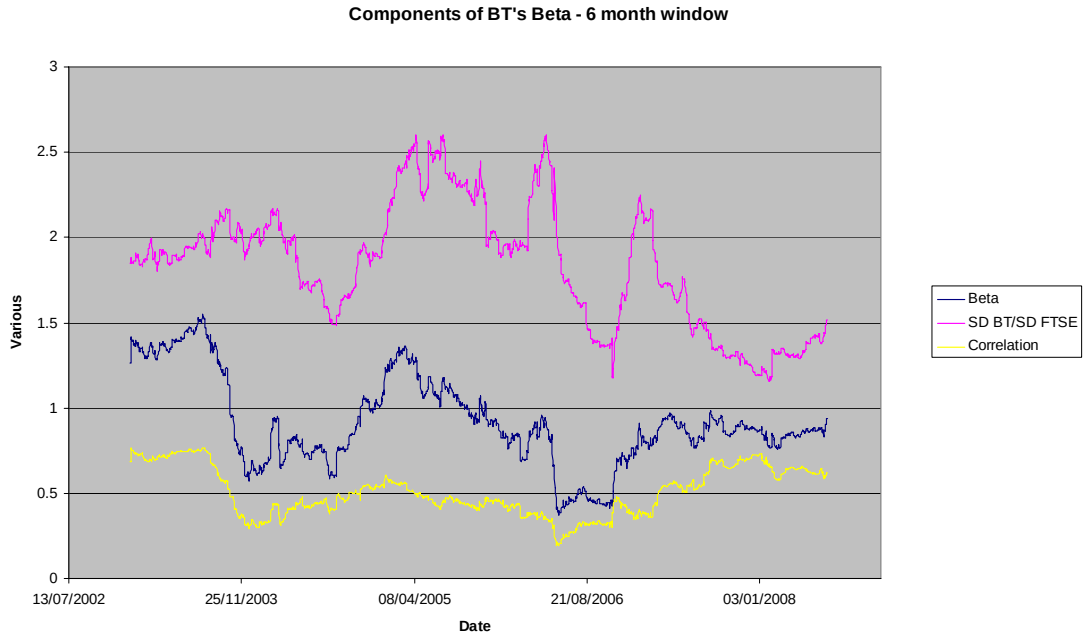
[12] The absolute volatility of the FTSE as a whole is lower than BT as it represents a more diversified portfolio.

[13] However, this fall in the ratio recently masks the increases in the absolute volatility of both series; since roughly mid 2007, the volatility of the stock market and BT have both risen sharply to levels not seen since 2003.

Figure B.4 Composition of BT's beta



Current beta estimates based on 6 month, 1 year and 2 year windows are very similar, close to 0.9 based on the FTSE All Share and higher than this if using a World Index with the 6 month Weighted index above unity. These are shown in Table B.5.

Table B.5 Beta estimates at 16 July 2008

Index	6-month	1-year	2-years
FTSE AllShare	0.936	0.852	0.874
World Index	0.906	0.888	0.895
Weighted Index	1.058	0.973	0.990

Focussing on Figure B.1, there is clear evidence that beta has been climbing from its low point around mid-2006, against *all* of these indices. The latest 2-year beta against the FTSE All Share is 0.874, whilst the latest against the weighted index is 0.990. At beginning of March (just after the end of the Brattle data period), the estimates were 0.777 and 0.867 respectively.

This upward trend in beta has broadly persisted since mid-2006. Equity beta on a 2-year window naturally puts equal weight on the 2 years worth of data; the shorter data windows reveal the upward trend toward unity more clearly. This is particularly the case for beta estimated against the recommended weighted index – BT's beta against this index has risen above and generally hovered around unity for the last year or so; this is clearly seen in Figures B.2 and B.3.

To emphasise the evidence, the current values for beta are already at or even above the upper bound of the range which Ofcom has proposed for BT Group. BT considers that this evidence is compelling and should form a material part of Ofcom's assessment — just as Ofcom put significant weight on the recent reduction in BT's beta at the time of the 2005 review.

Thus, putting most weight on the evidence based on the more recent data, and noting the general tendency of beta to 'regress toward unity' (Blume [1975]), there is an argument for centring the equity beta range closer to unity, even when equity beta is estimated against the FTSE all share index.[14]

(iv) Future beta for regulatory Determination

It is important to recognise that the requirement is a forward looking estimate for beta; Brattle simply reports on estimates of historic beta. That is, what is important is the likely average value and range for beta over the regulatory review period. Noting that the experience of beta following the outcome of the TSR during 2006, the latest evidence suggests really quite strongly that the range for equity beta should be set higher than Ofcom proposes.

The evidence suggests the following in summary:

- BT-group beta, estimated on a 2-year data window, shows a relatively steady upward trend (against all indices). This upward trend is suggestive that future beta is highly likely to be above current beta.
- There are theoretical arguments why, relative to the beta measured using historical market data, an estimate of future beta should be adjusted toward unity.
- The evidence on beta estimated against the FTSE AllShare suggests a central estimate for *current beta* of about 0.9.
- There is a reasonably strong case for putting at least some weight on the world index when considering beta estimation. The evidence on beta estimated against the weighted index is that this is indistinguishable from unity.

BT's view is that the relevant index is the weighted index, and that the central estimate for Group beta should be unity, with a range of 0.9–1.1. The recent determinations by ComReg and ARCEP had beta values of 1.02 and 1.0 for

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[14] Academics have noted some tendency of beta to 'regress to unity' (following the seminal article by Blume [1975]). This provides a rationale for using adjusted betas when forecasting future beta. For example, the simple estimator for Beta as (2/3) the historical raw beta plus (1/3) of unity is often used. Also, given the population average beta of unity, it can be argued that sample estimates that deviate from this are more likely to be affected by sampling error. Bayesian adjustments then imply some adjustment in the beta estimate toward unity (Vasicek [1973]). These observations also motivate choosing an estimator of future beta at a value closer to unity, compared to the evidence from historic data.

the incumbent operators respectively at notional gearing ratios only a little higher than BT's at 40% compared with BT at 35%.

BT considers that beta estimates obtained using the Wright et al Weighted Index are relevant, given the international scope of BT's operations and that finance is raised by BT outside the UK. This suggests even more forcefully that the forward-looking estimate for beta should be at least unity. If, in order to be consistent with its previous analysis, Ofcom chooses to adopt the FTSE All Share Index, then the central estimate for *the forward-looking* beta measured should be at least 0.95, with a range of 0.85–1.05.

B.2.4 Openreach Equity beta

BT remains of the view that there is no compelling evidence to suggest that Openreach should be attributed with a beta significantly different from BT Group. We recognise that there is a theoretical argument that can be put forward on the comparative stability of revenues for Openreach with respect to the economic cycle on beta. This is not self-evident; a beta value for Openreach of 0.9 as a central estimate might be viewed as reasonable, with a range of 0.8–1.0.[15]

B.2.5 The Risk Free Rate and Inflation Assumptions

In comparison with the 2005 Determination where a single number was used for the Risk Free Rate (RFR), this Consultation proposes a range of 4.2–4.6%.

BT considers that constructing a range for the RFR is appropriate. The RFR over the regulatory review period is unlikely to remain constant, and investments made at different times are likely to incur different financing costs. That is, if the allowed rate of return was continuously indexed to account for future changes in the risk free rate, the level of uncertainty concerning the rate would be merely that associated with estimating the current rate (and thus the range would be fairly narrow). In the absence of such an adjustment clause, it is appropriate to recognise this by using a somewhat wider range.

The difference between the high and low end of the range for the RFR (0.4%) might be seen as reasonable in this context, but BT considers that the lower end of the range is too low and the midpoint should be above 4.4%. BT would suggest that if a range is to be used, then it should be *at least* 4.4%–4.8%.[16] *In any case, the current (spot) value of the RFR is already substantially above the upper bound which Ofcom proposes as shown in Table B.6 below.*

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[15] This is consistent with Ofcom's adjustments from the Group values.

[16] The reason for this lies with certain biases that can arise in estimation procedures. See NERA, [2007] for a fairly detailed review of the issues and alternative estimation approaches. It is also relevant to note that based on yields in early August when Ofcom's analysis is replicated, the range increases to 4.6%-4.9%/ The accompanying Oxera Report suggests that yields may have also recently been depressed by large movements in capital.

BT believes that it is reasonable to recognise potential sources of bias on interest rates arising from various distortions concerning the demand and supply of Government securities of different types, for example:

- From institutional investors (notably pension funds).
- From recent turbulence in financial markets (which may have tended to boost the demand for Government securities and so depress yields).[17]
- From the experience of inflation (the level is expected to be persistently over target for the next 2 years and uncertainty over its future level is clearly higher than it has been for some time) with expressed doubts by the Bank of England of its ability to keep to the target level.[18]

It can also be argued that the average nominal rate of interest likely to hold over the regulatory review period may be rather higher than the midpoint, 4.4% of this range from the choice of comparator. Ofcom focuses on 5 year nominal zero coupon gilts. There is a case for also considering 10 year and 20 year Gilts; whilst 5 year Gilts have a duration similar to the regulatory review period, the 10 and 20 year Gilts have duration more similar to the duration of BT investments.

Table B.6 gives some results (as per Figure 5 in Ofcom [2008]) for these bonds, and Figure B.5 charts the nominal rates over the last 5 years.

[17] Which no doubt explains the reduction shown during 2007 on Ofcom Figure 4.

[18] As shown in Ofcom Figure 5 where nominal inflation is above 3%. The Consumer Price Index was 3.8% in June and the Governor of the Bank of England is reported as saying that it is expected to rise above 4% later this year.

Table B.6 Historic averages for nominal interest rates[19]

	20 year zero coupon Gilts	10 year zero coupon Gilts	5 year zero coupon Gilts
Monthly average (Month end 30 June 2008)	4.88	5.14	5.17
Monthly average (Month end 31 May 2008)	4.78	4.84	4.64
Monthly average (Month end 31 April 2008)	4.70	4.64	4.27
Monthly average (Month end 31 March 2008)	4.53	4.45	4.04
Averages over the last			
3 months	4.79	4.87	4.69
6 months	4.64	4.69	4.46
1 year	4.62	4.80	4.73
2 years	4.49	4.76	4.85
3 years	4.39	4.61	4.67
5 years	4.49	4.65	4.65

[19] Data source: Bank of England

Figure B.5 Nominal interest rates (from Zero Coupon Gilts)

A number of points can be made concerning the time paths for nominal interest rates. For 10 and 20 year Gilts, interest rates have generally been above 4.5% for at least a year or so. The other feature is that the rates for 5 year Gilts were higher than for 10 and 20 year Gilts, but have been falling since August 2007 below the 10 and 20 year rates since the beginning of 2008, but have started to rise again and are now back to their historic position of a little above the 10 and 20 year Gilts.

In many ways, in making a judgement about future interest rates, Figure B.5 is more revealing than the simple averages reported in Table B.5 (as these averages are all based on the same end date of 31 May 2008). Simple visual inspection of these graphs strongly indicates that Ofcom's proposed range of 4.2%–4.4% is too low. To put into perspective, NERA [2008] quote a nominal RFR of 5.30% as relevant over the historic ten year period of 1998-2008 against a comparator of the RPI rather than the CPI. NERA [2008] notes that of the nine key regulatory settlements in the UK over the last 8 years, the real RFR has been set at either 2.5% or 2.8%.

In summary, the objective is to make an assessment of the level for the risk free rate that is likely to hold over the coming regulatory review period. BT is therefore of the view that the central estimate of *at least* 4.6% should be accompanied by a range of *at least* 4.4%–4.8% given expectations of increases in rates in the short to medium term. This view is strongly supported by the accompanying report by Oxera in Annex C to this Response.

B.2.6 The Debt Premium

BT notes and agrees with Ofcom that the BT Debt Premium has risen considerably since 2005. In fact, the most recent debt issues by BT have premia in excess of 300bps above the top of the Ofcom range. The range proposed by Ofcom appears to be reasonable but in BT's view, the central estimate for the Debt Premium cannot be below the midpoint of this range. BT therefore is in agreement with a range of 2%-3% with a central estimate of no less than 2.5%.

BT has invited Oxera to provide commentary on the origins of the rise in debt costs which gives context to the high costs of debt and availability of finance. Their report gives firm evidence that the rise in debt costs will be a durable feature of financial markets for a considerable period of time.

B.3 Constructing a consistent range for the WACC

B.3.1 Methodology

BT has a number of observations to make on the principles underpinning the construction of a range for the WACC as well as specific comments on the particular values which Ofcom presents in Tables 1 and 2 of the Consultation.

The approach taken by some UK regulators concerning ranges for parameters, and how these translate into ranges for the final WACC, might be seen as unsatisfactory. The problem is that there is no commonly agreed methodology in UK regulatory determinations for how to 'combine' ranges for different parameters into a range for the WACC itself. For example, it is clearly not appropriate to simply take the extremes for each parameter when computing an overall range for WACC.

Ofcom's approach in this Consultation has some unique features which BT has not observed in any other comparable regulatory assessments of WACC. Whereas in 2005, the only source for a range for overall WACC was from a range for the ERP (all other parameters were deemed to be point estimates and known 'for certain'), in this Consultation the major source of uncertainty is in the debt premium, a parameter which has hitherto been taken to be known with a high degree of certainty. BT agrees that there is uncertainty in the debt premium, but there is also uncertainty in all the other parameters as well.

Ofcom's current assessments generate a narrow range for WACC, of only 1%, for two reasons. Firstly, Ofcom takes a very narrow range for the ERP which, as noted above, is an unusual practice. Secondly, Ofcom implicitly assumes perfect negative correlation between the risk free rate and the debt premium. Whilst some degree of negative correlation might be an appropriate assumption, Ofcom present no evidence for the procedure. Consequently, it is impossible to construct Ofcom's ranges from the ranges in the parameters which underpin the WACC itself as it is not possible to meaningfully combine the ranges of the risk free rate and the debt premium.

To illustrate the unusual nature of the Ofcom ranges, Table B.7 gives the impact of Ofcom ranges on the WACC. In each case, midpoint values are

used for all parameters, and then for each parameter in turn, it is flexed from the lower to the upper value in the Ofcom range.

Table B.7 Ofcom ranges – impact on WACC (BT calculations)

Parameter	% point impact on WACC
Debt Premium	0.35%
Risk Free Rate	0.50%
ERP	0.17%
Beta	0.42%

Ofcom's analysis has the RFR having the biggest impact on the range in the WACC and the ERP having the least, which is not what would be anticipated.

There is no established approach to 'combining' ranges for different parameters. Although never articulated, in our opinion, regulators actually have in mind what looks like a reasonable range for WACC, and then construct essentially arbitrary ranges for input variables (ERP, Debt premium etc.) in order to realise this range. None of the ranges for input variables are interpreted as confidence intervals – or anything else.

In might be more transparent simply to use best estimate parameter values and, subsequently, add a range to that central estimate of WACC. However, whilst straightforward, such an approach is not satisfactory. The confidence interval for the WACC distribution is unlikely to be invariant across firms and sectors (given variations in standard errors on beta, debt premia and also because of variation in gearing levels). For this reason, the WACC range needs to be assessed in a more coherent and consistent way.[20]

BT's endorses the adoption of the methodology used in the regulatory review of Heathrow and Gatwick Airports. This used a Monte Carlo simulation approach to derive an approximate probability distribution for the WACC, followed by then explicitly choosing a percentile value above the median for the regulatory WACC. Such an approach has been widely advocated in recent work; see e.g. Bowman [2004, 2005], Dobbs [2008], SFG [2005], CEPA [2006], PWC [2006].[21]

If welfare losses arising from under- versus over-estimation are not significantly asymmetric, then it is reasonable for Ofcom to select a 'best estimate, a 'mid-point' or 'average value' for the regulatory WACC. However, Ofcom has previously acknowledged that there is likely to be significant

[20] See also Schaeffer (2007).

[21] Schaefer [2008] also proposed this methodology – see the Europe Economics [2008] paragraph 2.76.

asymmetry in the loss function, with the losses arising from under-estimation likely to greatly exceed those from over-estimation (see Ofcom [2005]). This point has been fully accepted by many other regulators across widely differing sectors including Ofgem and the CAA as well as the Competition Commission.

The logic then is that the regulatory WACC should be set at a point above the mean value of the WACC distribution. The key point to understand here is that if this idea is accepted but the distribution for the WACC is not formally assessed, the ranges assumed by the regulator start to play an important role in determining the choice of WACC.

Assuming very narrow ranges for key parameters is likely to introduce a bias and, potentially, lead to a lower WACC, which would not provide the appropriate incentive to invest. Ofcom's approach here has some of these features from its rather unusual approach to the derivation of ranges at the individual parameter level as noted above.

Whilst it is our view that the simulation approach has much to recommend it, if nevertheless Ofcom does not adopt such a methodology, it is still of concern that the ranges it assesses should be internally consistent. The following section therefore compares ranges using the more traditional approach.

B.3.2 WACC Ranges

Table B.8 presents Ofcom's parameter values and ranges for both 2005 and 2008 and also BT's equivalent values.

Table B.8 Estimates for key parameters and ranges (BT Group)

Variable/Parameter	**Ofcom 'conservative' Assessment at July 2005**	**Ofcom probable 'best estimate at July 2005**	**Ofcom 2008 Condoc Midpoint range**	**BT 2008 Assessment Midpoint/ range**
Risk free rate	4.6%	4.6%	4.4% [4.2-4.6]	4.6% [4.4-4.8]
Equity Risk Premium	4.5% [3.0-5.0]	4.0% [3.0-5.0]	4.6% [4.5-4.75]	5.0 [4.0-6.0]
Equity Beta	1.1	1.0	[0.8-0.9]	0.95 [0.85-1.05]
Debt Premium	1.0%	1.0%	[2.0-3.0]	2.5 [2.0-3.0]
Corporate Tax Rate	0.3	0.3	0.28	0.28
Gearing	[0.3-0.35]	[0.3-0.35]	0.35	0.35

B.4 Comparison with other companies

It is not straightforward to make comparisons either within or between different sectors of the economy even where regulators use the same underlying CAPM model to calculate WACC. There is some considerable variation in the choice of WACC itself with many UK regulators adopting a post-tax real return with an uplifted HCA asset base and this too is not straightforward to convert into the formula used by Ofcom based on CCA. Companies may also differ markedly in their capital structures.

Nevertheless BT considers there is some merit in undertaking a benchmarking exercise and this Section includes information on Ofcom's proposals and on recent decisions by ComReg and the CAA/Competition Commission. We have included the ARCEP decision but there is circumstantial evidence that France Telecom is significantly benefiting from lower debt costs through significant state ownership and, for example, reflected in the low Debt Premium.[22]

Within the CAPM/ Modigliani-Miller framework, a firm's expected return on equity, and its associated equity beta, are theoretically dependent upon two key firm-specific factors: (a) the underlying systematic risk of its operating assets, and (b) the level of gearing.

Different firms do different things; they have different products and services. In theory, the systematic risk of a firm, and hence the firm's asset beta should reflect what it does. That is, a firm whose operating profits fluctuate in ways that are largely independent of the macro-environment and financial markets should have a relatively low asset-beta. Firms whose cash flows are heavily pro-cyclical are more likely to have a higher asset beta.

Given the underlying asset beta for a firm, its expected return on equity, and its equity beta, can be driven to any given higher level by an appropriate choice of gearing. That is, increases in the extent to which the firm finances itself using debt will lead to increases in the riskiness of the residual return to equity, and hence will lead to increases in the expected return on equity – and increases in the equity beta.

Given this it is difficult to directly compare the WACCs estimated by different regulators for different firms. It is of course meaningful to compare the regulators' estimates for economy-wide components used in the computation of the WACC; that is, for the risk free rate and for the expected risk premium (or the expected return on the market) and these comparisons are presented above.

The point is that, with different gearing and different lines of business, there are legitimate reasons why the WACC estimates should not be the same, since firm-specific components can legitimately vary. The best that can be done, by way of comparison is to consider whether the differences in

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[22] There is a long-running State Aid case being conducted by the Commission on this issue.

estimates are consistent with differences in underlying operating risk and/or gearing.

It is possible to adjust for gearing; that is, it is possible to make a prediction of what the WACC would be for an unlevered (all equity) company. The validity of the de-gearing calculation depends upon assumptions, and its empirical performance is not particularly robust.

However, to illustrate the type of computation involved, assume a Modigliani-Miller (MM) world in which there are corporate taxes. It then follows that the return on equity can be written as:

$$R_e = R_u + (D/E)(1-\tau_c)(R_u - R_d)$$

where R_e is the expected return on equity of the levered firm nominal post tax; R_u is the post tax expected return on equity on the firm when it is unlevered i.e. it is the WACC when there is no debt); R_d is the return on debt pre-tax; τ_c the corporate tax rate; and D/E is the gearing (debt/equity) ratio.

Rearranging this:

$$R_u = \frac{R_e + (D/E)(1-\tau_c)R_d}{1+(D/E)(1-\tau_c)}$$

Thus, given estimates for the return on equity and the return on debt, and under the assumption that the return on debt is fixed as gearing is changed, the WACC of an unlevered firm can be recovered. This is the after corporate taxes unlevered WACC. The pre tax version is then given as:

$$R_u/(1-\tau_c)$$

These formulae are used to compute unlevered WACCs across recent regulatory determinations in Table 9 (which also adjusts to give nominal rather than real WACCs, for ease of comparison with the nominal WACC determination made by Ofcom). Table 9 converts the ARCEP, ComReg and CAA determinations onto equivalent bases i.e. they represent 'ungeared' values of WACC all using a common rate of corporation tax at 28% and an assumed inflation rate of 2.5%.[23]

[23] The adjustment for inflation is simply that the real risk free interest rate is converted into a nominal one by adding a 2.5% inflation rate across the board. The computation of the before/after tax equity returns is then after having computed the nominal risk free rate and the nominal equity market return. This makes some sense since taxes are applied to nominal cash flows (not real cash flows).

Table B.9 Recent regulatory determinations (standardised for 28% tax and for gearing)

Regulator	Ofcom			CAA	CAA	Arcep	Comreg	Ofcom mid-point proposal		
Sector Determination	Openreach	Rest of BT	BT	BAA Airports Heathrow	BAA Airports Gatwick	France Telecom	Eircom	Openreach	Rest of BT	BT
Date of Determination	Aug-05	Aug-05	Aug-05	Mar-08	Mar-08	May-08	May-08	May-08	May-08	May-08
Vanilla WACC (%) nominal	7.57	8.52	8.14	7.93	8.15	7.78	8.67	7.53	8.13	7.83
Pre-tax WACC (%) nominal	10.00	11.40	10.84	9.52	9.82	9.92	11.07	9.52	10.35	9.94
Post-tax WACC (%) nominal	7.00	7.98	7.59	6.85	7.07	7.14	7.97	6.85	7.45	7.15
Pre-tax WACC (%) nominal, unlevered	11.14	12.61	12.02	11.44	11.80	11.20	12.46	10.55	11.48	11.02
Post-tax WACC (%) nominal, unlevered	7.80	8.83	8.42	8.24	8.49	8.07	8.97	7.60	8.26	7.93

Table B.10 Comparison of Ofcom and BT assessments of Regulatory WACC (Central Estimates 2008)

Regulator	Ofcom			BT view		
Sector Determination	Openreach	Rest of BT	BT	Openreach	Rest of BT	BT
Date of Determination	May-08	May-08	May-08	May-08	May-08	May-08
Vanilla WACC (%) nominal	7.53	8.13	7.83	8.40	9.05	8.73
Pre-tax WACC (%) nominal	9.52	10.35	9.94	10.70	11.60	11.15
Post-tax WACC (%) nominal	6.85	7.45	7.15	7.70	8.35	8.03
Pre-tax WACC (%) nominal, unlevered	10.55	11.48	11.02	11.86	12.86	12.36
Post-tax WACC (%) nominal, unlevered	7.60	8.26	7.93	8.54	9.26	8.90

The most relevant comparator row is that of the pre-tax nominal WACC 'unlevered'. It can be seen that BT Group is lower than both the other telecom companies and both airports.

An approximate calculation can also be made taking the *upper value* of the Ofcom range for BT Group at 10.5%, this would translate into an unlevered pre-tax WACC of about 11.6%.[24] *This would be significantly below the award to Eircom and also be below Gatwick Airport. BT contends that this is unsustainable*. *Ofcom's range is undisputedly too low*. This arises from Ofcom adopting central estimates for the CAPM parameters which are too low and a range for the WACC which is not entirely consistent with the ranges for the constituent parts.

Using the same formulae, Table B.10 compares the mid-points of Ofcom and BT, also on equivalent bases. It can be seen that BT's mid-point value would still be below the award to Eircom by a modest margin. This itself seems perverse given that the market position of Eircom is of traditional dominance at both wholesale and retail levels in all fixed infrastructure services in contrast to BT where Ofcom has recently deregulated large parts of the UK from wholesale broadband obligations.

[24] Taking the ratio of 9.94 and 11.02 in Table B.7.

B.5 Incentivisation of investment

B.5.1 Ofcom's approach — giving uplift to services

Ofcom in this Consultation, in contrast to the equivalent consultation in 2005, devotes very little space to the issue of incentivisation of investment. BT recognises that Ofcom has issued a number of other related consultations, for example on NGN and NGA, which link to this matter - but we would have welcomed a rather more extensive discussion of how the setting of the WACC affects the investment strategies of BT and other industry players.

In particular, while the issue of welfare losses arising from changing tariffs for existing services is briefly discussed by Ofcom in the Impact Assessment (Annex 5), there is no discussion of the importance of asymmetries in welfare loss associated with dampening future investment from setting the WACC below its 'true' level, or of how this links to the calibration of ranges for the WACC itself.

If the aim is simply to choose a 'best estimate' for the WACC, the choice of ranges might be of limited consequence (assuming midpoints of such ranges are not biased). However, if the aim is to choose a regulatory WACC above the midpoint, then the extent of the assessed range has a material impact. The narrower the range, the smaller the adjustment that is likely to result. For example, if the decision is taken to set the WACC at the 75th percentile of the probability distribution, then the wider the distribution (range), the higher the determined WACC itself.

Any bias in the estimated range (too small in the current Ofcom Consultation) - is likely to result in too small an uplift in the Regulatory WACC relative to the mean value of the WACC distribution.

Ofcom's previous approach in 2005 was to err on the side of 'caution' implying an assessment for regulatory WACC above the central point. That is, to set a value that is above the central estimate of the estimated WACC distribution (in order to take account of welfare loss asymmetries associated with under versus overestimation concerning the true WACC). In adopting this approach, Ofcom had been consistent with other regulatory bodies; unless Ofcom abandons this approach, the range it assesses for the WACC distribution plays a role in the final WACC determination.

B.5.2 BT's comments on Ofcom's approach to incentivisation

Ofcom indicates that it has not moved from previously stated positions that uplift to WACC would have to be assessed on a project-specific basis.[25] Ofcom has made clear that the burden of proof is on the stakeholder i.e. BT to demonstrate that the market demands higher returns because in a 'quasi-

[25] BT refers to the analysis of 'real options' made by Ofcom in the 2005 NGN Consultation and subsequent statements in 'Future Broadband' regarding asymmetries from risk, including regulatory risk.

competitive' market, finance will not be forthcoming for the investment at the lower (regulated) return.

In essence, Ofcom repeats this line of argument in the current Consultation at 6.51–6.54 and A10.57–A10.63.

BT has some concerns with this approach. The first is the level of burden of proof on BT prior to making the investment to demonstrate a *prima facie* case for such an uplift. Secondly, it assumes that Ofcom will actually then undertake what would be a mixture of ex ante and ex post assessment of risks (the latter returns being observed after assets have been in place for a period of time). Both factors will negatively impact on investors' willingness to finance such infrastructure investments – as they will doubt the ability of BT to earn the proper rate of return on such investments.

Cash flows by definition will only be visible after the investment is made and products are sold in the marketplace. Many projects are highly interlinked not only delivering related services at the network layer, but also to a multiplicity of downstream services to completely different sets of consumers and end-user markets. Some of these markets could be regarded as highly competitive, whilst others might have some element of market power.

It would be a challenging task for Ofcom or any other party to disentangle the approximate, let alone precise, proportion of any one project which might be due an uplift on WACC calculated using CAPM. Networks are built using common capabilities of support systems and platforms and in any case, may not comfortably sit within one specific line of business within BT.

BT therefore has very significant reservations on the suggestion that specific services have to be demonstrable as justifying any uplift of WACC from a central estimate value.

B.5.3 BT's view on uplift to WACC

It is precisely for these reasons that BT is interested in the methodology advanced by the Competition Commission in the case of airports. They recognised that it is feasible to set the level of regulated WACC explicitly taking account of both uncertainty in the WACC and from asymmetries in welfare.

Indeed, given a trade-off between under and over-investing, it is possible to set the relevant percentile precisely. Hence the CAA implicitly set the overall WACC at the 95th percentile for airports outside the naïve range of parameters which Ofcom quotes for example for the ERP.

In this section, we set out our estimates of the distribution function for the future WACC for BT and compare how these distributions relate to Ofcom estimates based on central estimates and truncated distributions as discussed above. As the Consultation will result in a WACC specifically for Openreach, these results are presented; comparable simulations are available for the rest

of BT Group and summaries of the percentiles for Rest of BT (RoBT) and BT Group are shown below.

Table B.11 presents Ofcom and BT central estimates along with ranges which are suitable for statistical simulation. The assumed standard deviations are approximate estimates – naturally these figures can be debated and likewise, the upper and lower bounds imposed on variables can also be debated.

Table B.11 Distributional assumptions underpinning the WACC distribution (Openreach)

Parameter/Variable	Distribution	Ofcom Openreach Mean	BT Openreach Mean	S.Dev	Min	Max
Gearing L=D/V		0.35	0.35		0.35	0.35
R_f *(nominal)*	Normal	4.4%	4.6%	0.3%	3.8%	5.8%
ERP	Normal	4.625%	5.0%	2%	3%	7%
Equity Beta	Normal	0.75	0.9	0.1	0	2
Tax Rate		28%	28%		28%	28%
Debt Premium	Normal	2.5	2.5	0.3%	1.5%	3.5%

As a preliminary application, it is assumed that all variables are distributed normally and are uncorrelated. This is an assumption commonly made in most previous work of this type e.g. Bowman (2005). Additional work (not reported) also suggests that that the results do not seem to be particularly sensitive to making alternative assumptions concerning correlations.

The simulation works by taking sample drawings for each parameter from the above distributions, and for each drawing calculating a WACC. The simulation procedure involves making a large number of drawings (1 million in this application), in order to develop an empirical distribution for WACC. Any drawing which lies outside the ranges in Table B.11 are discarded (so variables are in fact distributed as truncated normal).

Using the data in Table B.12 the simulation methodology generates the following results for the WACC distribution.

Table B.12 Mean and Percentiles for pre-tax WACC for Openreach

	Ofcom View	**BT view**
Mean	9.72	10.70
Std. Dev.	0.93	1.05
95% Confidence Interval	8.3-11.3	9.06-12.50
Percentiles		
50th	9.66	10.66
55th	9.78	10.81
60th	9.92	10.96
65th	10.05	11.12
70th	10.20	11.28
75th	10.36	11.46
80th	10.53	11.65
85th	10.73	11.86
90th	10.98	12.13
95th	11.34	12.50
99th	11.98	13.16

It can be seen that the current (2005) regulatory WACC of 10% corresponds to around the 65th percentile of the WACC distribution according to Ofcom's [2008] view. As discussed below, the economic literature that has tackled the choice of WACC in the face of asymmetry in welfare losses arising from under versus over-estimation generally proposes choosing WACC percentiles greatly in excess of the 65th. Thus, even on Ofcom's view of the WACC distribution, there is a very strong case for at *the minimum* holding to the current WACC of 10%.

A summary of the impact of using equivalent simulations and central estimates of parameters discussed above is shown in Table B.13.

Table B.13 Mid point and percentile values for WACC

BT	Ofcom			BT		
	Mid point	75th Percentile	90th Percentile.	Mid point	75th Percentile	90th Percentile.
OpenR.	9.52	10.35	10.97	10.70	11.46	12.13
RoBT	10.35	11.37	12.08	11.60	12.50	13.26
BTGroup	9.94	10.86	11.52	11.15	11.98	12.69

The Competition Commission demonstrated that making just one assumption on relative welfare losses from under-investment, combined with some appreciation of the statistical distribution of the WACC, it is possible to determine precisely what percentile to choose. In the case of airports, the Competition Commission/CAA took a very high value of around 90%.

As noted above, BT adopted the same methodology as CC/CAA, using *Ofcom's central estimates* and the plausible range of parameter values, in Table B.11 to generate a WACC distribution for BT.

The optimal choice of regulatory WACC then depends on the extent of welfare loss asymmetry, as indicated in Table B.14. The greater the loss asymmetry, the higher the regulatory WACC should be (the cells in colour yellow indicate minimum welfare loss values).

Table B.14 Optimal WACC based on welfare

Regulatory WACC	Percentile	Loss Asymmetry Factor (LAF)					
		1	2	3	5	10	20
9.16	**30**	1.183	2.253	3.323	5.462	10.811	21.508
9.42	**40**	0.961	1.711	2.461	3.960	7.709	15.207
9.66	**50**	0.871	1.389	1.906	2.940	5.527	10.699
9.79	**55**	0.872	1.294	1.716	2.560	4.670	8.890
9.92	**60**	0.908	1.244	1.581	2.254	3.936	7.299
10.06	**65**	0.981	1.245	1.510	2.039	3.361	6.006
10.20	**70**	1.100	1.301	1.502	1.905	2.911	4.923
10.36	**75**	1.275	1.423	1.570	1.866	2.605	4.083
10.53	**80**	1.522	1.625	1.728	1.935	2.451	3.484
10.73	**85**	1.883	1.949	2.015	2.147	2.477	3.137
10.98	**90**	2.451	2.487	2.522	2.594	2.772	3.129
11.33	**95**	3.467	3.481	3.494	3.521	3.589	3.724
11.96	**99**	5.870	5.872	5.873	5.877	5.886	5.903
Optimal WACC percentile		50	60	70	75	80	90

Thus when the LAF=1, welfare losses from over-estimation are symmetric with those from under-estimation, and the 50th percentile is the optimal choice for regulatory WACC. With LAF=10, this means that welfare loss from under-estimation is ten time larger than that from over-estimation – and the optimal choice of regulatory WACC is the 80th percentile (and so on). An equivalent finding for BT using the CC/CAA methodology would suggest a WACC of around 11%, using the 90th percentile. However, it is worth emphasising that this simulation is based on Ofcom's central estimate which is manifestly too low; based on BT's central estimate and range, this would imply a further uplift of roughly 1.5% to a level of about 12.5%.

BT's position in summary is that transparency in the setting of WACC is vital and this involves all of the following:

- The choice of central estimates.
- The choice of ranges for central estimates.
- The construction of a range for the WACC overall.

- The choice of WACC within the range and the link of this choice to the incentivisation of investment.

BT contends that the current Ofcom consultation and analysis fall short of meeting these requirements. In particular, there is no robust evidence or justification for the reduction in the WACC. On the contrary there is significant evidence that BT's cost of capital has increased.

As noted above, this higher level of WACC is strongly supported by the survey of all major investment institutions contained in the accompanying Report by the independent consultant of Teleq Consulting.

B.6 References

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