# **Estimating BT's Cost of Capital**

A Report from Europe Economics on behalf of BSkyB and TalkTalk

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# 1 INTRODUCTION

# **This Report**

- 1.1 Europe Economics has been commissioned by BSkyB and TalkTalk to assist with their submissions to Ofcom regarding cost of capital determinations in the context of the 2011 consultations on charge controls for WBA, WLR and LLU services. As large purchasers of these wholesale services, BSkyB and TalkTalk are duty-bound to ensure that the costs of these services are kept to a minimum while allowing BT to make a reasonable rate of return. Therefore, Europe Economics was asked to provide advice on whether the cost of capital for BT as a whole, and Openreach in particular, is being set at a level that is no higher than that justified by market fundamentals and regulatory precedent.
- 1.2 In summary, we propose a range for the Openreach beta that overlaps, considerably, with that proposed by Ofcom. We offer some remarks for Ofcom's consideration in respect of the generic parameters of the CAPM model the risk-free rate and the equity risk premium. However, the most substantive analysis here relates to the estimation of the Openreach asset beta. We propose what we believe are some improvements on Ofcom's methodology, in particular relating to the treatment of debt beta (where our approach, which involves apportioning half of changes in debt premia to debt beta effects (and is justified in more detail in Appendix 1), produces a more stable asset beta is virtually identical to that of Ofcom, and our proposed range for the Openreach equity beta overlaps with Ofcom's across almost all of the range.
- 1.3 As such, our analysis can thus be seen as broadly buttressing and building upon Ofcom's results.

# **Ofcom's Draft Proposals**

1.4 Ofcom's draft proposals are set out in its *Consultation document and draft notification of decisions on charge control in WBA Market 1.*<sup>1</sup> The proposal for the weighted average cost of capital (WACC) is set out below, with the May 2009 figures quoted for comparison, drawn from Ofcom Tables 6.2 and 6.3.

http://stakeholders.ofcom.org.uk/binaries/consultations/823069/summary/condoc.pdf The key relevant sections of the consultation document to which this discussion relates are:

 <sup>(</sup>a) Section 6 (pp78ff)
 (b) Approx 9 (cp72ff)

<sup>(</sup>b) Annex 8 (pp177ff)

<sup>(</sup>c) Estimate of BT's Equity Beta, October 2010, prepared by the Brattle Group.

There is also some limited relevant discussion in Annex 7.

	Oper	Openreach		Group	Rest of BT	
	May 2009 Jan 2011		May 2009	Jan 2011	May 2009	Jan 2011
Equity Risk Premium	5%	5%	5%	5%	5%	5%
Asset beta	0.55	0.4 – 0.55	0.61	0.45 – 0.60	0.68	0.5 – 0.65
Equity Beta	0.76 (35% gearing)	0.68 – 0.98 (50% gearing)	0.86 (35% gearing)	0.78 - 1.08	0.96 (35% gearing)	0.88 - 1.18
Real risk-free rate	2%	1.5%	2%	1.5%	2%	1.5%
Inflation	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
Debt premium	3%	2% - 2.5%	3%	2% - 2.5%	3%	2% - 2.5%
Tax rate	28%	25%	28%	25%	28%	25%
Post-tax real WACC	4.8%	3.9% (mid- point)	5.1%	4.2% (mid- point)	5.4%	4.4% (mid- point)
Pre-tax nominal WACC	10.1%	8.0% - 9.2%	10.6%	8.3% - 9.5%	11.0%	8.6% - 9.9%
Pre-tax nominal (extended range)		7.9% – 9.4%		8.2% - 9.7%		8.5% - 10.0%
Pre-tax nominal (mid- point)		8.6%		8.9%		9.3%

# Table 1.1: Comparison of Ofcom January 2011 and May 2009 Cost of Capital Components

# 2 **RISK-FREE RATE**

#### **Proposed Value**

2.1 Ofcom proposes a draft figure of 1.5 per cent. As a figure "rounded" to the nearest half percentage point, this figure seems broadly defensible on Ofcom's methodology, though when Ofcom produces more precise figures for its final determination, its approach is arguably more indicative of a figure of 1.4 per cent.

#### **Ofcom's Key Bases**

- 2.2 Ofcom regards the Bristol Water judgement as the most important regulatory precedent.<sup>2</sup> This provides a range of 1-2 per cent.
- 2.3 The most important data basis Ofcom employs appears to be the five-year averages for 5-year and 10-year gilts, both of which are 1.4 per cent, and the ten-year average for 5-year gilts, 1.7 per cent.
- 2.4 Ofcom also offers a principle of regulatory policy:<sup>3</sup>

"When estimating regulatory cost of capital rates, we are mindful of the potential negative effects of making sudden very large changes, which could create regulatory uncertainty."

This principle of regulatory policy appears in the context of a previous (2009) decision for the risk-free rate of 1.8 per cent.

2.5 Ofcom places relatively little weight upon spot and recent data, which it notes had (for 5year gilt yields) been in the range -0.5 to +0.5 per cent over the previous year.<sup>4</sup> It remarks<sup>5</sup>

> "While we would generally tend to give more weight to more recent rates than averages over past years, we are mindful (as in past charge controls) that we do not wish to give too much weight to a rate based on a period of unusual market activity. Therefore we tend to give more weight to longer term averages than more recent rates."

 $and^{6}$ 

"We are particularly mindful that current low rates reflect very specific conditions (including the Bank of England's Quantitative Easing programme) and take this into account when making estimates."

<sup>&</sup>lt;sup>2</sup> Ofcom, op cit, paragraph 6.54

<sup>&</sup>lt;sup>3</sup> Ofcom, op cit, paragraph 6.68(c)

<sup>&</sup>lt;sup>4</sup> Ofcom, op cit, paragraph 6.51 <sup>5</sup> Ofcom, op cit, paragraph 6.60

<sup>&</sup>lt;sup>5</sup> Ofcom, op cit, paragraph 6.60 Ofcom, op cit, paragraph 6.68(c)

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2.6 The main cross-check employed is implied forward rates in three years' time, which Ofcom states<sup>7</sup> were around 1 per cent.

#### **Issues Arising from Ofcom's Approach**

- 2.7 We identify three problems with Ofcom's approach:
  - (a) Ofcom is inconsistent in its interpretation of the Bristol Water determination<sup>8</sup>, indicating in one place<sup>9</sup> that the Competition Commission (CC) chose "*the very top of the range*" (i.e. 2 per cent) and, in another<sup>10</sup>, that it chose a point estimate of 1.5 per cent. The former claim is confused (see (b) below) while the latter claim is incorrect.
  - (b) Ofcom is mistaken to assert<sup>11</sup> that the CC "chose a point estimate at the very top of the range" (at least, it is mistaken if this is to be interpreted as the claim that the CC chose a point estimate for the risk-free rate at the very top of the risk-free rate range). 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<sup>12</sup>, at the very top of its 3.8-5.0 per cent range, it produces a table<sup>13</sup> 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 choosing a total WACC at the very top of its recommended range, not a separate recommendation as to the correct risk-free rate. To be clear, the CC Bristol Water recommendation for the risk-free rate is 1-2 per cent.
  - (c) Ofcom's claim, in respect of the risk-free rate, that there is "an observed tendency for mean reversion"<sup>14</sup> is not consistent with the use of CAPM or the Modigliani-Miller Theorem (both of which imply weak efficiency in financial market pricing, which is inconsistent with mean reversion<sup>15</sup>). It is also in tension with Ofcom's treatment of the equity risk premium, in the case of which the value favoured (5.0 per cent) is that arising from "arithmetic" returns (i.e. without mean-reversion) as opposed to the rather lower numbers for "geometric" returns (i.e. with mean-reversion).
- 2.8 Furthermore, in relation to the data bases that Ofcom employs, it is worth noting that falls in gilt yields are not a recent phenomenon, though the fall in five-year gilts into negative territory is indeed recent. Figure 2.1 reports index-linked gilt (ILG) yields for the ten years up to the month of Ofcom's consultation document (January 2011). The dashed lines

<sup>&</sup>lt;sup>7</sup> Ofcom, op cit, paragraph 6.71

Bristol Water plc Price Limits Determination - http://www.competition-commission.org.uk/rep\_pub/reports/2010/558Bristol.htm

<sup>&</sup>lt;sup>9</sup> Ofcom, op cit, paragraph 6.54

<sup>&</sup>lt;sup>10</sup> Ofcom, op cit, paragraph 6.64

<sup>&</sup>lt;sup>11</sup> Ofcom, op cit, paragraph 6.54

<sup>&</sup>lt;sup>12</sup> CC, op cit, Annex N Paragraph 156

<sup>&</sup>lt;sup>13</sup> CC, op cit, Table 12, Annex N, page N46)

<sup>&</sup>lt;sup>14</sup> Reference for quote used <sup>15</sup> A "weakly efficient" market

<sup>&</sup>lt;sup>5</sup> A "weakly efficient" market follows a random walk (with or without drift), in consequence of which future prices cannot be predicted by analysing past prices. However, in a mean-reverting market future prices *can* be predicted from past prices as prices tend to revert to the mean.

exhibit linear trends. It is clear that gilt yields have been on a downward trend for some time.



Figure 2.1: UK ILG Yields for the 10 years to 31<sup>st</sup> January 2011

- 2.9 Given this, it is clear that, even though the last year's data very probably understates the risk-free rate, a ten-year average very probably overstates it, since a ten-year average includes datapoints from a period in which the risk-free rate was very probably materially higher than it is today.
- 2.10 One potential implication is that if, as Ofcom has indicated itself minded to do, one gives greater weight to averages than the most recent data, one should view ten-year averages as likely to be an over-estimate (and indeed, if the downward trend continued, by 2013/14 increasingly an over-estimate). That is, of course, what Ofcom has done in its draft proposals by taking 1.5 per cent as its risk-free rate. However, it is unclear on what basis Ofcom prefers 1.5 over 1.4 per cent. On the face of it, there seems little basis for this choice other than to choose "rounded" values in half-percent intervals, but Ofcom has not taken this approach to the risk-free rate in the past (e.g. its 2005 decision implied 1.8 per cent).

## **Considerations for the Final Determination**

2.11 Given Ofcom's approach, a risk-free rate of 1.5 per cent seems broadly defensible as a "round" figure, in reviewing this figure ahead of its final determination, it would seem

natural to consider whether a value of 1.4 might be preferred, as reflecting the five-year averages for both 5-year and 10-year gilts.

# **3 EQUITY RISK PREMIUM AND TOTAL MARKET RETURN**

#### **Proposed Value**

- 3.1 Ofcom chose<sup>16</sup> a figure of 5 for the equity risk premium (ERP), as in its May 2009 statement, based on a 4.5-5.0 per cent range<sup>17</sup>.
- 3.2 Given Ofcom's approach, a value of 5 per cent seems broadly defensible as an upper bound of a range. However, we are not convinced that Ofcom offers a robust rationale for favouring 5 per cent as a point value over 4.5 per cent (or some value in between), and if other parameters of the overall WACC were to rise (e.g. if the risk-free rate were to be raised on the basis of "mean reversion" arguments), the case for reconsidering whether 4.5 might be preferred to 5 would become stronger, for reasons we shall explore below.

#### Ofcom's Key Bases

- 3.3 Ofcom indicates<sup>18</sup> a preference for the arithmetic risk premium, as noted by Dimson Marsh and Staunton (DMS) in their authoritative studies on the topic, which constitute the standard basis for ERP estimation for UK regulators. Ofcom states that DMS recommend 4.5-5.0 per cent for the "world index".
- 3.4 Ofcom considers itself particularly bound by what it believes to be the figure chosen by the CC in the Bristol Water determination, namely 5 per cent, stating<sup>19</sup>

"We would find it difficult to diverge from such a determination without compelling evidence to demonstrate that this value has changed. We are not aware of any such evidence."

## Issues Arising from Ofcom's Approach

- 3.5 We identify three problems with Ofcom's approach:
  - (a) Ofcom has misinterpreted the CC's findings in the Bristol Water case. The CC recommends a total market return of 5.0-7.0 per cent and a risk-free rate range of 1.0-2.0 per cent, which it states can be interpreted as indicating an "implied range" for the ERP of 4.0-5.0 per cent<sup>20</sup> (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<sup>21</sup>, at the very top of its 3.8-5.0 per cent range, it produces a table<sup>22</sup> in which it quotes a "projected" ERP of 5.0 per cent.

<sup>&</sup>lt;sup>16</sup> Ofcom, op cit, paragraph 6.107

<sup>&</sup>lt;sup>17</sup> Ofcom, op cit, paragraph 6.106

<sup>&</sup>lt;sup>18</sup> Ofcom, op cit, paragraph 6.94

<sup>&</sup>lt;sup>19</sup> Ofcom, op cit, paragraph 6.103

<sup>&</sup>lt;sup>20</sup> CC, op cit, Annex N, paragraph 100

<sup>&</sup>lt;sup>21</sup> CC, op cit, Annex N Paragraph 156

<sup>&</sup>lt;sup>22</sup> CC, op cit, Table 12, Annex N page N46

Just as with the risk-free rate, that "projected" ERP is simply a mathematical implication of the CC choosing a total WACC at the very top of its recommended range, not a separate recommendation as to the correct ERP.

- (b) Ofcom's stated preference for the arithmetic mean premium for the ERP is in tension with its stated view that there is mean reversion in the risk-free rate. If a market as deep, broad and liquid as that for government bonds is not a weak-form efficient market (which it would not be if it exhibited mean reversion), then it would seem very likely that would imply that standard finance theories about the efficient transmission of information through prices are not good models of financial market behaviour. That issue would seem very likely to apply to equity markets, also (given that government bonds markets are likely to be at least as efficient as equity markets, since government bond markets are at least as deep, broad and liquid and are even longer-established), implying that one would expect mean-reversion models to be superior in respect of equity returns, and consequently that the geometric returns values for the DMS studies should be preferred. That would imply an ERP towards the bottom of the DMS range (4.5 per cent or even below).
- (c) Ofcom appears to believe that it would need a strong basis for moving away from the CC's Bristol Water determination. However, Ofcom's 2005 ERP estimate was 4.5 per cent<sup>23</sup> and it states that its May 2009 judgement (of 5.0 per cent) involved a 0.5 uplift in the ERP to reflect equity market volatility at that time.<sup>24</sup>

"we believed that the volatility we observed in equity markets at the time suggested that investors required a higher level of return in exchange for holding risky equity assets, and an increase of 0.5% in our ERP estimate did not seem unreasonable in this context".

The key period of high volatility in equity markets was from late 2008 to mid-2009. In the Ofwat determination on which the CC was commenting in the Bristol Water case was from late 2009, the CC reduced Ofwat's ERP determination (which had been 5.4 per cent). This was already naturally interpreted as indicating that the CC felt that, even by November 2009, Ofwat was tending to overstate how much uplift in the ERP was required to reflect equity market volatility but that the view as to how much uplift was required was evolving. Given a further ten months of evidence on equity market conditions, if it turned out that equity market volatility had indeed materially subsided, Ofcom should find no particular difficulty in concluding that no uplift to the ERP was any longer justified.

That being so, given that Ofcom explicitly states that it employed a 0.5 per cent uplift in its May 2009 determination, it is not apparent why Ofcom could not conclude for a

<sup>&</sup>lt;sup>23</sup> Ofcom, op cit, paragraph 6.91

<sup>&</sup>lt;sup>24</sup> Ofcom, op cit, paragraph 6.92

4.5 ERP this time — particularly if it expressed a view that asset markets involve a degree of mean reversion.

#### **Considerations for the Final Determination**

- 3.6 A range of 4.5-5.0 per cent seems broadly defensible. If there were to be any rise in the determined risk-free rate above 1.5 per cent, especially if Ofcom's rationale for such a rise were mean reversion, then it would seem natural to move lower within this 4.5-5.0 range (e.g. maintaining the total market return the sum of the ERP and the risk-free rate at 6.0-6.5 per cent, at or a little above above the mid-point of the CC's proposed 5.0-7.0 per cent range for the total market return). There are three key reasons for this:
  - (a) The total market return is more stable than the individual components, as has been stated in multiple previous regulatory determinations building on the arguments in Smithers & Co's seminal 2003 methodology paper.
  - (b) If there is mean reversion in government bond markets, then it is implausible that any financial market is truly weak-efficient, implying that there would be likely to be mean reversion in equity markets also, implying that geometric averages of the ERP would be relevant i.e. those lower in the DMS range.
  - (c) A rise in the risk-free rate would imply a view on the part of Ofcom that the market trends of the past five and more years — which have included equity market turmoil on which basis Ofcom has, since 2009, included a 0.5 per cent uplift to the ERP, as well as a deep and sustained fall in yields in gilt markets — have decisively reversed. Many of the key arguments that would provide a rationale for a higher risk-free rate (e.g. mean reversion in asset markets) would also provide a rationale for a lower ERP.

# 4 THE BT GROUP EQUITY BETA

## **Proposed Value**

- 4.1 On behalf of Ofcom, the Brattle Group finds a one year equity beta of 0.96 and two-year equity beta of 0.84, at the actual BT Group gearing.<sup>25</sup>
- 4.2 Ofcom uses these equity beta estimates, in combination with estimates of gearing and an assumption about the debt beta, to construct an estimate for the asset beta, and thence to proceed to an assumption about the equity beta at Ofcom's determined level of gearing. (We consider these other components of the asset beta in later sections.)

## **Key Basis**

- 4.3 The estimation is based on a standard Ordinary Least Squares regression of returns from holding stock in BT on returns of a broad market index. The benchmark market index used is the FTSE All-Share, but the broader FTSE All-World is also used as a cross-check.
- 4.4 With regards to data frequency and the size of the data window, betas have been estimated on daily returns and over a time span of two years (though results for a one year window are also reported). The former choice is correctly justified on the ground that BT stocks are amongst the most liquid stocks around and therefore any concerns that would favour the use of weekly or monthly data are not material. The use of a two-year window is also plausible because it guarantees a large sample size (and thus more robust estimates) without extending the estimation period so far back in time that it would potentially overlap with significant operational changes (if any such occurred).
- 4.5 In order to assess the stability of the betas, rolling estimates have been performed on twoyear, one-year, and six-month windows. Overall, the analysis shows that the two-year equity beta for BT is relatively stable (though price volatility can be observed in both the one-year and six-month betas).
- 4.6 Working as instructed by Ofcom, the Brattle Group also estimated betas for two reference samples<sup>26</sup>. The first reference sample is a comparator group consisting of five UK utilities which share with BT a similar UK regulatory regime.<sup>27</sup> The estimated betas for the utility group appear to be significantly lower than that of BT Group. The other reference group consists of a large US telecommunications stocks. Of the US telecommunications companies included, some focus primarily on wireline services, some on wireless operations, and some on both. This composition of the sample is particularly useful because it allows investigation of whether the beta for wireline activities (which is

<sup>&</sup>lt;sup>25</sup> Ofcom, op cit, paragraph 6.123

Estimate of BT's Equity Beta, October 2010 - http://stakeholders.ofcom.org.uk/binaries/consultations/823069/annexes/brattle.pdf

<sup>&</sup>lt;sup>27</sup> Brattle, op cit, Figures 2 to 6.

informative for BT's local loop business) is different from that of pure-play wireless companies and diversified companies (i.e. companies active in both wireline and wireless activates). The analysis of comparators indicates that the risk of wireline operations is not perceived to be significantly different from that of other telecom businesses.

#### **Issues Arising from Ofcom's Approach**

4.7 Setting aside minor methodological quibbles, the calculation of the equity betas seems standard.

## **Considerations for the Final Determination**

4.8 No considerations required.

Debt Premia and Debt Beta

# 5 DEBT PREMIA AND DEBT BETA

#### **Debt premium: Proposed Value**

5.1 Ofcom proposes a debt premium of 2-2.5 per cent, stating that it considers this *"consistent with our average gearing level assumption of 50%"*.<sup>28</sup>

#### Debt premium: Ofcom's Key Basis

5.2 Ofcom focuses upon the yield on BT's 2016 sterling-denominated bond, "*over and above benchmark gilt yields*". It focuses upon the following figure.



#### Figure 5.1: BT 2016 debt spread over gilt rates (Ofcom version)

Source: Ofcom Figure 6.3, sourced as "Bloomberg"

5.3 Ofcom remarks:

"During the past 12 months the spread has been broadly between 2% and 2.5%, with a brief dip below 2% during January 2010, and a brief peak above 2.5% in June 2010."

# Debt premium: Issues Arising from Ofcom's Approach

5.4 We observe that the only period since late 2009 in which this yield has been above 2.5 per cent was at the period around the peak of the Eurozone sovereign debt crisis in May 2010. Subsequently, even by the time of the data cut-off in October 2010, yields had fallen back to 2 per cent (a level typical of early 2008) — the bottom of Ofcom's range. When we consider subsequent data up to March 2011, we see that spreads have been consistently at or around 2 per cent since October 2010.

<sup>&</sup>lt;sup>28</sup> Ofcom, op cit, paragraph 6.150





Source: Europe Economics calculations on Bloomberg data

5.5 Indeed, we note that in Ofcom's consideration of the total cost of debt for BT, the observed yield was 4 - 6 per cent which is markedly lower than the 6 to 6.5 per cent total nominal cost of debt implied by Ofcom's assumptions. Ofcom itself remarks<sup>29</sup>

"we may be affording BT a slightly higher cost of debt than that which is currently observed in the market"

Of course, one important driver for the higher total cost of debt in Ofcom's proposals compared to observed market yields is the higher risk-free rate. For the reasons explained in Section 2 above, it does indeed seem appropriate that Ofcom determine a higher risk-free rate than that currently observed from gilt yields. However, we would observe that Ofcom is making an assumption here (quite a strong assumption, albeit one that we would support) that the total cost of debt will rise. If that assumption is wrong, then the total cost of debt is very likely to be lower than Ofcom proposes.

<sup>&</sup>lt;sup>29</sup> Ofcom, op cit, paragraph 6.152

## Debt premium: Considerations for Final Determination

- 5.6 In that context, a cautious approach might imply choosing a number towards the bottom of the range for the debt premium, so as to minimize the risk of over-shooting on both components (debt premium and risk-free rate) of the cost of debt.
- 5.7 Thus, although Ofcom's 2-2.5 per cent range seems broadly defensible on the basis of the data it favours, if the data continue to congregate around 2 per cent to the time of the final determination, it would seem natural for Ofcom to favour a number towards the bottom of its range.
- 5.8 This point is further reinforced by Ofcom's view that the Openreach part of BT's business should *"carry less specific risk than the rest of BT Group."*<sup>80</sup> This being so, a natural implication is that the default risk on Openreach, regarded as a standalone entity, would be expected to be less than that of BT as a whole. Consequently, the risk of default element within the debt premium should be expected to be lower for Openreach than for BT as a whole. That implies that using the BT Group debt premium as the debt premium for Openreach will tend to overstate Openreach's cost of debt. Ofcom has shown a preference for using a common cost of debt for BT Group and Openreach, but one way to reflect the tendency for this approach to overstate Openreach's cost of debt would be to be prepared to choose a point low in the range for the debt premium.

## **Debt Beta: Proposed Value**

- 5.9 Ofcom assumes various different debt betas at different points in its analysis, but all lie within the range 0.1-0.15 and in most cases they are focused upon a mid-point of 0.125.<sup>31</sup>
- 5.10 Ofcom notes that 0.125 is higher than the debt beta assumed by the CC for Bristol Water, arguing that this reflects the higher debt premium for BT.<sup>32</sup>

## Debt Beta: Key Basis

5.11 Ofcom assumes an invariant debt beta of 0.125. Specifically, Ofcom makes no allowance for the debt beta rising and falling as BT's debt premium rises and falls.

# Debt Beta: Issues Arising from Ofcom's Approach

5.12 The cost of debt is typically obtained by regulators as a combination of the risk free rate and the debt premium observed in bond market spreads. However, the debt premium observed in spreads is likely to include an element of insurance against default on the

<sup>&</sup>lt;sup>30</sup> Ofcom, op cit, paragraph 6.138

For example, 0.125 is the assumption in footnote 132. In footnote 134 the assumption is 0.1-0.15 with 0.125 as a mid-point. The Brattle Group assumes a debt beta of 0.15.

<sup>&</sup>lt;sup>32</sup> Ofcom, op cit, footnote 134

debt, regardless of whether the default occurs for systematic or idiosyncratic factors. Therefore, it is not appropriate to think of all of the debt premium, or spread, as an indicator of market covariant risk covered by the debt beta.

5.13 By definition, the Market Debt Premium (MDP) for a company is given by:

 $MDP \equiv r_{MD} \text{ - } r_{f}$ 

where:  $r_f$  = the risk-free rate, and  $r_{MD}$  = the market rate for debt

- 5.14  $r_{MD}$  is not equal to the expected return from holding debt,  $r_D$  the relevant concept for CAPM, since:
  - (a) there is some probability of default, leading to no return
  - (b) there is some probability of losing the initial investment, even on secured debt
  - (c) there is some probability of the perceived risk of default falling after purchase of the bond but before maturity, leading to the value of the bond rising (and so the actual return being greater than the market rate)
- 5.15 The worst-case scenario is that whenever there is a default, the whole value of the bond is lost. The expected return from holding debt is:

 $1 + E(r_D) = (1 + r_{MD}).(1 - p_d)$ 

where,  $p_d$  = the probability of default

5.16 The expected return on debt, expressed in CAPM terms, considers only systematic risk:

 $E(r_D) = r_f + ERP.\beta_D$ 

5.17 Hence, in this worst-case scenario

$$r_f + ERP.\beta_D = (1 + r_{MD}).(1 - p_d) - 1$$

$$= (1 + r_f + MDP).(1 - p_d) - 1$$

$$= r_f + MDP - p_d(1 + r_{MD})$$

 $\Rightarrow \beta_D = MDP / ERP - p_d.(1 + r_{MD}) / ERP$ 

5.18 More generally, when there is some element of loss of principal as a result of default (as opposed to total loss), the formula is:

 $\beta_D = MDP / ERP - p_d.(cost of bankruptcy as proportion of debt principal + r_{MD}) / ERP$ 

- 5.19 This formula states that the debt beta is the debt premium observed on the market, divided by the general market risk premium, less the expected loss from default divided by the market risk premium. The result is the expected return on debt relative to the expected return on the market as a whole.
- 5.20 There will typically be some correlation between the risk of default and the broader economic cycle companies tend to be more likely to go bust in a broader downturn. So not all default risk is diversifiable and the debt beta is above zero.
- 5.21 Now, from 2007 to 2010 (and even to some extent still today) credit markets have been impaired, and corporate credit spreads elevated. Some element of this was doubtless the consequence of perceived increased risk of default, but it also seems likely that another driver of increased debt premia was increased debt betas. (After all, the perceived increased risk of default occurred at the same time as a deep recession, so it seems implausible that, given the correlation in time between these two events, there was not, equally, some increase in perceived correlation between defaults and recessions in general.)
- 5.22 We thus believe that one is not safe to assume that debt betas have been invariant during the period 2007 to 2011 the assumption made by Ofcom and by the Brattle Group, particularly in their estimation of asset betas. In Figures 5.3 and 5.4 below we first illustrate how one- and two-year debt betas would have evolved from 2007 to 2011 under the extreme (and rather implausible probably equally as implausible as the debt beta being invariant) assumption that *all* of the rise in debt premia reflected increased beta risk, if they had been at Ofcom's preferred value of 0.125 as the credit crunch began in mid-2007.
- 5.23 Next, we note that, absent a robust basis for attributing changes in the debt premium between default risk and beta risk, we suggest that a natural approach is to divide equally between them. Hence, we also include in the charts an intermediate case (equal apportionment) in which half of the change in debt premia is attributable to changed risk of default and half to changed debt beta.



Figure 5.3: Variable one year debt betas

Source: Europe Economics





5.24 The latest data point for one-year debt beta is about 0.2, whilst for two-year debt beta it would be about 0.25.

## **Debt Beta : Considerations for Final Determination**

5.25 We do not believe it is defensible for Ofcom to assume — as its approach implicitly does — that all of the rise in debt premium after 2007 was attributable to increases in the risk of default and that none was attributable to debt beta changes. Our proposal of focusing upon equal apportionment is not the only option (e.g. one could, instead, assume that the ratio between debt beta and risk of default in the debt premium stays stable), and Ofcom may wish to consider alternative assumptions. However, we would recommend use of a variable debt beta.

# 6 BT GROUP ASSET BETA

## **Proposed Value**

6.1 Ofcom proposes a range of 0.45–0.60 for BT Group's asset beta, based on the Brattle Group's estimates of equity beta, the assumed constant debt beta, and estimates of gearing based on market capitalization data and Bloomberg data on net debt.<sup>33</sup>

## **Key Basis**

- 6.2 The Brattle Group calculated BT Group's gearing using daily market capitalisation data and adjusted net debt data from Bloomberg. It then relevered its one- and two-year equity betas (based on rolling averages of daily data), assuming a constant debt beta of 0.15, to produce asset betas.
- 6.3 The cut-off date for the Brattle data was 27 October 2010. Ofcom was concerned that this meant the two-year data was unduly affected by including datapoints from October 2008 that might have been seriously distorted by the events that followed the quasinationalisation of the Federal National Mortgage Association (Fannie Mae) and Federal Home Loan Mortgage Corporation (Freddie Mac) in early September 2008, most notoriously, the bankruptcy of Lehman Brothers. Ofcom therefore extended the data series to January 2011, as illustrated in Ofcom Figure 6.3, duplicated below.

<sup>&</sup>lt;sup>33</sup> Ofcom, op cit, paragraph 6.132



Figure 6.1: 1 yr and 2 yr asset betas for BT Group, January 2008 – 2011 (Ofcom version)

Source: Ofcom Figure 6.3

6.4 Of com notes<sup>34</sup> that the asset beta for the two years to 27 October 2010 would have been 0.46, whilst the one year asset beta as at 11 January 2011 was 0.58.<sup>35</sup> It therefore concludes for a range of 0.45-0.6. Of com places heavy caveats upon its numbers, noting<sup>36</sup>:

"it is possible that the removal from our asset beta evidence of some data relating to the credit crisis, will move our asset beta estimate towards the higher end of our range."

#### **Issues Arising from Ofcom's Approach**

6.5 For the reasons explained in Section 5, we believe that Ofcom's assumption that debt beta is invariant is flawed. The implication is that the asset beta calculation, based upon that assumption of constant debt beta (and hence that all of the rise in debt premia in 2007 onwards is default risk and none is increased debt beta), is flawed. Specifically, it produces excessive and spurious volatility in the asset beta.

<sup>&</sup>lt;sup>34</sup> Ofcom, op cit, table 6.8

<sup>&</sup>lt;sup>35</sup> Ofcom, op cit, paragraph 6.132

<sup>&</sup>lt;sup>36</sup> Ofcom, op cit, paragraph 6.43

## **Considerations for Final Determination**

- 6.6 We propose that, instead of assuming an invariant debt beta and all change in debt premium reflecting changed default risk, Ofcom should consider a range between an invariant debt beta and an invariant default risk, focusing particularly on the intermediate case in which the change in debt premium is apportioned equally between debt beta and default risk.
- 6.7 In the following two figures, 6.2 and 6.3, we recalculate the asset beta based on the assumption that *half* of increased debt premium since 2007 has been due to increased debt beta and half due to increased default risk.



Figure 6.2: One year asset betas



Figure 6.3: Two year asset betas

6.8 We can see that, on this approach, the asset beta is much more stable than under Ofcom's approach — indeed, the asset beta is even more stable than the raw equity beta. The benchmark two-year series has ranged from 0.55 to 0.64 over the two years April 2009 to March 2011. The five-year average since April 2006 is 0.6.<sup>37</sup> Thus, a range of 0.55-0.64 for the BT Group asset beta seems appropriate — somewhat higher than that found by Ofcom in its consultation document, with the difference arising because Ofcom's approach underestimated the BT Group debt beta.

#### Implied Re-Levered Equity Beta Range

6.9 Re-levering Ofcom's range at its preferred 50 per cent notional gearing assumption, based on a debt beta range of 0.2 to 0.25, we obtain a BT Group equity beta range of 0.9 to 1.03. This is narrower than Ofcom's 0.78 – 1.08 range, re-levered on the assumption of a 0.125 debt beta, partly because the asset beta range itself is narrower and partly because a higher debt beta reduces the level of the equity beta after relevering, and our approach includes a range for the debt beta.

<sup>&</sup>lt;sup>37</sup> We note the standard recommendation to take five-year averages of the two-year series.

# 7 OPENREACH ASSET BETA

#### **Proposed Value**

7.1 Ofcom proposes a value for the Openreach asset beta of 0.4-0.55.<sup>38</sup> On its assumption of 50 per cent gearing, that implies an Openreach equity beta of 0.68-0.98.

#### **Key Basis**

7.2 Ofcom states that it believes that Openreach is subject to less systematic risk than the BT Group as a whole.<sup>39</sup> It also stated that

"we consider Openreach to have many characteristics of a network utility, and therefore to carry less specific risk than the rest of BT Group."<sup>40</sup>

- 7.3 To explore this point, it commissioned the Brattle Group to "prepare a comparative analysis of network utilities and their equity betas alongside their analysis of BT's equity beta...Brattle's analysis suggests that comparable UK network utilities would have asset betas in a range of 0.3 0.4 (assuming a debt beta of 0.15)."
- 7.4 Regarding the relative systematic risks of Openreach and BT Group, Ofcom states<sup>41</sup>:

"We believe that a reasonable estimate of Openreach's asset beta, taking into account that of BT Group and of the comparable UK network utilities, would be 0.05 lower than for BT Group, so that at the bottom end of the range (i.e. 0.40) our estimate is at the very top of the utility asset beta range".

## **Issues Arising from Ofcom's Approach**

- 7.5 We observe that, in coming to a view on the WACC for this regulatory purpose, it is important to recognise the purpose to which the WACC is to be used. In particular, the sole current purpose of the "Openreach WACC" is to derive costs for LLU and WLR, and the position of BSkyB and TalkTalk is that any rise in BT's cost of capital associated with the roll-out of NGA should not result in a rise in LLU and WLR charges, which apply to copper based access products, not fibre-based ones.
- 7.6 The BT Group cost of capital may well be increased as a result of the increased risk associated with its roll out of NGA. Before its NGA roll out, most of Openreach's activity related to less risky copper access.<sup>42</sup> This has now changed with NGA roll out (and its heightened riskiness) meaning Openreach's cost of capital could be higher than it was

<sup>&</sup>lt;sup>38</sup> Ofcom, op cit, paragraph 6.141

<sup>&</sup>lt;sup>39</sup> Ofcom, op cit, paragraph 6.136 and footnote 137

<sup>&</sup>lt;sup>40</sup> Ofcom, op cit, paragraph 6.138

<sup>&</sup>lt;sup>41</sup> Ofcom, op cit, paragraph 6.140

<sup>&</sup>lt;sup>12</sup> We note that it does provide some Ethernet leased line products (backhaul and business connectivity services which are subject to separate charge controls that adopt the higher "rest of BT" cost of capital).

when it was only selling copper-based access products and wholesale Ethernet leased line services).

- 7.7 That might imply, for example, that the appropriate WACC to employ for LLU and WLR charge controls would exclude Openreach's investment in NGA. The disaggregation of BT's cost of capital into that for Openreach and the rest of BT reflected analysis in 2005 that there was a sufficiently relevant difference in systematic risk between these two parts of the business for it to be proportionate to employ the standard corporate finance insight that a company is a bundle of projects, each (strictly speaking) with its own different cost of capital. Whilst it is not proportionate to assess every different investment, when there is a sufficiently large difference between different elements of a business, assessment of different costs of capital may be appropriate. In 2005 that was between a notional copper business and the rest the concept was not to reflect a particular internal business arrangement, but, instead, conceptually separate investments. That the Openreach business happens to take on a materially different set of assets does not change the fact that the relevant component of BT Group's business, for this regulatory purpose, remains the copper business, not fibre.
- 7.8 This will be particularly relevant if (as seems plausible) NGA has a much higher systematic risk (and, hence, asset beta) than the rest of Openreach, reflecting costs that are largely fixed and the demand that is unpredictable. (Indeed, our understanding is that this is the official view of both BT and Ofcom themselves, as expressed, for example, in the WLA market review.) Thus, strictly speaking, the NGA business should (for this regulatory purpose) be included in the "rest of BT" WACC. (Indeed, it may be useful and add clarity if Ofcom refers to the "Openreach WACC" as the "Openreach (ex NGA) WACC", or even reverts to its 2005 convention of referring to the relevant WACC as that of BT's "copper access business".)
- 7.9 One consequence is that, since the NGA business (being risky), may well have an associated project WACC above that of the rest of the non-Openreach part of BT, it is likely to increase the wedge between the BT Group WACC and the Openreach (ex NGA) / copper access WACC above that previously applicable in, for example, 2009.
- 7.10 Furthermore, although Ofcom states that it comes to a view regarding the relative riskiness of "Openreach" and the rest of BT, its methodology suggests that, instead, it forms a view as to the appropriate minimum bottom end of the Openreach asset beta range namely the top of the network utilities asset beta range, drawn from comparator data, i.e. 0.4 and then works backwards from there to the wedge between the BT Group asset beta and the Openreach asset beta, i.e. 0.05.
- 7.11 One danger of conflating the direct estimation of the bottom end of the Openreach asset beta range and the estimation of a wedge between the BT Group and Openreach asset

betas is that if the bottom of the BT Group asset beta range were to rise — as Ofcom itself indicates is likely<sup>43</sup> — then the bottom of the Openreach asset beta range would rise, as it were "inadvertently", and cease to correspond to the top of the network utilities range from comparator data.

- 7.12 We suggest that a more robust methodology reflecting what Ofcom has actually done would be to anchor the bottom of the Openreach asset beta range to the top of the network utilities range from the comparator data.
- 7.13 Although Ofcom states that the asset beta range derived by the Brattle Group is 0.3-0.4, in fact, the range which appears in Table 2, p11 of Brattle's report<sup>44</sup> produces a range of 0.29 (Northumbrian Water) to 0.36 based on a debt beta of 0.15. Even this overstates the range Ofcom should arguably have employed, since Ofcom elsewhere assumes a debt beta of 0.125 for BT, the application of which to the comparator utilities would translate into an asset beta range of 0.27 to 0.35, and Ofcom's 0.125 figure itself is based on the CC's view that network utilities have a debt beta of 0.1 but lower debt premia than BT (Ofcom discusses this point in footnote 134, p98), which would take the asset beta rate for the network utilities down even further. Even allowing for any preference for rounding, this would appear to imply that 0.25-0.35 would be a range that more accurately reflects Brattle's results (and, of course, if the debt beta were lower then the asset betas of the comparator data as the basis for estimating a wedge between the BT Group and Openreach asset betas, the value should have been 0.1 (0.45 0.35) rather than 0.05.
- 7.14 This suggests that even an asset beta of 0.4 for Openreach would be well above the asset betas Brattle found for comparator network utilities, on a debt beta assumption of 0.125 (though that would be closer to the correct value if the debt beta for the comparators were higher, as we think likely). We therefore suggest that a consistent application of its methodology would imply that Ofcom should regard 0.4 or even 0.35 as the bottom of the Openreach asset beta range (this applying even more strongly in the case of Openreach (ex NGA) / BT copper access), and maintain that value even if Ofcom's methodology for calculating BT Group's asset beta tends (as Ofcom indicates it considers likely) to drag up the BT Group asset beta by the time of the final determination.

## **Considerations for the Final Determination**

Implied Openreach (ex NGA) / BT Copper Access Asset Beta Range

7.15 By the methodology we have set out in previous sections, the BT Group asset beta range is 0.55-0.64. We have argued here that the bottom of the Openreach (ex NGA) / BT copper access range should be that determined by the comparators, namely 0.35 on

<sup>&</sup>lt;sup>43</sup> Ofcom, op cit, paragraph 6.43

<sup>&</sup>lt;sup>44</sup> http://stakeholders.ofcom.org.uk/binaries/consultations/823069/annexes/brattle.pdf

Ofcom's debt beta assumption or 0.4 on a more plausible higher debt beta assumption. Since Ofcom's methodology involved calculation of a wedge from the comparator data to be applied at the top of the range, and the correct wedge should have been 0.1 (0.45 - 0.35), and since the wedge between Openreach (ex NGA) / BT copper access and the rest of BT Group is likely to increase with NGA, the implied Openreach (ex NGA) / BT copper access asset beta range is therefore 0.4 – 0.54, almost precisely that found by Ofcom.

#### Implied Openreach (ex NGA) / BT Copper Access Equity Beta Range

- 7.16 Re-levering Openreach (ex NGA)'s / BT copper access' asset beta range, at 50 per cent notional gearing and using a debt beta range of 0.2 to 0.25, we obtain an equity beta range of 0.6 to 0.83, a little lower than Ofcom's 0.68 to 0.98 range. The key accounting driver of the lower equity beta range, despite the near-identical asset beta range, is the higher debt beta.
- 7.17 We observe that the wedge between our proposed equity beta range for the copper access business and BT Group is 0.2 at the top and 0.3 at the bottom, versus Ofcom's constant 0.1 wedge. In 2005 the wedge between the copper access business and BT as a whole was 0.2 on equity beta, at a gearing of 35 per cent, equivalent to a wedge of 0.26 at 50 per cent gearing. Thus, our wedge of 0.2-0.3 is approximately equivalent to that in 2005, at this higher level of gearing. We do not believe that Ofcom has a robust basis for believing that the wedge is smaller than it was in 2005 indeed, if anything, with the advent of NGA the wedge may be larger. The 0.2 wedge at the top of our range reflects what we believe is the larger wedge in asset betas (0.1 versus 0.05) implied by Ofcom's methodology. The larger wedge at the bottom (0.3) reflects the fact that the bottom of our range is estimated directly from the comparator data, rather than via a wedge on BT Group data.

# 8 CLOSING REMARKS AND SUMMARY

8.1 The following table summarizes the range of values considered in this report.

#### Table 8.1: Comparison of Ofcom January 2011 and this report Cost of Capital Components

	Open	reach	BT Group			
	Ofcom	This report	Ofcom	This report		
Equity Risk Premium	5%	4.5-5.0%	5%	4.5-5.0%		
Asset beta	0.4-0.55	0.4-0.54	0.45-0.60	0.55-0.64		
Debt Beta	0.125	0.2-0.25 0.125		0.2-0.25		
Equity Beta	0.68-0.98 (50% gearing)	0.6-0.83 (50% gearing)	0.78 - 1.08 (50% gearing)	0.9-1.03 (50% gearing)		
Real risk-free rate	1.5%	1.4-1.5%	1.5%	1.4-1.5%		
Inflation	2.5%	2.5%	2.5%	2.5%		
Debt premium	2-2.5%	2-2.5%	2%-2.5%	2-2.5%		
Tax rate	25%	25%	25%	25%		
Post-tax real WACC	3.9% (mid- point)	3.0-3.9% (3.5% mid- point)	4.2% (mid- point)	3.6-4.4% (4.0% mid- point)		
Pre-tax nominal WACC	8.0-9.2%	7.4-8.7%	8.3%-9.5%	8.3-9.4%		

- 8.2 Though in this report we have offered Ofcom thoughts for reflection upon the Equity Risk Premium, the risk-free rate and the debt premium, its approach and results seem broadly defensible, provided that it does not feel it must automatically conclude for numbers high in its proposed ranges.
- 8.3 We have not discussed in any detail the proposals made concerning gearing or inflation. These, however, seem broadly defensible to us at this stage.
- 8.4 The key area of challenge we have offered relates to Ofcom's assumptions about debt betas and the use it made of comparator data. On the latter point, it appears to us that Ofcom has simply mis-calculated the range implied by its own approach, neglecting to adjust properly for the fact that the Brattle Group employed a different debt beta assumption from that used by Ofcom, and that the range for network utilities should have been 0.27-0.35, not 0.3-0.4 as Ofcom stated. Furthermore, it appears to us that Ofcom sensibly relies upon the top of the network utilities comparator data range to obtain the bottom of the Openreach range, the consequence being that the same bottom of the Openreach range. Moreover, if Ofcom had used the correct 0.35 figure for the

top of the comparator data range, the wedge between Openreach and BT Group would have been 0.1, not 0.05.

- 8.5 Regarding the use of debt betas and their role in calculating asset betas, it does not appear to us to be safe, on Ofcom's method of estimating asset betas from raw equity betas and market capitalisation data, to assume that debt betas have been invariant during the financial crisis of 2007 onwards. To assume invariant debt betas is to assume that all of the rise in debt premia over that period was rises in default risk an assumption not made, for example, by those ratings agencies whose expertise resides in estimating default risk and which are relied upon by regulators and the CC at a number of stages of cost of capital analysis. We acknowledge, however, that it is not straightforward to apportion changes in debt premia between changes in risk of default and in debt betas. We therefore propose that the natural approach would be to apportion changes in debt premia equally between default risk and debt beta. By applying this approach we have exhibited much more stable asset betas than Ofcom's approach implies, which might be seen as support for our proposed methodology.
- 8.6 The overall consequence is a range for the BT Group equity beta that is a little narrower than Ofcom's proposed range a little lower at the top; a little higher at the bottom. For Openreach, the bottom of the equity beta range is also a little lower than Ofcom's proposed range, reflecting both the greater weight we suggest Ofcom's methodology implied should be placed upon the comparator data than is obvious in the consultation document and our argument that that comparator data, in fact, implies a slightly lower asset beta than Ofcom claims, given its own debt beta assumptions.

## **Choosing Within the Range**

- 8.7 Unlike a number of other regulators, and the CC, Ofcom does not explicitly indicate that it chooses a WACC high in its range aiming up. The standard argument for aiming up is that there is an asymmetry of consequences: if the WACC is a little too high, then consumers lose out a little, by paying higher prices; but if the WACC is a little too low, then consumers lose out because the regulated company does not invest in new technologies and equipment, and losses of the latter sort are thought to be larger than of the former.
- 8.8 BSkyB and TalkTalk do not accept this argument at all. However, insofar as it has any, its force is clearly less when applied to wholesale products than to retail ones, because in the case of the wholesale product a price that is too high reduces incentives for wholesale purchasers of the product themselves to invest in new technologies and equipment meaning that consumers lose out.
- 8.9 We observe, also, that discussions of the argument for "aiming up" have moved on from simply arbitrarily choosing a value at the top of the range to discussions of how much to aim up. For example, in its 2009 Ofwat Report, Europe Economics argued that one

standard deviation was sufficient aiming up, even in the context of the serious financial crisis and great uncertainty at that time, and that the two-standard-deviation aiming up proposed by the CC in the London Airports determination was excessive.<sup>45</sup>

- 8.10 Ofcom's preferred use of ranges is to select values for individual components so as to come to a judgement about the appropriate overall WACC, rather than as a basis for aiming up. That being so (and reflecting that approach), we note that certain of the ranges quoted above are skewed, in the sense that the most likely appropriate value lies towards the bottom of the range (e.g. we have argued this for the debt premium).
- 8.11 Exactly where within these ranges Ofcom should choose will reflect developments between now and the time of the final determination. We offer the following bases for selection within these ranges:
  - (a) If gilts market yields stay low, either 1.4 or 1.5 per cent would be a reasonable value for the risk-free rate.
  - (b) If equity markets normalise and gilt market yields rise in reflection of more optimistic expectations for the sustainable growth rate of the economy, values less than 5.0 per cent should be considered for the ERP. If a value of 1.4 or 1.5 has been chosen for the risk-free rate, values towards the upper end of the ERP range are more plausible.
  - (c) A value of 1.5 per cent for the risk-free rate, or even higher, would naturally be associated with a debt premium towards the bottom of the 2-2.5 per cent range. And if market debt premia continue at around 2.0 per cent, a figure right at the bottom of that range should be considered plausible.
  - (d) The higher the debt premium is, the higher the assumed debt beta.
  - (e) Using the equal apportionment approach, the asset beta for BT Group has been pretty stable at around 0.6 for some time, meaning that, unless something significant and explicable happens to equity betas between now and the final determination, a figure towards the middle of the BT Group range would be most defensible, implying a BT Group equity beta of order 0.95-1.0 at 50 per cent gearing.
  - (f) A wedge of around 0.25-0.3 (roughly equivalent to that in 2005) between the copper access business and the whole of BT would therefore imply a copper access business beta of around 0.7-0.75, around (or even slightly above) the middle of the copper access business equity beta range.

<sup>&</sup>lt;sup>45</sup> See Section 8.8ff of http://www.europe-economics.com/publications/cost\_of\_capital.pdf

# APPENDIX 1: APPORTIONING DEBT PREMIUM CHANGES BETWEEN DEBT BETA AND RISK OF DEFAULT

#### **Purpose of this Appendix**

#### Debt beta vs. risk of default

- A1.1 The Market Debt Premium (MDP) can be broken down into two elements<sup>46</sup>:
  - (a) The difference between the promised cost of debt (the market rate) and the expected cost of debt, to account for the risk of default.
  - (b) The debt beta.
- A1.2 By definition, the MDP for a company is given by:

 $MDP \equiv r_{MD} - r_{f}$ 

where:  $r_f$  = the risk-free rate, and  $r_{MD}$  = the market rate for debt

- A1.3  $r_{MD}$  is not equal to the expected return from holding debt,  $r_D$  the relevant concept for CAPM, since:
  - (c) there is some probability of default, leading to no return
  - (d) there is some probability of losing the initial investment, even on secured debt
  - (e) there is some probability of the perceived risk of default falling after purchase of the bond but before maturity, leading to the value of the bond rising (and so the actual return being greater than the market rate)
- A1.4 The worst-case scenario is that whenever there is a default, the whole value of the bond is lost. The expected return from holding debt is:

$$1 + E(r_D) = (1 + r_{MD}).(1 - p_d)$$

where,  $p_d$  = the probability of default

A1.5 The expected return on debt, expressed in CAPM terms, considers only systematic risk:

8.12  $E(r_D) = r_f + ERP.\beta_D$ 

A1.6 Hence, in this worst-case scenario

<sup>&</sup>lt;sup>46</sup> It should be noted that both of these elements (risk of default and debt beta) will be present even if all risk is systematic (as opposed to idiosyncratic).

 $\begin{aligned} r_{f} + & \text{ERP.}\beta_{\text{D}} = (1 + r_{\text{MD}}).(1 - p_{\text{d}}) - 1 \\ &= (1 + r_{f} + \text{MDP}).(1 - p_{\text{d}}) - 1 \\ &= r_{f} + \text{MDP} - p_{\text{d}}(1 + r_{\text{MD}}) \end{aligned}$ 

 $\Rightarrow \beta_D = MDP / ERP - p_d (1 + r_{MD}) / ERP$ 

A1.7 More generally, when there is some element of loss of principal as a result of default (as opposed to total loss), the formula is:

 $\beta_D = MDP / ERP - p_d.(bankruptcy cost as proportion of debt principal + r_{MD}) / ERP$ 

A1.8 This formula states that the debt beta is the debt premium observed on the market, divided by the general market risk premium, less the expected loss from default divided by the market risk premium. The result is the expected return on debt relative to the expected return on the market as a whole.

#### Apportionment between risk of default and debt beta

- A1.9 In our Main Report, we argue that Ofcom's approach of (implicitly) assuming that all changes in the debt premium after 2007 are changes in risk of default, and none are associated with increases in debt beta, is mistaken. As an alternative, we propose instead apportioning changes in default premium equally between debt beta and risk of default.
- A1.10 One basis for this equal apportionment approach is that, absent a strong basis for apportioning in some other way, equal apportionment is the natural default approach. We believe that this should be the start point of analysis: unless there is some good basis for an alternative, the approach to adopt should be equal apportionment.
- A1.11 We supplement this default position here in three ways:
  - (a) First, we consider the proportion of default premium found to be due to credit risk (risk of default) for bonds of various classes in past academic studies.
  - (b) Second, we consider the proportion of the debt premium in the Competition Commission (CC) assumption of a 0.1 debt beta in the London Airports determination<sup>47</sup>, and, thence, Ofcom's initial assumption of a 0.125 debt beta.
  - (c) Third, we directly calculate debt beta from bonds market data, finding that it increased from 2007 to 2009.

<sup>&</sup>lt;sup>47</sup> http://www.caa.co.uk/docs/5/ergdocs/ccreport\_appf.pdf

## Academic Studies of Proportion of Debt Premium due to Credit Risk

A1.12 Almeida & Philippon (2007)<sup>48</sup> summarize the findings of a number of authoritative academic studies concerning the proportion of debt premium due to risk of default for bonds of various ratings.<sup>49</sup> Ofcom reports the relevant BT bond as having a credit rating of BBB-. In Table A1.1, we present the Almeida & Philippon table lines for bonds of A, BBB and BB ratings.

	Huang & Huang (2003)	Longstaff et al. (2005)	Chen et al. (2005)	Cremers et al. (2005)	Almeida & Philippon (Method 1)		Almeida & Philippon (Method 2)	
Credit rating	10-year spread	5-year spread	4-year spread	10-year spread	4-year spread	10-year spread	5-year spread	10-year spread
Α	0.234	0.56		0.512	0.609	0.613	0.511	0.570
BBB	0.336	0.71	0.702	0.627	0.724	0.731	0.732	0.729
BB	0.633	0.83			0.846	0.846	0.872	0.872

#### Table A8.2: Fraction of debt premium allocated to risk of default

A1.13 Focusing upon the BBB line, we see the range runs from 0.336-0.732, midpoint 0.534.

## Implied Initial Apportionment from CC and Ofcom

#### CC

- A1.14 In CC's report in the London Airports inquiry<sup>50</sup>, the CC gives its view on the range for the breakdown of the debt premium between beta and non-beta effects.<sup>51</sup> Of 110 basis points of debt premium, it contends that the beta element should be assumed to constitute 31-66 basis points, i.e. 28-60 per cent.
- A1.15 We note that the data context for the CC judgement was mid-2007.

#### Ofcom

A1.16 Ofcom proposes a debt beta of 0.125. Given the CC's determination related to mid-2007, and at that time BT had a higher debt premium than BAA, we believe that the relevant initial apportionment to consider is the proportion of BT's total debt premium, as of mid-2007, attributed to beta effects by an assumed debt beta of 0.125.

<sup>&</sup>lt;sup>48</sup> Almeida, H. & Philippon, T. (2007), "The risk-adjusted cost of financial distress", *Journal of Finance*, LXII(6), pp2557-2586

<sup>&</sup>lt;sup>49</sup> *ibid.* Table II ("Fraction of the Yield Spread Due to Default"), p2568

<sup>&</sup>lt;sup>50</sup> CC, op cit, Table 5, paragraph 104 of Appendix F

<sup>&</sup>lt;sup>51</sup> The CC breaks down non-beta effects between "liquidity premium" and "default premium" effects. Since the CAPM model recognises no role for "liquidity premium", we believe that this distinction has no role. In any event, that point makes no difference to the analysis here.

Closing Remarks and Summary

A1.17 Let's use the term "adjusted debt premium" to refer to the debt premium attributable to beta effects, and denote it by ADP. Then we have

ADP = MDP-  $p_d$ .(cost of bankruptcy as proportion of debt principal +  $r_{MD}$ ).

And

 $\beta_D = ADP / ERP \text{ or } ADP = \beta_D x ERP$ 

- A1.18 Thus, for a given  $\beta_D$ , the ADP depends on the ERP. The year 2007 lay within the period of the 2005 price control determination, in which the ERP was 4.5 per cent. But, by 2009, the determined ERP had a 50 basis points uplift. So, taking a range for the 2007 ERP of 4.5-5.0 we have a range for the ADP of 56.25-62.5 basis points.<sup>52</sup>
- A1.19 The BT debt premium determined in 2005 was 1.0 per cent, but based on an A- credit rating. For much of 2006 to mid-2007 BT's 10-year bonds were trading at around 105-150 basis points. So our range for the ADP constitutes some 38-60 per cent of the total debt premium being attributable to debt beta effects, mid-point 49 per cent.<sup>53</sup>
- A1.20 Thus we contend that the CC's decision and Ofcom's 0.125 assumed debt beta both attribute around half of the initial debt premium, as of mid-2007, to beta effects.
- A1.21 Hence, if we apportion increases in the debt premium equally between debt beta effects and risk of default effects, we are broadly maintaining the ratio initially established. Absent a strong basis for attributing increases in the debt premium mainly to beta effects or mainly to risk of default effects, this seems a natural approach.

#### **Direct Estimation of Debt Beta**

A1.22 Next we compare debt betas estimated using monthly data on BT's corporate bond maturing on 07/12/2016 with debt betas imputed using that bond's debt premium. Recall that, under the CAPM, the debt premium can be expressed as:

 $MDP = \beta_D \cdot ERP + p_d \cdot (L + r_{MD})$ 

Where MDP is the market debt premium,  $\beta_D$  the debt beta, ERP the equity risk premium,  $p_d$  the probability of default, L the loss given default and  $r_{MD}$  the return on the bond. If half of the debt premium is attributable to beta risk, debt betas can then be imputed as:

 $\beta_D = \frac{1}{2} \cdot MDP / ERP$ 

<sup>&</sup>lt;sup>52</sup>  $0.125 \times 4.5 = 0.5625$ .  $0.125 \times 5 = 0.625$ .

<sup>&</sup>lt;sup>53</sup> 56.25 / 150 = 37.5 per cent, whilst 62.5 / 105 = 59.5 per cent. For reference, we note that if one assumed a BT debt beta of 0.1 for mid-2007, the ADP would be 45-50 basis points, implying that debt beta effects constituted 30-48 per cent of the total debt premium.

- A1.23 Although debt betas can be estimated directly, by correlating movements in bond prices with those of the equity market as a whole (in a way closely analogous to that for equity betas), there are a number of problems:
  - (a) It is unclear what timescale is required to deliver efficiency in pricing. Broadly, empirical studies suggest that no developed economy market is evenly weakly efficient if the timescale is sufficiently short (e.g. seconds), whilst all deep broad liquid markets in developed economies are weakly efficient if the timescale is sufficiently long (e.g. a year).<sup>54</sup> It is possible that the relevant timescale for efficient information transmission (i.e. to achieve what is called "semi-strong efficiency" in pricing) is longer between equity price movements and bond price movements than it is between equity price movements and bond price for estimating equity betas is to use daily data, it is possible that daily data are not appropriate for debt beta estimation (because semi-strong efficient absorption of information derived from equity market movements into bond prices is not achieved over the timescale of a day).
  - (b) The betas obtained from direct estimation are often of low statistical significance and extremely sensitive to timescale chosen and other methodological choices. For such reasons, the CC considered that estimating debt betas by decomposing the debt premium into its components was a superior methodology to direct estimation.<sup>55</sup>
- A1.24 Thus, although we present direct estimates of the level of debt beta here, our main interest is in the following two questions:
  - (a) Did debt betas rise during the period 2007-2009? and
  - (b) (Most crucially) to what extent are estimates of the change in debt beta over time compatible with the assumption we use in our Main Report namely that half of the change from mid-2007 onwards was debt beta?

#### Did debt betas rise during the period 2007-2009?

A1.25 In Figure A.1 we see imputed debt betas under the assumptions of an equity risk premium of 4.5 per cent and 5 per cent, alongside estimated debt betas and their 95 per cent confidence interval.

<sup>&</sup>lt;sup>54</sup> For a review of various relevant academic studies, see Malkiel, B. G. (2003) "The Efficient Market Hypothesis and Its Critics", *Journal of Economic Perspectives*, 17(1), pp59–82, http://pubs.aeaweb.org/doi/pdfplus/10.1257/089533003321164958

<sup>&</sup>lt;sup>55</sup> See paragraphs 92 to 93, pF24, http://www.caa.co.uk/docs/5/ergdocs/ccreport\_appf.pdf



Figure A.1: Estimated and imputed debt betas for BT (2003-2011)

A1.26 We see the debt betas rising from mid-2007 to mid-2009, then falling back in late 2010/early 2011.

# To what extent are estimates of the level of debt beta compatible with the assumption that half of the debt premium is debt beta?

- A1.27 It is visually fairly clear that the debt betas obtained by direct estimation are incompatible with those derived from the assumption that half of the debt premium is debt beta only in late 2003 / early 2004, late 2007 / early 2008, and (with a 4.5 per cent ERP) from late 2008 onwards (though for much of the time it is compatible with half the debt premium being debt beta and a 5 per cent ERP).
- A1.28 We demonstrate this more formally in Figure A.2 which gives test statistics for a two-tailed test of the null hypothesis that the estimated debt beta is equal to the imputed debt beta, namely:

Test statistic =  $\beta_D^{\text{estimated}} - \beta_D^{\text{imputed}} / \text{SE}(\beta_D^{\text{estimated}})$ 

where  $SE(\beta_D^{estimated})$  is the standard error of the estimated debt beta. When the test statistic is above the relevant critical value, the difference between the estimated and imputed debt beta is statistically significant at that level.

A1.29 Between late 2003 and mid-2004 and between mid-2007 and mid-2008 the imputed and estimated betas are significantly different at both and five and ten per cent levels. Over the course of 2009 and 2010, the estimated debt betas are significantly different to the imputed debt beta with a 4.5 per cent equity risk premium at both the five and ten per cent levels. However, by May 2011, the difference between the two series has again ceased to be significantly different.



Figure A.2:Test statistics for null hypothesis that  $\beta_D^{estimated}$  -  $\beta_D^{imputed}$  = 0 (2003-2011)

- A1.30 One possible interpretation of these statistics is that they imply that default risk, relative to debt beta, was regarded as unusually high for a brief period in late 2003 and in late 2007 and early 2008, but in each case the debt beta eventually rose, perhaps suggesting that what was initially regarded as largely an idiosyncratic event eventally came to be seen as part of a systematic trend. Another possibility is that the ERP was temporarily elevated above 5 in both late 2003 and from mid-2007.
- A1.31 Of course, the debt betas obtained from half of the debt premia themselves have a confidence interval, since they obtained from two-year rolling averages. Thus, in Figure A.3 we show the 95 per cent confidence interval for the estimated betas alongside the imputed debt betas together with the range equal to twice their standard deviation. As can be seen, with the exception of the period between late 2003 and early 2004, these ranges consistently overlap.



Figure A.3: Estimated and imputed debt betas (2003-2011)

# To what extent are estimates of the change in debt beta over time compatible with the assumption that half of the change from mid-2007 onwards was debt beta?

A1.32 In the main report we do not assume that half the debt premium is always debt beta. Instead, we take Ofcom's preferred debt beta estimate of 0.125, assume that that applied from mid-2007, and assume that half of the subsequent *change* in debt premium is to be attributed to changes in debt beta. (This is not precisely the same, because using a 0.125 debt beta even in mid-2007 implies that less than half the BT debt premium is debt beta-related, so apportioning half the change to debt beta means raising, a little, the proportion of debt premium that is debt beta. It can be seen from the charts, however, that the difference is small.) Figure A.4 compares the debt beta imputed in this way (i.e. the debt beta we use in our estimates of asset beta in the Main Report) with the direct debt beta estimates. We see that the direct estimates of debt beta tended to lie above the imputed estimates from 2005 to early 2007, but otherwise the imputed estimates tend to be higher. However, the imputed estimates lie within the confidence interval of the direct estimates in all periods except late 2003 to early 2004, late 2007 to early 2008, and at the very end of the period in early 2011.



Figure A.4: Estimated debt betas and imputed debt betas (2003-2011)

- A1.33 We conclude that although the direct estimates of debt beta are intrinsically non-robust and have occasionally lain materially below estimates imputed from the debt premium, and cannot be considered strong supportive evidence for our "equal apportionment" approach, they:
  - (a) do suggest that debt beta rose from 2007 to 2009; and
  - (b) are broadly compatible with the estimates of debt beta we used, though perhaps suggesting that either an ERP of above 5 per cent might have been appropriate in 2009 or that the proportion of debt premium that is debt beta-related may be lower today than was the case in 2005/6.

#### Conclusion

- A1.34 In this Appendix we have considered the evidential basis for use of the "equal apportionment" approach to the treatment of the increases in debt premium from 2007 to 2009, used in our Main Report. We have argued that:
  - (a) equal apportionment should be the default position i.e. that, absent a good reason for doing otherwise, equal apportionment is the natural approach;

- (b) academic studies suggest ranges for the proportion of debt premium attributable to default risk that overlap equal apportionment, and have a mid-point very close to 50 per cent;
- (c) the CC's range for the debt beta overlapped equal apportionment, and has a midpoint close to 50 per cent; and
- (d) direct estimates of debt beta, though unreliable and non-robust and not *supportive* of equal apportionment are, nonetheless, broadly *compatible* with it.