Ofcom Pension Review

Adjusting BT's beta to account for pension risk

October 2010

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Executive Summary

1. Ofcom launched its Pension Review in December 2009 to consider its regulatory approach in the context of the increased deficit payments and capital market scrutiny of BT's pension scheme (BTPS). An important element of this review is whether an adjustment should be made to the observed cost of capital to take account of the impact of pension fund risks.

2. In March 2010, PricewaterhouseCoopers LLP (hereafter "PwC" or "we") was appointed by British Sky Broadcasting Group plc, Cable and Wireless Worldwide plc and TalkTalk Group to prepare a report in relation to responding to Ofcom's Pension Review. In that report we focused on the aggregate impact of attenuation factors on the appropriate adjustment to the cost of capital to reflect pension risk. Ofcom have since issued a second consultation in relation to BT's pension scheme. We have again been appointed by British Sky Broadcasting plc, Cable and Wireless Worldwide plc and TalkTalk Group to respond to the ongoing consultation. Specifically, we were asked to produce a robust estimate of an appropriate adjustment to be applied to BT's asset beta in order to account for pension risk.

3. The methodology we use to calculate the impact of pensions risk on the cost of capital has been set out by Li Jin, Robert Merton and Zvi Bodie (JMB) who proposed that alternative cost of capital expressions be used to take account of the differential risk of the pension scheme. This concept is broadly accepted, including by Professor Cooper in both of his reports for Ofcom, who then includes additional attenuation factors for pensions risks not borne by shareholders (and shared with other stakeholders). The key inputs required in the refined JMB approach therefore include:

   a. the beta of pension liabilities (β_{PL});

   b. the beta of pension assets (β_{PA}); and

   c. the attenuation factor (i.e. the flow-through risk from the pension plan to the shareholders).

4. To calculate β_{PL}, we first calculate the beta of a long-duration UK government index-linked gilt (β_{ILG}). We take a long-term view on the level of β_{ILG} (over 20 years) in order to smooth out the cyclical fluctuations that occur in the beta over time. We refine our estimate by adjusting for the risk relating to real wage growth, a risk factor relevant to pensions and suggested for inclusion by a number of commentators. This approach provides an estimate for β_{PL} of 0.17.

5. We have undertaken extensive analysis to estimate $\beta_{PA.}$ We calculate the beta for each of the asset classes in the BTPS and then take a value weighted average of each asset class beta to estimate an overall β_{PA}. This provides a β_{PA} estimate of 0.53.

6. We have updated the attenuation factors we presented in our first report to take account of comments and suggestions made by other commentators, particularly Professor Cooper. We use, for the most part, the same attenuation assumptions as in the first report but include an additional factor that takes account of the probability of default. Our revised range for the aggregate attenuation factor is 45% – 66%.

7. Using this build up approach, with our estimates of β_{PA} and β_{PL} and the aggregate attenuation factor, we calculate a refined JMB adjustment factor of 0.18-0.29 (i.e. the asset beta should be adjusted downwards by this amount).

8. Any assessment of the robustness of the estimated JMB refined adjustment needs to consider:

   a. The validity of the concept that the observed cost of capital is an aggregate of pension risk and operating risk and the risk of a company's pension scheme and the underlying risk of its operating assets are not necessarily the same;

b. The validity of the refined JMB approach for quantifying the impact of the pension risk; and

c. The precision of the inputs used in the refined JMB formula.

9. With regard to (a), most commentators accept that the risk of a company's pension scheme and the underlying risk of its operating assets are not necessarily the same.

10. With regard to (b) there also seems to be acceptance among the commentators that in principle the refined JMB formula is an appropriate approach that can be used to quantify the effect of pension risk on the observed beta. All commentators (except BT) consider that in the case of BT the likely affect of this adjustment is a downward adjustment to the observed asset beta of BT Group.

11. Given the above, the robustness of the estimated adjustment using the refined JMB formula relies on the precision and certainty around the inputs. There is most uncertainty around the estimation of β_{PL} and some uncertainty over whether all effects have been captured in the attenuation factor analysis. However, we consider that we have incorporated all key suggestions into our analysis from the responses to Ofcom's consultation and wider commentary. There is no more uncertainty in the estimation of β_{PA} than for other cost of capital estimates.

12. Professor Cooper was asked by Ofcom for his best estimate of a refined JMB adjustment to apply to BT Group's asset beta to adjust for pensions risk. He relies more heavily on an empirical approach and from this suggests an overall downward refined JMB adjustment of 0.05. He also suggests it is highly uncertain and definitely not robust.

13. To obtain an adjustment figure of a reduction of 0.05 using our build up approach requires inputs at the bottom end of a reasonable range – a figure for β_{PL} of around 0.3 can be justified from the historical record of beta of index-linked government bonds (if a particular period is used), but this is significantly above the historic average. A figure for β_{PA} of around 0.43 requires assuming very low (and possibly implausible) asset class betas in property assets and other assets (which are the more uncertain variables). Finally, the attenuation factor necessary to deliver a 0.05 JMB adjustment is around 60% which is towards the upper end of our attenuation factor range (and which drives a lower JMB adjustment).

14. We therefore consider a downward JMB adjustment of 0.05 to be at the bottom end of a reasonable range. By reviewing the inferred asset beta of BT Group in relation to other regulated utilities, we select a reduction of 0.18 at the top end of our reasonable range.

15. The choice of a point estimate within this range of 0.05 to 0.18 requires regulatory judgement. Such judgement does often reflect the risk and consequence of setting the cost of capital too high or too low and regulators tend to err on the side of caution, as the consequences of setting a cost of capital too low can be more economically damaging than setting the cost of capital too high.

16. Therefore, a best estimate of a refined JMB adjustment that could be applied to BT Group's asset beta to take account of the pension risk can be derived by taking a point estimate slightly below the mid-point of 0.18 (our low estimate under the build up approach) and 0.05 (Professor Cooper's estimate using the empirical approach). This gives a downward adjustment of approximately 0.10.

17. We recognise that there is uncertainty around β_{PL} and uncertainty over whether all effects have been captured in the attenuation factor analysis. However, there is usually uncertainty over the estimation of financial parameters within the cost of capital and regulators have a duty to make an assessment of their best estimate, even if there is a wide range around this estimate.

18. In these circumstances making no adjustment would appear to be less robust than applying the best available estimate of the adjustment, however uncertain such an estimate may be.

Introduction

Background and Scope

19. Ofcom must decide how BT Group's pension scheme costs should be treated when considering the efficiently incurred costs of providing a regulated product or service. To refine its regulatory approach, and in the context of the increased deficit payments and capital market scrutiny of BT's pension scheme (BTPS), in December 2009 Ofcom published its Pensions Review[1]. This review covered ongoing service charges and deficit repair payments, as well as considering whether an adjustment should be made to the observed cost of capital to take account of pension scheme risks.

20. The risk of a company's pension scheme and the underlying risk of its operating assets are not necessarily the same, and therefore it is possible that the underlying cost of capital of the operating assets is not the same as the observed cost of capital of the whole company (which in part reflects the pension scheme). For companies with a small pension scheme, or for companies which happen to have an underlying operating risk profile similar to that of the pension fund, the difference between the observed beta and the underlying operational beta is likely to be small. However, in the case of BT, with its £34bn direct benefit (DB) pension scheme[2], and the low underlying utility risk profile for its regulated business, this difference is likely to be relatively important. With part of its pension scheme invested in equities or similar higher risk instruments, the theory suggests the observed beta for BT could be materially higher than the underlying operational beta for the business. So to set the cost of capital for use in calculating regulated wholesale prices an adjustment can be made to the observed cost of capital.

21. This concept was set out by Li Jin, Robert Merton and Zvi Bodie (JMB)[3] who proposed that alternative cost of capital expressions be used to take account of the differential risk of the pension scheme. This concept is broadly accepted[4] and the effect of this adjustment is likely to be a downward adjustment to the observed asset beta of BT Group[5].

22. In its first consultation, Ofcom considered two options regarding an adjustment to the observed cost of capital. Under Option 1, Ofcom would maintain the status quo (i.e, use the existing estimated beta in its cost of capital calculations without making any adjustment for pension scheme risk). Under Option 2 Ofcom would exercise "*regulatory judgement in order to estimate the cost of capital for a notional company without its pension scheme. If this was the case, the likelihood is that the cost of capital would reduce*"[6].

23. The full JMB approach assumes that all risk from a defined benefit scheme directly impacts shareholders (i.e. they bear all the risks associated with pension fund deficits and surpluses). In Professor Cooper's first report to Ofcom (ICReport1), he rejects the application of the JMB adjustment in full, referring to this as a "*naïve*" approach[7]. Professor Cooper argues that the full JMB approach fails to take account of a number of attenuation factors which would reduce the amount of this adjustment.

24. Ofcom's Pensions Review invited response to these issues. In March 2010, PriceWaterhouseCoopers LLP (hereafter "PwC" or "we") was appointed by British Sky Broadcasting Group plc (BSkyB plc), Cable and Wireless Worldwide plc and TalkTalk Group to respond to Ofcom's pension review of BT Group's pension

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[1] http://stakeholders.ofcom.org.uk/consultations/btpensions/
[2] BT, *"BT and Trustee announce agreement on the triennial funding valuation of the BT Pension Scheme as at 31 December 2008",* 11 February 2010. £34bn represents the value of the pension scheme assets. http://www.btplc.com/News/Articles/Showarticle.cfm?ArticleID=CEEAF183-1FBC-43F6-951F-0646AB9D40FF
[3] Li Jin, Robert Merton and Zvi Bodie (2006) *Do a firm's equity returns reflect the risk of its pension plan?,* Journal of Financial Economics, 81, 1-26
[4] For example Professor Cooper states in the introductory section of his paper "*Some regulated firms have large DB pension plans. For these firms the observed cost of capital reflects the risks of both their operating businesses and their pension plans"*
[5] In ICReport1, Professor Cooper states that *"the direction of the adjustment is probably downwards" (Summary page 3)*
[6] Pensions Review, 1st consultation, paragraphs 9.65 to 9.66
[7] See, for example, ICReport1, page 3 and ICReport2, page 12

scheme[8]. Our first report focused on the assessment of the attenuation factors that were set out in ICReport1[9].

25. Respondents included BSkyB plc, Cable & Wireless plc, TalkTalk Group, BT Group and Professor Ian Dobbs (for BT Group). The responses were divided. Some suggested that Ofcom should make the adjustment while others suggested that it should not.

26. Subsequent to this, Ofcom has launched its second consultation[10]. Ofcom's current position, as set out in the second consultation document, is to make no adjustment to BT Group's cost of capital on account of pensions risk. Ofcom suggests that this approach makes the regulatory process consistent over time and is consistent with other proposals within the consultation.

27. However, Ofcom suggests that this *"conclusion is in part dependent upon the low materiality and significant uncertainty over any required adjustment"* [11]*.* Ofcom claim that this view is supported by the analysis conducted by: (i) Professor Cooper in his second paper (ICReport2)[12]; and (ii) the empirical assessment undertaken by Gallagher, McKillop and Pogue (GMP)[13]. The results from the GMP report have been incorporated by Professor Cooper into the analysis set out in ICReport2.

28. ICReport2 concludes that:

    a. making an adjustment to the estimated cost of capital for BT Group to take account of risk associated with a DB pension scheme is possible, but is very difficult to do with a high degree of certainty; and

    b. any adjustment to the cost of capital would require Ofcom to exercise a high degree of regulatory judgement. Professor Cooper states that his best guess is a downward adjustment of 0.05 to BT Group's asset beta. This translates into an impact of 0.3 percentage points on the WACC (approximately a 1% reduction in regulated prices). However, Professor Cooper cautions that this estimate *"is highly uncertain and definitely not robust…there is significant uncertainty about* β_{PL}*, the attenuation factor, and whether stock market betas respond in the perfect way JMB assume"*[14].

29. Considering this analysis, Ofcom concludes that it does not *"believe the evidence to be clear enough or robust enough for us [Ofcom] to depart from our [Ofcom's] current position"*[15]*.* Moreover Ofcom also notes that it believes even if it were to make an adjustment it would be small, perhaps less than a 0.3 percentage points impact on the WACC for BT Group.

30. However, Ofcom does suggest in the second consultation document that *"if compelling evidence emerged that changes this position, then we may review our proposal and treatment in the future*"[16].

31. For our second report, we, PwC, were commissioned by BSkyB plc, Cable and Wireless Worldwide plc and TalkTalk Group to provide:

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[8] PwC, *The aggregate impact of attenuation factors in adjusting the observed cost of capital for pension risk in regulated companies – some preliminary views*, 19 March 2010
[9] Professor Ian Cooper, *The effect of defined benefit pension plans on measurement of the cost of capital for UK regulated companies: A report for Ofcom*, London Business School, 2 September 2009
[10] http://stakeholders.ofcom.org.uk/consultations/pensions-review/
[11] Pensions review, 2nd consultation, para. 5.43
[12] Professor Ian Cooper, *Comment on responses to the report: The effect of defined benefit pension plans on measurement of the cost of capital for UK regulated companies: A report for Ofcom*, London Business School, 13 May 2010
[13] Ronnan Gallagher, Donal McKillop and Michael Pogue (2010) *The influence of pension plan risk on equity risk: A study of FTSE100 companies – 2002 to 2008*, Queen's University Belfast and University of Ulster
[14] ICReport 2, page 30
[15] Pensions review, 2nd consultation, para. 5.44
[16] Ibid. para. 5.46

a. Our estimate of the beta of pension liabilities (β_{PL}). Our overall approach is similar to other commentators' approaches, which involves regressing the returns on government bonds against the returns on the market portfolio. We also review existing estimates for β_{PL} and adjust for other risks associated with pensions liabilities.

b. Our estimate of the beta of pension assets (β_{PA}). For this, we undertake an empirical assessment of the betas of individual asset classes within the investment portfolio that make up BT Group's pension scheme. We calculate the equity beta for each asset class and then build up β_{PA} by weighting these asset class betas in proportion to their value in the pension scheme.

c. An update to our assessment of pensions risk attenuation factors from our first report through consideration of the relevant points raised by Professor Cooper in ICReport2; and

d. Our best estimate of the overall adjustment that Ofcom should apply to BT's Group asset beta to account for pensions risk. We were also asked to provide our views of the robustness of this estimate.

32. We were commissioned to assess the impact of the pension risk on BT Group's estimated asset beta. However, in principle, pensions risk can also have an impact on the assessed cost of debt, which we have not investigated. This impact would depend on how the cost of debt is estimated for the purpose of setting a regulatory cost of capital; if it is drawn from BT market data, then any pensions effect could be present; if it is drawn from benchmark or wider market data the effect could be more subdued if those benchmarks are not inflated by pension scheme risk.

33. These four parts of the analysis are taken in turn in the following sections.

Assessment of β_{PL}

34. In this section, we set out the conceptual basis for determining a figure for the β_{PL}, review the β_{PL} analysis undertaken by other commentators and then set out our own approach and estimates.

Conceptual framework

35. The main challenge in the assessment of β_{PL} arises from the fact that in essence we are trying to estimate the beta of a liability (the claim held by the fund pensioners) that is not traded. Therefore, it is necessary to infer β_{PL} by analogy from the betas of comparable traded securities.

36. Pension liabilities (at any point in time) are the present value of all the future benefits to be paid to past and current employees. These claims by their nature are both long-term and contractually required (since the pension fund has legal obligations to make pensions payments). Moreover, in the event the employer defaults and the funds in the pension fund are insufficient to cover the liabilities, the protection provided by the pension regulator ensures that scheme members continue to receive almost the same level of pension payments.

37. Pension liabilities are generally considered by most observers to be similar in risk profile to a long duration government bond. This is because government bonds are generally considered to be very low default risk (as the government is expected to fulfil its obligations) and the long-dated maturity makes them similar to the long-term nature of pension liabilities. This suggests that a possible starting point in assessing the β_{PL} would be the beta of a long-duration government bond.

38. However, pension liabilities do not have exactly the same risk characteristics as long-duration fixed income securities, as they are exposed to uncertainty surrounding expected real wage growth[17]. This is because the ultimate amount of pension benefit depends on the final and/or average salary that a scheme member earns prior to drawing a pension. For current employees, the expected pension depends on their expected real wage growth[18]. Therefore, to calculate β_{PL}, the beta of a long-duration default free bond would have to be adjusted for the relationship between expected real wage growth and equity returns.

39. The need to make such a real wage growth adjustment has been suggested by both Professor Cooper and Professor Dobbs[19]. Two additional factors that Professor Cooper points out in ICReport1 that should be considered to infer β_{PL} include: (i) *"potential risk-sharing by pensioners in the risk of pension assets"*; and (ii) *"any sharing in the risk of the pensions assets by agents other than pensioners, shareholders and debtholders"*[20]. These points are covered in the attenuation factor analysis as they relate to the level of the overall JMB adjustment rather than to the value of β_{PL}, specifically.

40. Considering the above, we estimate β_{PL} by calculating the beta of a long-dated government bond, to which we then apply an adjustment to account for the systematic risk relating to expected real wage growth. The approach used by other commentators to estimate β_{PL} mainly focuses on calculating the beta of a long-duration default free fixed income security. None of them make any adjustment for the risk related to real wage growth. For example:

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[17] Another risk to which pensions liabilities are exposed to is longevity/mortality. This risk is more specific in nature and therefore considered as part of the quantification of expected benefits in actuarial assessments. Longevity risk exists due to the increasing life expectancy trends among policy holders and pensioners, and can result in payout levels that are higher or lower than originally anticipated. However, this is likely to have little correlation with the stock market, as the movement in life expectancy is unidirectional (life expectancy is expected to grow over time) and evolves very slowly in relation to broader systematic risks.
[18] Note only the benefits of current employees depend on the expected real wage growth, not current pensions (including deferred beneficiaries). We discuss this point in more detail below in paragraphs 63-70.
[19] See, ICReport2, page 14 and Dobbs, *Defined benefit pension plans, the cost of capital and the regulatory allowed rate of return: A report for BT*, Newcastle University Business School, 29 January 2010, paragraph 38
[20] ICReport1, page 28

a. In the context of Ofcom's ongoing pensions review, the JMB paper is the initial reference for estimates of β_{PL}. Their β_{PL} estimate is based on the beta for the period 1993 to 1998 using monthly data for a 30-year US Treasury bond. They employ two methods (see Table 1) to arrive at a range for β_{PL} of 0.18 – 0.46. JMB suggest that the wide range is due to specific events that can affect the beta. For instance, they believe that their first estimate is lower because it captures the effects of a flight to quality resulting from the 1998 Russian bond crisis and the Long-Term Capital Management crisis[21].

b. In ICReport1, Professor Cooper calculates an estimate of β_{PL} by carrying out a 60-month regression of the returns on a UK Treasury 2% index-linked gilt maturing in 2035 on the FTSE all-share index for the period up to 30 June 2009. This provides a beta estimate of 0.33. However, Professor Cooper also carries out a regression for the same time period using 2-year daily data, which he notes gives a different (lower) estimate.

c. In ICReport2, Professor Cooper uses the estimates of β_{PL} provided in the most recent GMP paper (which are set out below).

d. In their 2009 paper, McKillop and Pogue[22] use two methods to estimate β_{PL} similar to those implemented by JMB, but using UK data rather than US data. They perform a market-model regression using monthly data for a 30-year UK Treasury bond and the FTSE all-share index for the period 2002 to 2006 (60 months) to estimate a range of β_{PL} of 0.28 – 0.38.

e. In their 2010 paper, Gallagher, McKillop and Pogue (GMP) conduct a similar analysis to the McKillop and Pogue paper. They carry out the same analysis but for the period 2002 to 2008. Again, they employ two methods, and calculate an estimated β_{PL} range of 0.28 – 0.30.

41. The β_{PL} estimates of various authors are summarised in the table below.

Table 1: Summary of β_{PL} estimates used by others

Commentator	Estimate of β_{PL}	Method
Jin, Merton and Bodie (2006)	0.18 – 0.46	Beta of a 30-year US Treasury bond • In-sample estimate calculating a 60-month rolling estimate using all monthly returns up to the end of the previous year = 0.46 • Estimate using all 72-months of in-sample data from 1993-1998 = 0.18
McKillop and Pogue (2009)	0.28 – 0.38	30-year UK Treasury bond regressed against the FTSE all-share index. • Average of five yearly estimates using 60 months rolling data up until the end of the prior years from 2002 to 2006 = 0.28 • In sample estimate of 60 months data from 2002 to 2006 = 0.38
Cooper (2009) ICReport1	0.33	UK Treasury 2% Index-linked Gilt of 2035 regressed against the FTSE all-share index • For the period up to 30 June 2009 using 60 months data
Gallagher, McKillop and Pogue (2010)	0.28 – 0.30	Monthly closing prices of a 30-year UK Treasury bond and the FTSE all-share index are employed in a market regression model • In-sample estimate using a 60 month rolling estimate consisting of all monthly returns up to the end of the previous year = 0.30 • Estimate using all 84-months of data from 2002 to 2008 = 0.28
Cooper (2010) ICReport2	0.28 – 0.30	Using estimates by GMP (2010). In Professor Cooper's opinion, this is broadly consistent with the beta of long-term default free index-linked security

Source: JMB (2006); McKillop and Pogue (2009); ICReport1, ICReport2; GMP (2010)

[21] Jin, Merton and Bodie, page 10
[22] McKillop and Pogue (2009) *The influence of pension plan risk on equity risk and credit ratings: a study of FTSE100 companies*, Journal of pension economics and finance, 8(4), 405-428.

42. The estimates and methods presented above highlight four key factors to consider when estimating β_{PL}:

a. There is a broad consensus that the correct proxy for estimating β_{PL} is a long duration (30-year) government security[23];

b. There is some debate surrounding whether a nominal or index-linked bond should be used to estimate β_{PL};

c. The range of estimates suggests that β_{PL} is highly sensitive to the time period for which it is estimated[24] and to a lesser degree to the measurement approach (5 year monthly or 2 year daily); and

d. The approaches used by these commentators make no adjustment for the risk associated with real wage growth.

43. In the following section we set out the approach we have undertaken to estimate β_{PL}.

Estimation of β_{PL}

44. To estimate β_{PL} we first calculate the beta of a long-duration fixed income security and then adjust it for risk related to expected real wage growth. Below we discuss each in turn.

Type of security

45. Table 1 in the previous section shows that a number of commentators have used a beta of long-duration government bonds to proxy β_{PL}– primarily because it reflects the long-duration of the pension liabilities.

46. While most commentators have used nominal government bonds, Professor Cooper suggests that an index-linked bond may be more appropriate. One reason is because pension benefits increase with inflation over time. This means that shareholders bear all the inflation risk. This is analogous to the position of an issuer of an index-linked bond where the issuer also bears the inflation risk.

47. For the reasons above, we have used the beta of an index-linked UK government bond as a starting point for our assessment of the β_{PL}.

Time period

48. The next issue to consider is the time period that should be used to calculate the beta of index linked bonds (the beta is highly sensitive to the time period used for measurement).

49. The JMB, Professor Cooper and GMP analyses are all based on two types of beta calculation, both of which involve calculating a beta at a period in time:

a. Spot betas – calculated using 5 to 7 years of monthly data.

b. Short term average of spot betas – calculated using an average of 5 to 7 (year end) spot betas.

[23] JMB also suggest that AA-rated bonds of "significant maturity" could be an alternative.
[24] For instance, the difference between McKillop and Pogue's 2009 paper and the GMP 2010 paper shows that by extending the period in question by 2-years changes the in-sample data estimate by -0.1 (i.e. 0.38 to 0.28). This illustrates that the time period used is important to the measurement of β_{PL}.

50. Conceptually, a beta is a forward looking measure and should reflect investors' views of the future systematic risk of an asset (or liability). However, in practice it is estimated using historic data, which means we need to be careful that the historic period of estimation is appropriate for the estimation of forward looking betas.

51. In this respect, the assessment of the beta of a fixed income security appears to be different in many ways from a conventional equity beta. The systematic risk exposure associated with a fixed income security reflects is the correlation between movements in the price of the fixed income security and the level of the market portfolio.

52. According to Cornell[25] (and Dobbs), for fixed income securities such as government bonds that have very low default risk and have contractually set coupon cash flows, changes in prices are driven by changes in expectations about future interest rates (which affect the expected rate of return – the discount rate). If we assume that this is correct, then there are two important points to note here:

   a. Expectations of interest rates would evolve over the duration of the bond. The movement in bond prices would depend upon where the expected interest rates are in relation to what was anticipated when the bond was issued – not the state of the interest cycle per se. For example, consider a two year zero coupon bond. For a given face value, the price at the time of issuance is dependent on the first year interest rate (which is known at the time of issuance) and the expected second year interest rate. Over the duration of the bond the expectation of the second year might change from the initial expectation. This difference between the initial expectation and the expectation at any future point in time can change substantially over time. As expectations change, so the bond price changes and this can be picked up as a correlation with changes in market values, affecting the calculated beta. The fact that movements in expectations affect the beta calculation, and these expectations can change dramatically in a particular time period, makes the calculation of beta in any particular period very sensitive to the conditions of the time. This contrasts with equity beta estimation, where betas can reasonably be expected to be determined according to fundamental business factors such as the underlying cyclicality of revenues and the degree of operational and financial leverage, which evolve but should not change dramatically in any particular period (unless the business being considered is undergoing significant change, in which case short term historic beta calculation would be seen as uncertain). This means that while it might be appropriate to estimate an equity beta using short term historical data (particularly if a forward looking target rate of financial gearing is applied), this might not hold when estimating the betas of fixed income securities.

   b. If expectations of future interest rates are the primary drivers of price movements for risk-free fixed income securities, then beta could in principle be negative depending on the state of the interest rate cycle compared with prior expectations and how the trend in interest rates relates to economic growth and the state of the equities market. For instance, as shown in Figure 1 below, one explanation for high positive betas in the mid 1990s, could be that interest rates fell ahead of expectations (the prices of bonds therefore rose), resulting in lower borrowing costs, which may have boosted economic growth and equity values, resulting in a measured positive correlation between bond prices and equity prices and hence a calculated positive β_{PL}. On the other hand, it could be hypothesised that during the long period of steady growth up to 2007/8, the economy benefitted from more stable interest rates and more stable interest rate expectations exerting a downward pressure on beta β_{PL}.

53. The above highlights the problems relating to the measurement of fixed income securities betas and how significantly they can fluctuate overtime. To illustrate this sensitivity, we recreated JMB's analysis by regressing a 30-year US Treasury bond against the S&P 500 Index using the two methods described in their paper. This produced β_{PL} estimates of 0.15 to 0.41 for the period 1993-1998, which is approximately

[25] Bradford Cornell (1999) *Risk, duration, and capital budgeting: New evidence on some old questions*, Journal of Business, 72(2), pages 183-200

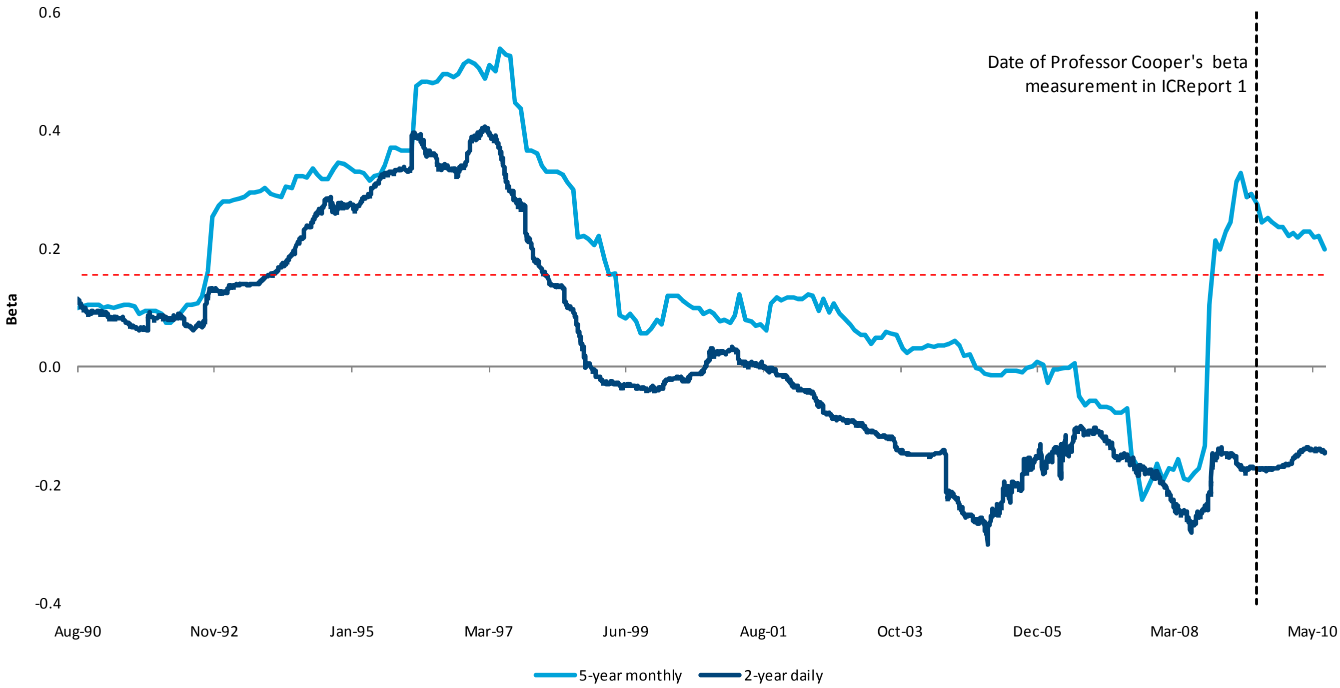
in line with the estimates calculated by JMB[26]. However, when we use the same methodology and same security but calculate β_{PL} for the period 2003-2008 we obtain a range of -0.07 to -0.18 which is quite different from the range in the earlier period. It also illustrates that *a priori* it is not even clear whether the underlying beta should be positive or negative. Lower than expected interest rates boost fixed income bond prices. If such lower than expected interest rates are associated with high growth and high equity prices (which would be the case if low interest rates boost demand) beta will be positive. If, on the other hand, such lower than expected interest rates are associated with low growth and low equity prices (which would be the case if low interest rates are a policy response to a poorly performing economy) beta will be negative.

54. Which effect is more prevalent over the longer term, and the direction and extent to which interest rate expectations have changed over time, are empirical questions. In principle it appears that the beta of a relatively risk-free fixed income security issued by the US or UK government can fluctuate from positive to negative over time, but on average should be close to zero. Indeed if this were not the case it would have implications for the calculation of the cost of capital in a regulatory setting with potentially more far-reaching consequences than the narrow pension deficit issue. Most regulators, including Ofcom in the context of this review of BT[27], use the yield on such an instrument as a proxy for the risk-free rate. If the yield in fact incorporates an uplift to reflect the systematic risk associated with such a security, this would need to be netted off the equity beta used in order to avoid double-counting of systematic risk.

55. Taking account of the above, we consider that the best practice to obtain a robust measure of the beta of a fixed income security would be to cover a long time period over which interest rate expectations can be expected to be more accurate and short-term fluctuations in beta can be expected to balance out.. This long-term estimation period is most suitable for use in assessing the risk of pensions liabilities over the longer term for which any recent historic short-term estimate is far less relevant and potentially misleading. Therefore, we calculated 60-month rolling betas for a UK Treasury 2.5% index-linked security regressed against the FTSE all-share index for the period from August 1990 to July 2010[28]. We then took an average of all the betas in this time period (i.e. a 20-year average) using all 240 months which produced an estimate for beta of the index linked bond (β_{ILG}) of 0.16. This is illustrated in Figure 1 below with the red dashed line representing the period average of the 5-year monthly beta.

[26] The difference is likely due to the choice of security used in the regression analysis, as the returns of each security will differ slightly. Also, JMB do not say which market index they use in their beta calculations.
[27] Ofcom, New pricing framework, Annex 10, page 93
[28] Because of the long-period of analysis (1990 to 2010) we needed to splice together a number of different bonds to form a long-term series, otherwise the long dated bond at the early part of the data series would become a short-dated bond by the end of the data series. We shifted to a longer dated bond when the redemption maturity dropped to 20 years.

Figure 1: Beta of a 30-year UK Treasury Index-linked Gilt (August 1990 – July 2010)



Source: PwC analysis, DataStream

56. A related issue to consider in terms of the time period is whether to calculate betas using monthly (in which generally a 5 year period is used) data or daily data (which is generally estimated using 2 years of data). In ICReport1, Professor Cooper produces a similar analysis using a UK Treasury 2% index-linked gilt of 2035 regressed on the FTSE all share index for the period 2007 to 2009. He suggests that any estimate of β_{PL} will be imprecise because of the observed difference between a 5-year monthly beta and a 2-year daily beta. Indeed, for the time period he considers there is a large spread between the 5-year and 2-year measurements. As set out in the figure above, over the long-run the two beta measurements follow similar movements. Although, there are differences, these are similar to the differences observed in the course of normal company equity beta estimation and do not invalidate the analysis.

57. We have no preferred approach to calculating betas. Each has its own relative advantages and disadvantages as set out in the table below. For the purposes of calculating β_{PL}, we have estimated 5-year monthly betas because we are more interested in estimating a longer term figure than capturing short-term variations. We do note that using a 5 year monthly estimate might be considered conservative in the sense that it implies a higher β_{PL} and so a lower JMB adjustment.

Table 2: Assessment of alternative frequencies for estimating betas

	Frequency – daily	Frequency – monthly
Advantages	Large number of observations, so standard errors are generally lower	Typically a slower moving and more stable estimate
Disadvantages	Daily estimates are typically more volatile Requires high volume trading Not appropriate across timezones	Requires 5 years of data to provide sufficient observations. Over a 5 year period the risk profile of the entity may change

Source: PwC assessment

58. Therefore, for calculating β_{PL}, we use the 5-year monthly estimates, which is also consistent with other commentators and provides the highest figure for β_{PL}.

59. In summary, our assessment for a long-run estimate of β_{ILG} is 0.16. This figure is somewhat lower than most other commentators and has a significant impact on the overall JMB adjustment. The main reason for this difference is the timeframe used. Figure 1 shows that index-linked gilt betas were higher in the late 1990s, but that this period is not representative of the longer term. However, the 0.16 figure is higher than the most recent time period (i.e. 2000 to 2010) where the average beta (5 year monthly) is about zero. Moreover, a positive beta relies on:

    a. Interest rate expectations being confounded; and

    b. lower (higher) than expected interest rates being associated with higher (lower) market portfolio values.

60. We would expect neither of these to operate consistently over time. As a result we would expect the value of beta to be close to zero. It is important that this is the case given the conventional use of index-linked gilt yields as the basis for the estimation of the risk-free rate.

61. Our approach accounts for these issues as our estimate of β_{ILG} captures all of the fluctuations in beta over a long period, rather than only for a short period that may not be an accurate representation of the beta over the longer-term.

Real wage growth adjustment

62. As set out earlier, conceptually, any estimate of β_{PL} should reflect the risk of real wage growth. This has been suggested by both Professor Dobbs and Professor Cooper in their submissions to Ofcom. It is important to make an adjustment for this risk because pension payments are based on an employee's final or average salary. Due to this it is necessary to adjust β_{IIG} (for the risk of real wage growth resulting from changes in pension contributors' salaries over time) to estimate $\beta_{PL.}$

63. Khorasanee[29] (cited by Professor Dobbs and Professor Cooper) has analysed the beta of the relationship between real wage growth and the stock market using UK data from 1946-2005. His assessment suggests that this beta is equal to 0.086. We use this estimate of the effect of real wage growth to adjust our β_{ILG} estimate to account for the risk of real wage growth.

[29] Zaki Khorasanee (2008) *What discount rate should be used to value a cash flow linked to final salary?*, Pensions Economics and Finance, 8.3, 351-360

64. However, because not all scheme members are current employees (i.e. a proportion of scheme members are already drawing on their pension) their claims are not linked to the expected growth rate in real wages. As a result, this adjustment should only be applied to the pension liabilities that are payable to *current* contributors to the pension scheme. This adjustment can be expressed as follows:

$$\beta_{PL} \text{ (adjusted for real wage growth risk)} = \beta_{ILG} + \beta_{RW} * C$$

where: β_{ILG} is the beta a long-duration index linked bond;

β_{RW} is the beta of real wage growth rate; and

C is the proportion of forecast pension liabilities attributable to current employees.

65. Given our own estimate of β_{ILG} and Khorasanee's estimate of β_{RW}, the only unknown in the above equation is "C", which represents the proportion of BT Group pension liabilities related to current employees.

66. In order to estimate C, we need to assess the value of the pension liabilities relating to current employees. There is no direct information provided in BT's statutory accounts on this. However, the accounts do report the increase in the pension liability as a result of one year extra service of current employees. As the value of the pension liability relating to one additional year of service is known for the active membership, the total value of their liabilities can be estimated by multiplying this by the average length of their past service.

67. Our assessment suggests that the annual increase in pension liability as a result of one additional year of service is £332m (row A). We assume an average length of past service of 20 years based on our experience with other pension schemes (row B)[30]. Multiplying the two figures gives an estimate of the total liabilities attributed to current employees for the scheme of £6,630m (row C).

68. The total liabilities for the scheme at the accounting date as given in the financial accounts are £43,293m (row D). These figures suggest that the proportion of pension liabilities relating to current employees (and therefore exposed to expected real wage growth) is around 15% (row E)[31].

[30] The annual increase in pension liability as a result of one year of extra service of the current employees is set out in the financial accounts. However, the figure quoted (£221m) in BT Group's 2010 accounts is based on discount rate assumptions adopted at the start of the accounting period (i.e. 31 March 2009) rather than the assumptions at the accounting date (31 March 2010). The total pension liability (£43,293m) is based on the discount rate assumption as of the end of the year. Therefore to make them consistent we adjust the annual increase in pension liability to reflect the discount rate assumption as 31 March 2010. This gives a figure of £332m.

[31] The BT DB pension scheme was closed to new entrants in 2001; therefore, the risk of real wage growth with regards to the DB pension liabilities is a continually diminishing risk factor as current employees continue to retire.

Table 3: Proportion of DB pension liabilities that accrue to current BT employees

DB pension scheme		
Cost of one year's benefits to active members of DB scheme	A	£332 m
Average past service of active members	B	20 years
Liabilities attributed to current employees	C= A * B	£6,630 m
Total liabilities of DB scheme	D	£43,293 m
Proportion of DB pension liabilities attributable to current employees	**E = C / D**	**15%**

Source: PwC analysis, BT Annual report & Form 20-F 2010

69. Applying a 15% factor to the risk of real wage growth provides our overall assessment of β_{PL} of 0.17. The calculations are summarised in the table below. We note that Ofcom would be able to gain access to data from BT that would allow refinement of this estimate.

Table 4: Adjusted β_{PL}

β_{ILG}	A	0.16
Salary-linked beta	B	0.09
Proportion of DB pension liabilities attributable to current employees	C	0.15
Adjusted β_{PL}	**D = A + B * C**	**0.17**

Source: PwC analysis

Assessment of β_{PA}

70. The second key input to the JMB adjustment is β_{PA}. In this section we briefly review the assessment of β_{PA} analysis undertaken by other commentators before setting out our own approach.

Estimates of β_{PA}

71. The assessment of β_{PA} is comparatively more straightforward than the assessment of β_{PL} as it focuses on real assets, many of which are traded and therefore their betas can be calculated directly.

72. In principle, β_{PA} can be estimated by calculating the beta for each asset class invested in the BTPS and then by constructing the overall β_{PA} by weighting these asset class betas in proportion to their value in the pension fund. This is the approach that has been followed by all of the commentators reviewed in the course of our work.

73. In the JMB analysis, asset class betas are based on a study undertaken by the Harvard Management Company[32]. Other commentators have mainly used these asset betas as well (See Table 5 below). The weights used to build up the overall β_{PA} for the BTPS are based on the breakdown of pension scheme assets (which is reported on a regular basis). (Note that the overall estimates of JMB, MP and GMP β_{PA} are not relevant as they are not specific to BT Group and therefore are not presented in the table below).

Table 5: Summary of β_{PA} estimates used by other commentators

	Asset class	Estimate of β_{PA}	Method
Jin, Merton and Bodie (2006)	Equities*	1.000	Estimates are drawn from a study done by the Harvard Management Company
	Bonds	0.175	
	Real estate	0.150	
	Cash	0.006	
McKillop and Pogue (2009) GMP (2010)	Equities	1.000	Beta estimates for different asset classes taken from JMB paper
	Bonds	0.175	
	Property	0.150	
	Other	0.006	
Cooper (2009, 2010)	Equities	1.000	Beta estimates for different asset classes taken from JMB paper
	Bonds	0.175	
	Property	0.150	
	Alternate assets	0.006	
	β_{PA} used	**0.41**	

* JMB's equities category also includes "Preferred Stock" which has an assumed beta of 0.175

Source: JMB (2006); McKillop and Pogue (2009), Gallagher, McKillop and Pogue (2010), Cooper (2009, 2010)

[32] Jay O. Light (2001) *Harvard Management Company*, The Harvard Business School Case 201-209

PwC approach to β_{PA}

74. To calculate β_{PA}, we based our analysis on the broad asset classes of the pension assets, as presented in BT Group's 2010 annual report[33]. More specific data regarding the nature and value of assets is available in the BTPS 2009 annual report[34], which we used to inform our analysis.

75. Below we set out the analysis of each asset class in turn and explain how we estimated its beta.

UK and non-UK equities

76. For UK equities we used a beta of 1. This is consistent with the estimates used by JMB, Professor Cooper and GMP.

77. For non-UK equities, BTPS's annual report breaks down its non-UK equity assets by region. These regions include: Europe, North America, Japan, emerging markets and the Pacific Basin (ex. Japan)[35]. As of 31 March 2010, non-UK equities in the BTPS were valued at £7.5 billion corresponding to 21% of the total value of the BTPS assets.

78. Table 6 below summarises our analysis of non-UK equities. In order to capture the relative risk of these assets compared to UK equities, we regressed the main stock market index for the non-UK country/region against the FTSE all-share index. We then took a 10-year average of 5-year monthly betas[36] for each foreign index and weighted the average by their respective values in the BTPS. Our overall value weighted average beta for non-UK equities is 1.05.

Table 6: BTPS non-UK equities and assigned betas

Asset type	Asset fair value £bn	%	Equity beta	Approach
Non-UK equities	**7.5**	**21**		
Europe	2.5	7	1.13	FTSE Euro First 300 index regressed against FTSE all-share index
North America	2.5	7	0.99	S&P 500 regressed against FTSE all-share index
Japan	0.5	1	0.84	Nikkei 225 regressed against FTSE all-share index
Emerging markets	1.7	5	1.09	MSCI emerging markets index regressed against FTSE all-share index
Pacific basin ex. Japan	0.3	1	0.92	MSCI AC Asia Pacific ex. Japan index regressed against FTSE all-share index
Value weighted average			**1.05**	

Source: PwC analysis, DataStream, BT Annual report & Form 20-F 2010, BTPS annual report 2009

Fixed-interest securities

79. The BTPS fixed interest securities portfolio consists mainly of corporate bonds. There are two main approaches to estimating the beta of corporate bonds (the corporate debt beta): (i) the decomposition

[33] BT Group plc, *Annual report & Form 20-F 2010*, page 130
[34] BT Pension Scheme, *Annual report 2009* (http://www.btpensions.net/BTPS/reports/annual_reports.htm)
[35] Ibid., page 45
[36] We calculate monthly betas, because there are problems in calculating daily betas across different time zones.

approach which involves backing out the corporate debt beta embedded in credit spreads; or (ii) by regressing the returns on corporate bonds with the returns on the market portfolio.

80. The decomposition approach is an indirect method of calculating the corporate debt beta that has been used by regulators as well as the Bank of England. This approach separates credit spreads of corporate debt over a risk-free security into their constituent components in order to isolate the debt beta. It makes use of the following equation:

$$\textbf{Debt premium} = \textbf{liquidity premium} + \textbf{default premium} + \beta_D * \textbf{EMRP}$$

81. We have undertaken an analysis using the decomposition approach to calculate our corporate debt betas. Using this approach, we estimate a corporate debt beta range of 0.17 to 0.26. This is set out in Appendix 1.

82. In addition to this we have looked at corporate debt betas estimated by: (i) academics; and (ii) regulators. Both of these make use of the above two approaches.

83. The corporate debt beta is generally quite low with a range across all three sources of 0 to 0.26. The corporate debt betas derived from each source are summarised in Table 7 below and set out in more detail in Appendix 1.

Table 7: Summary of debt beta estimates

	Corporate debt beta estimate
Academic views	0 – 0.25
Regulator views	0.09 – 0.22
Decomposition approach	0.17 – 0.26

Source: See Appendix 1

84. Considering the evidence from these sources and from our own (illustrative) analysis, we assume a corporate debt beta of 0.1 for fixed-interest securities in the BTPS. This is the most common figure used by a mix of UK and international regulators who have assessed the corporate debt beta.

Index-linked securities

85. For index-linked securities we used our estimate of β_{PL} (before adjusting for real wages risk) as this was based on the beta of an index linked security. Our estimate for the beta of index-linked securities is 0.16.

Property

86. The property portfolio of the BTPS consists of office, retail and industrial properties as laid out in Table 8 below. The total value of property is £3.8 billion or 11% of total assets of the BTPS.

Table 8: BTPS property assets

		Asset fair value	
		£bn	%
UK	Offices	1.50	4.3
	Retail	1.61	4.6
	Industrial	0.30	0.9
Overseas	Offices	0.06	0.2
Other		0.33	0.9
Total		3.8	10.8

Source: PwC analysis, BT Annual report & Form 20-F 2010, BTPS annual report 2009

87. In order to calculate a beta for the BTPS property assets we looked at a variety of property company betas. We examined betas for both residential and commercial property companies and found that companies that deal primarily with residential properties have relatively low betas, whereas commercial property companies exhibit higher betas. Considering that the BTPS does not contain any residential properties, we excluded residential property companies from our analysis.

88. We calculated a 10-year average of 2-year daily equity betas[37] for a number of commercial property companies, shown in Table 9 below, which had a similar portfolio of property assets to the BTPS. We then calculated the average of these property company betas to produce our overall estimate of β_{PA} of 0.58.

Table 9: Property benchmarks

Name	Sector	Equity beta
Derwent London	Mostly commercial	0.52
Shaftesbury plc	Retail / offices	0.63
Capital shopping centres group plc	Retail	0.67
Capital and regional plc	Retail	0.55
AVG immobilien AG	Offices / storage	0.57
Average of benchmark equity betas		**0.58**

Source: PwC analysis, DataStream

Alternative assets

89. The BTPS "alternative asset" category is made up of investments in hedge funds, private equity, commodities, credit opportunities and other. These assets represent £5.9 billion or 17% of the total value of the BTPS. The breakdown of the assets is based on their share in the total pension fund as presented in the 2009 BTPS accounts, as this is the most recently available information. We have assumed that the proportion of each remains unchanged.

90. For hedge funds and private equity assets we took betas calculated by Barrie and Hibbert[38] based on the returns of the Credit Suisse Tremont Hedge Fund index and the 3i Group private equity index,

[37] In practice, both 5-year monthly and 2-year daily betas can be used to measure systematic risk of normal equities. For our analysis of property companies, we have used a 2-year daily betas, because we are not concerned about timezone issues. To smooth out the impact of the last two years' volatility in real estate markets we use a long-term average of the 2 year daily betas in our calculations. The average beta calculated on a 5-year monthly basis is 0.90.

respectively. The hedge fund beta is 0.28 and private equity beta is 1.54. The reason for hedge funds having a low beta is that they typically make investments which run counter to the general direction of the market. Private equity, in contrast, typically involves investing in companies, but using higher levels of financial leverage, which pushes up the beta of this asset class.

91. For commodities, we regressed two commodity indices, the Thomson Reuters equal weight CCI index and the Dow Jones UBS commodity index, against the FTSE all-share index and took a 10-year average of their betas. Both betas were similar and the average of the two was 0.17.

92. For credit opportunities and the "other" category we made an assumption for beta of 0.5 for each category[39]. This is because of (i) a lack of information regarding the make-up of these assets and (ii) the relatively small share of total assets that they comprise. Table 10 summarises our beta analysis and shows a value-weighted average beta of 0.58 for all alternative assets.

Table 10: BT's alternative assets and assigned equity betas

Asset type	Asset fair value £ bn	%	Equity beta	Approach
Alternative assets	**5.9**	**17**		
Hedge funds	2.1	6	0.26	Source: Barrie + Hibbert (2010) – Based on the returns on the Credit Suisse Tremont Hedge Fund index.
Private equity	1.3	4	1.54	Source: Barrie + Hibbert (2010) - Based on the returns on the 3i group private equity index
Commodities	1.1	3	0.17	Average of the 10-year averages of 5-year monthly equity betas of the Thomson Reuters equal weight CCI index and Dow Jones UBS Commodity Index against FTSE all-share
Credit opportunities	1.0	3	0.50	PwC assumption
Other	0.4	1	0.50	PwC assumption
Value weighted average			**0.58**	

Source: PwC analysis, DataStream, BT Annual report & Form 20-F 2010, BTPS annual report 2009, Barrie and Hibbert (2010)

Cash and other

93. Cash and other are not broken down any further; we use the JMB beta for this asset class of 0.006 which we consider to be fair as cash has a very low risk profile.

Summary

94. The table below summarises our assessment of β_{PA}. Our overall estimate for β_{PA} takes a value-weighted average of the betas for each asset class discussed above. This gives us an overall beta of 0.53.

[38] Alexandre Pages and Harry Hibbert (2010) *Real-world alternative asset calibration: Distributional targets at end-March 2010*, Financial Economic Appliations

[39] This information is not publicly available but could be obtained by Ofcom from BT Group and could be used to refine the estimates.

Table 11: PwC β_{PA} estimate

Asset type	Asset fair value £ bn	%	Equity beta	Approach
UK equities	3.6	10	1.00	JMB estimate
Non-UK equities	7.5	21	1.05	PwC analysis
Fixed-interest securities	5.9	17	0.10	PwC analysis
Index-linked securities	5.8	16	0.16	Based on our estimate of β_{PL}
Property	3.8	11	0.58	PwC analysis
Alternative assets	5.9	17	0.58	PwC analysis
Cash and other	2.8	8	0.01	JMB estimate
	35.3	**100**		
Beta average weighted by value			**0.53**	

Source: PwC analysis, BT Annual report & Form 20-F 2010, BTPS annual report 2009

95. Our estimate of β_{PA} is higher than other commentators – Professor Cooper for instance estimates 0.41. The main drivers of this difference are:

a. The difference between estimates of the property assets beta. Other commentators have used a beta of 0.15 for property assets whereas our analysis suggests an estimate of 0.58. Our analysis suggests that the beta for residential and commercial properties differ significantly, with the residential property beta being lower, around 0.17 according to our analysis. This seems to suggest that property betas used by other commentators might be based on analysis of residential property investments. If this is the case, it is inappropriate as BTPS property portfolio consists of commercial properties.

b. The difference between estimates of the alternative assets beta. Professor Cooper uses a beta of 0.006 for alternative assets which he suggests is based on the figures set out in the JMB paper. However, the JMB paper uses a beta of 0.006 for cash, not for alternative assets (JMB analysis does not consider alternative assets). Moreover, it is difficult to see how alternative assets that are comprised of significant investments in hedge funds and private equity can have a beta as low as 0.006.

96. Taking account of the above, we consider that our estimate of β_{PA} is both robust and improves upon the analysis conducted by other commentators. If Ofcom wants to refine the data used in this calculation (in particular, a more accurate breakdown of the pensions assets), then it should be able to gain access to this from BT.

Pensions risk attenuation factor

Professor Cooper's attenuation factors

97. In ICReport1, Professor Cooper argues that a "*naïve*" application of the JMB approach to BT Group's estimated asset beta would reduce it from 0.64 to 0.24, a level which Cooper considered implausibly low implying that the adjustment was excessive. Professor Cooper then sets out a number of factors and reasons as to why the full effect of the JMB adjustment would not be appropriate – these are termed 'attenuation' factors. Full attenuation would mean that none of the JMB adjustment should be applied to the beta of 0.64, whilst no or zero attenuation would result in a figure of 0.24 for the asset beta for the operations of BT as implied by the JMB approach.

98. These attenuation factors included the following:

    1. Sharing of pension risks with pension insurance schemes
    2. Imperfect capture of pension risks in share prices (which is more of a measurement issue than a risk-sharing attenuation factor)
    3. Sharing of pension risks between pensioners and the firm
    4. Sharing of pension risks with employees through the labour bargaining process
    5. Sharing of pension risks with the Government through taxes
    6. Sharing of pension risks through the regulatory process (i.e. risk sharing with customers or wholesalers)

99. In our first report, we concluded that imperfect capture of pension risks in share prices (attenuation factor 2 above) is a broad issue in the analysis of betas and the cost of capital, but did not consider this a reason for dismissing or attenuating the JMB adjustment (see Appendix I of our first report for more details).

100. In particular the suggestion that share prices lag movements in pension scheme values does not accord with the high degree of disclosure associated with the BTPS, the speed with which BT Group's share price appears to respond to new information about its pension scheme, and the significance of the BTPS relative to the size of the business, all of which contribute to focussed and detailed analyst attention[40]. It is also inconsistent with the McKillop and Pogue empirical analysis which implied feed through (see para 144).

101. In ICReport2, Professor Cooper suggests that even if analysts follow the BTPS risk closely, it does not necessarily mean that this pension risk is reflected in the share prices as assumed by JMB approach. To substantiate his point, Professor Cooper cites the example of when BT Group's share price fell by 8% when it announced its pension recovery plan even though the announcement was made along with quarterly results slightly ahead of analysts' expectations[41].

102. However, it is very difficult to ascribe movements in a share price to any particular factor. Furthermore, even if the pension recovery plan did contribute to the fall in share price on this occasion, it is unclear what could have caused this. It may have been the revelation of unexpected movements in the value of underlying pensions assets and liabilities or of an unexpected outturn for the pension recovery plan. What it does show is that share prices do react quickly to new information, but that there is continually new information for investors to react to. In this context pensions information is like other information which influences share prices. For example, most commentators would agree that share prices reflect expectations of earnings, and a fall in the share price when a profits warning is issued is indicative that this is the case.

[40] For example, Fitch Rating, *"BT Pension Deficit Unlikely to be Short-Term Risk Despite Cash Flow Strain"*, 19 February 2010, and Evolution Securities, *"Poorly defined benefits"*, 16 February 2010.
[41] ICReport2, page 20-21

103. Considering this and the evidence set out in our first report, we reject imperfect capture of pension risk in share prices as having any material impact on the appropriate degree of attenuation.

104. For the remaining factors set out in the list, our first report examined these individually and presented ranges for the effect of each of the individual factors, and a view of the aggregate impact of the attenuation factors (the build up approach). In the following part of this section we summarise our views from the first report and update this following comment from Professor Cooper in ICReport2.

PwC's updated assessment of the attenuation factors

105. This section sets out our updated assessment of the attenuation factors that should be applied to the full JMB adjustment.

106. There is broad agreement on the treatment of two of the attenuation factors: (i) sharing of pension risks with pension insurance schemes; and (ii) sharing pension risk with the government through taxes.

107. As set out in our first report, we agree with Professor Cooper that sharing of pension risks with pension insurance schemes (attenuation factor 1 in the list above), certainly in the UK through the Pension Plan Fund (PPF), does not lead to risk sharing by shareholders, but rather impacts the risk borne by scheme members in the case when a firm goes bankrupt. As this implies that the scheme will only have any effect in a situation where shareholder value has already been eliminated this cannot provide any perceived reduction in pension fund risk for shareholders – resulting in an attenuation factor of 0%.

108. In relation to sharing pension risk with the government through taxes (attenuation factor 5 in the list above), we set out in our first report that the treatment of this factor is a broadly mechanical factor, and an attenuation figure of 28% is appropriate[42]. By itself this would reduce the full impact of the JMB adjustment by 28%. In sequencing attenuation factors, the tax effect must be applied to the residual risk borne by shareholders, implying that as other attenuation factors increase, the impact of the tax adjustment reduces, such that with full attenuation associated with other factors there would be no tax impact.

109. In ICReport2, Professor Cooper agrees with our assessment. In particular, he "agrees with the structure of PwC analysis, whereby the tax adjustment is made only after other factors have been included"[43].

110. To account for risk sharing with the government through taxes, we continue to use the same structure and level of attenuation factor as set out in our first report.

111. There is less consistency between commentators on the remaining attenuation factors. We set out each in turn below, briefly setting out the analysis we conducted in relation to each as part our first report[44], the review (of our analysis) conducted by Professor in ICReport2, and how we have updated our assessment[45].

Sharing of pension risks with scheme members

112. In our first report, we combined the **sharing of risks between pensioners and the firm** with the **sharing of pension risks with employees through the labour bargaining process**, as these are inexorably

[42] In the case where BT was not in a position of paying tax (e.g. loss making, or with capital allowances eliminating taxable profit), then the tax attenuation factor could fall below 28%. There are plans for the current headline rate of UK corporation tax to reduce to 24% by 2014. This means the attenuation factor will also fall to 24% over time.

[43] ICReport2, page 21

[44] PwC, *The aggregate impact of attenuation factors in adjusting the observed cost of capital for pension risk in regulated companies – some preliminary views*, 19 March 2010

[45] http://stakeholders.ofcom.org.uk/binaries/consultations/751766/annexes/Ofcom2009CooperReport.pdf

linked as both pensioners and employees are scheme members. We refer to this attenuation as **risk sharing with scheme members**. Evidence that scheme members do share risk is demonstrated by examples of actual past changes in scheme benefits and contributions which appear to have occurred as a result of deficits/surpluses arising (e.g. employee pension contribution holidays during periods of surplus and benefit reductions during economic downturns).

113. The extent of the ability of a company to share pension risk with scheme members is limited by the following factors:

a. A company is effectively able to share risk only with current scheme contributors as it is virtually impossible to change benefits of current pensioners deferred beneficiaries and accrued benefits of existing members. In the case of the BTPS current contributors only represent 19% of total scheme members (see Appendix II of our first report) – limiting the amount of risk sharing that is possible.

b. Generally the risk sharing with scheme members is achieved through altering future new benefits accrued (due to legislation and precedent court cases)[46]. This is particularly relevant in the case of BT given the relative maturity of its scheme where new liabilities are small in comparison to the existing liabilities (approximately £0.3bn per year versus £43bn of liabilities i.e. less than 1%).

c. Shareholders bear the pensions risk within normal risk bounds. Only beyond a certain threshold or 'tipping points' do scheme members begin to bear risk.

114. Professor Cooper's main challenge, as set out ICReport2, in relation to risk sharing with scheme members is that we assume certain factors cause no attenuation:

a. "*They [PwC] assume that the present value of future wage costs is unaffected by a growing pension deficit.*"

b. "*They [PwC] assume that the present value of pension liabilities is unaffected by default.*"[47]

115. We discuss each of these in turn below.

Present value of future wage costs is unaffected by a growing pension deficit

116. Professor Cooper states in ICReport2 that paragraph 25 footnote 20 of our first report suggests that we assume that the present value of future wage costs is unaffected by a growing deficit. Professor Cooper argues that there is evidence that suggests that the financial well being of a firm has implications for the level of future wages (e.g. Hanaka,1998[48]).

117. Our supposition, as set out in our first report, is that in making employment decisions, individual employees compare all the different aspects of the employment packages on offer. All other things being equal, an employer which requires employees to bear some of the risk of a pension scheme will be less attractive to employees than employers where this is not the case. Therefore, to recruit and retain employees in a competitive labour market some other aspect of the employment package will need to be improved to offset the employee evaluation of the pension risk. Consider the situation where all the firms

[46] Section 67 of the Pensions Act 1995 introduced restrictions on the power to make amendments to schemes which would or might affect members' previously accrued rights. Under Section 67, any modifications to pension schemes that are made without member consent must be certified by the Scheme Actuary as not being detrimental to members' benefits. This makes it almost impossible to reduce past service benefits unless members consent. In any event, prior to the introduction of this legislation, case law would have made it difficult for trustees of defined benefit pension schemes to reduce past service benefits.
[47] ICReport2, page 20
[48] Gordon Hanka (1998) *Debt and the terms of employment*, Journal of Financial Economics, 28, 245-282

operating in the labour market have a pension deficit problem that is similar in nature. In this case, there are two options to maintain the market equilibrium: all firms could exclude the sharing of pension risk with employees and bear the risk themselves or all firms could include the sharing of pension risk in the employment package (for example, through the potential of lower wages) without making any offsetting adjustment to any other element of the employment package. Now since all firms would make these choices, each option would remain equivalently attractive in terms of the employment package and therefore firms would be able to retain and recruit employees without making any improvements to the package to offset the pension risk.

118. On the contrary, if the pension deficit problem is unique to one firm, when this firm shares the pension risk with the employees, in order to be able to continue to recruit and retain people it will have to make improvements to the employment package to offset the pension risk; otherwise potential employees will choose employment packages at rival firms that exclude pension risk sharing.

119. In essence, it is important to recognise that the extent of pension risk that BT Group can share with its employees without making an offsetting adjustment to the value of the employment package depends on the level of pension risk sharing embedded into the "market clearing" value of employment package (where labour demand equals labour supply). So while we do recognise that a growing deficit can have effects on the present value of future wage growth, we consider that the competitive dynamics of the labour market limits the extent of these impacts. While a firm in a declining industry may be prepared to accept employee attrition, this is unlikely for BT which is regulated as a going concern.

“They [PwC] assume that the present value of pension liabilities is unaffected by default.”

120. Professor Cooper in ICReport2 states that in Appendix IV of its first report PwC considers default risk but does not include it in its calculation. We do acknowledge that in extreme (downside) situations, the risk sharing between shareholders and scheme members ceases and the scheme members or insurer/statutory guarantor bear all the risk[49].

121. To incorporate this effect we can use the default probabilities implied by the ratings provided by ratings agencies such as Moody’s and Standard and Poor’s for businesses with BT Group’s rating. BT Group is currently rated BBB- by Standard and Poor’s, Baa2 by Moody’s and BBB by Fitch, which is at the lower end of investment grade. Using historic cumulative default probabilities for BBB rated companies; this would suggest that there is a cumulative probability of default of between 7% and 14% over a 10 to 20 year horizon[50]. In the situation of default, we can assume shareholder value would be eliminated, and in this sense there would be 100% attenuation. This can be incorporated on a probabilistic basis into the overall attenuation range.

122. In summary we estimate two attenuation factors relating to risk sharing with scheme members. These can be combined in a probabilistic way.

    a. Treating BT Group as a going concern business, with no additional attenuation adjustment.

    b. If, however, we take account of the default scenario, we would add an additional attenuation factor range of up to 14% to the figures set out above.

[49] In the event that a company goes insolvent the scheme would become an unsecured creditor. If there are sufficient assets to secure all the member benefits then scheme members bear the risk. Otherwise, the scheme falls into the Pension Protection Fund, essentially a government set up insurance fund which provides a minimum level of benefits (typically slightly below the scheme benefits) to scheme members. In this case arguably, it’s the insurer/statutory guarantor bears all the risk.
[50] Moody’s. *‘”Corporate Default and Recovery Rates 1920 to 2009”*, February 2010

Sharing of pension risks through changed wholesale prices

123. The last attenuation factor we set out in our first report was the sharing of pension risks through the process of setting wholesale prices (i.e. higher or lower wholesale prices which is ultimately risk sharing with retail or wholesale customers). We assumed in our first report that this risk sharing could result in an attenuation factor of 15%.This is based on two numbers: (i) the risk sharing would be restricted to 30% of the pension deficit, where 30% is the proportion of BT who are employed in Openreach; and (ii) a 50% chance that the regulator would allow a pass through of pension deficit costs.

124. Professor Cooper, in ICReport2, suggests that "the probability assumption looks reasonable but also cannot be verified by the stock market evidence"[51].

125. Whether this attenuation factor exists, and if so its size, depends on shareholder perceptions of the regulatory approach to setting prices at the time of the measurement of BT Group's cost of capital. Ofcom's latest view on the Openreach cost of capital is set out in the "New Pricing Framework"[52] which was published on 30 May 2008 and was based on market expectations prior to that date. This suggests that, for consistency, investors' expectations should be considered around this date as well.

126. Clearly, there was limited evidence available at that time to suggest that Ofcom would allow Openreach to recoup the funding deficit through regulated prices, although some other UK and international regulators have allowed some pass through of deficit payments into regulated prices.

127. If the cost of capital in question is measured after 23 July 2010, the date on which Ofcom published its consultation document suggesting that BT Group should not be allowed to raise its wholesale charges to help remedy its pension fund deficit, it would be reasonable to assume that shareholders' perception of the regulatory process would be for no pass through (assuming Ofcom does not change its position).

128. However, we do note that even if Ofcom maintains its position that deficit repair costs cannot be recovered through regulated charges, there could still be a small amount of attenuation if investors considered that there was still a possibility Ofcom could at some point in the future allow some recovery of deficit payments in regulated charges.

129. Ofcom, itself, is of course in the best position to assess what the right attenuation factor in relation to regulatory risk sharing is as it depends entirely on its actions (on the pass through of pension deficit costs). For the purpose of this analysis we continue to use the range we present in our first report, but would anticipate this attenuation factor would fall over time as investors reduce their expectation of risk sharing with the regulator.

130. For the purpose of our analysis we consider two scenarios in relation to this attenuation factor. The adjustment to be made depends on the observed cost of capital that is being used as a reference point. If that cost of capital is observed at a time before the Ofcom decision not to allow pass through of deficit into charges then some attenuation due to regulatory pass through to consumers is appropriate. However, if the expectation is no pass through then no (or little attenuation) is appropriate:

   a. Scenario 1: If the JMB adjustment is applied to BT Openreach's cost of capital as assessed for the Pricing Framework published in May 2009, then our estimate of the attenuation factor for pension risk sharing through the regulatory process is 15% at the top end (as described above). We have updated the assumption at the bottom end to allow for some pass through of this adjustment. This has been set at 5%.

[51] ICReport2, page 22
[52] Ofcom, *"A New Pricing Framework for Openreach"*, 20 May 2009.

b. Scenario 2: If the JMB adjustment is applied to a cost of capital measured after Ofcom published its consultation document, then we consider that the attenuation factor for pension risk sharing through the regulatory risk sharing would be much closer to 0%. We set the range from 0% to 5%.

Summary

131. The table below summarises our estimate of each of the attenuation factors and our view of the aggregate factor. Our overall adjustment factor range is 45.4% to 66.3% - slightly higher than the range set out in our last report.

132. Note that the upper end of our range is very similar to the attenuation factor calculated by GMP of 59% to 66%, which Professor Cooper used in his calculations in ICReport2.

Table 12: Aggregate attenuation factor

Component	Calculation	Scenario 1		Scenario 2	
		Low	High	Low	High
Scheme member attenuation	A	13.5%	30.6%	13.5%	30.6%
Regulator attenuation	B	5.0%	15.0%	0.0%	5.0%
Shareholder pre-tax	C = 100% - A – B	81.5%	54.4%	86.5%	64.4%
Probability of default to apply 100% attenuation	D	7.0%	14.0%	7.0%	14.0%
Shareholder pre-tax (adjusted for default probability)	E = 0% * D + C * (1-D)	75.8%	46.8%	80.4%	55.4%
Tax @ 28%	F	28.0%	28.0%	28.0%	28.0%
Shareholder post-tax	G = E * (1-F)	54.6%	33.7%	57.9%	39.9%
Aggregate attenuation	**H = 100% - G**	45.4%	66.3%	42.1%	60.1%

Source: PwC analysis

133. The ranges within both scenarios result in three different estimates for the attenuation factor. In our analysis in the next section we use the range from Scenario 1 because we apply it to the estimated cost of capital, prior to this consultation. However, it is possible for Ofcom to update the attenuation factor in the middle of this range by applying it to the calculations in Table 14 below.

BT Group's adjusted beta under the build-up method

134. In this section, we bring together our analysis of β_{PA}, β_{PL} and the attenuation factor estimated using the build up approach to calculate the refined JMB adjustment that Ofcom could apply to the BT Group beta to adjust for the risk related to BTPS.

JMB Adjustment

135. As set out by JMB, the adjustment to a company's operating asset beta to remove the systematic risk arising from a DB pension scheme is calculated using the following formula:

$$JMB\ adjustment = \beta_{PA}\frac{PA}{D+E} - \beta_{PL}\frac{PL}{D+E}$$

136. To calculate the adjustment, we use BT Group specific inputs (equity, debt, pension assets, pension liabilities, BT Group unadjusted asset beta) from ICReport1 and our own estimates of $\beta_{PA,}$ and $\beta_{PL.}$ This is to maintain consistency with other respondents to this consultation. Ofcom may use more up-to-date figures depending on the time of the measurement of the beta to which it may apply this adjustment.

137. Table 13 below shows our estimate of the full JMB adjustment. For reference we also present the JMB adjustment based on the figures set out in ICReport2.

Table 13: JMB adjustment for BT Group (PwC and Professor Cooper's inputs)

Row		Equity (£bn)	Debt (£bn)	PA (£bn)	PL (£bn)	β_{PA}	β_{PL}	Full JMB adjustment
A	PwC's calculation	11.14	7.08	29.35	33.33	0.53	0.17*	0.53
B	ICReport2 calculations	11.14	7.08	29.35	33.33	0.41	0.28 – 0.30	0.10 – 0.13

Source: PwC analysis, ICReport1, ICReport2

* Note: our β_{PL} figure is adjusted for the associated with real wage growth.

138. The size of the JMB adjustment is driven by the difference between β_{PA} and β_{PL}. Compared to ICReport2, we have calculated a higher figure for β_{PA} and a lower figure for β_{PL}. Both of these contribute to a higher refined JMB adjustment.

BT's adjusted operating asset beta

139. Table 14 below combines all the components to show our calculations of BT Group's adjusted operating asset beta. We have provided the figures used by Professor Cooper in ICReport2 for comparison[53].

140. As set out in the table below, our assessment suggests a refined JMB adjustment of 0.18 to 0.29, which results in an adjusted BT Group beta of 0.29 to 0.38. This is considerably different from the adjustment range set out by Professor Cooper in ICReport2 (0.03 to 0.05).

[53] We have not included Professor Dobbs' analysis in this Table for comparison. One reason is that his estimate of β_{PA} is a lower figure than his estimate for $\beta_{PL.}$ We find this difficult to rationalise, both conceptually and on the basis of our empirical work set out above.

Table 14: BT Group's adjusted beta in Scenario 1

Input	Formula	PwC estimates		Professor Cooper's estimate
		Low	High	
β_{PL}	A	0.16	0.16	0.28 – 0.30
β real wages	B	0.09	0.09	n/a
Proportion of contributors to BTPS	C	15%	15%	n/a
Adjusted β_{PL}	D = A + B * C	0.17	0.17	0.28 – 0.30
β_{PA}	E	0.53	0.53	0.41
BT Pension assets (£bn)	F	29.35	29.35	29.35
BT Pension liabilities (£bn)	G	33.33	33.33	33.33
BT debt (£bn)	H	7.08	7.08	7.08
BT equity (£bn)	I	11.14	11.14	11.14
BT asset beta β_{E+D}	J	0.64	0.64	0.64
BT's operating assets (£bn)	K = H + I + G + F	22.20	22.20	22.20
JMB adjustment	L = E * F / (H+I) – D * G / (H+I)	0.53	0.53	0.01 – 0.13
Attenuation factor	M	66.3%	45.4%	59% - 66%
Refined JMB adjustment	N = L * (1 – M)	0.18	0.29	0.03 – 0.05
BT Group's adjusted asset beta	**O = J * (H+I) / K – N * (H+I) / K**	**0.38**	**0.29**	**0.48 – 0.50**

Source: PwC analysis, Khorasanee (2008), Cooper (2009, 2010)

141. The main drivers of the differences in our assessment of the overall refined JMB adjustment are:

a. A lower estimate of β_{PL} which is assessed over a long-term period to match the long-term nature of pensions liabilities (0.17 compared to 0.28 to 0.30 in ICReport2);

b. A higher estimate of the beta for property assets in the pensions fund (0.58 compared to 0.15 in ICReport2);

c. A higher estimate for the beta of alternative assets in the pensions fund (0.58 compared to 0.006 in ICReport2); and

d. Lower (low end) attenuation.

BT Group’s adjusted beta under the empirical approach

142. In this section we review the empirical approach that was undertaken by Gallagher, McKillop and Pogue (GMP) to estimate the level to which pension risk feeds through into the estimated cost of capital. This analysis can be used to imply the attenuation factor and this was used by Professor Cooper in ICReport2.

143. In their original 2009 study, McKillop and Pogue examined the relationship between the pension risk (of defined benefit pension plans) and equity risk measures for FTSE100 companies. They created an econometric model using panel data of FTSE100 companies with DB pension schemes for the years 2002 to 2006. They used three different measures of pension risk, one of which was the JMB adjustment discussed earlier in this report, and ran both univariate and multivariate regressions which included additional variables including: financial leverage, growth rate, the return on investment, firm size and equity beta.

144. The GMP (2010) study is essentially a replication of the original McKillop and Pogue methodology covering an extended period from 2002 to 2008 (in comparison to 2002-2006). They also include an additional estimate for β_{PL} of 0.30 (the earlier study focused on estimates for β_{PL} of 0.28 and 0.38) based on a 60-month rolling estimate consisting of all monthly returns up to the end of the previous year. GMP conclude that nearly all coefficient estimates of their analysis (except for the measure based on a β_{PL} of 0.38) are all positive suggesting that higher levels of pension risk do feed through into higher levels of firm risk and systematic risk.

145. In his second report, Professor Cooper draws on GMP’s empirical analysis to inform his best estimate of an adjustment to BT Group’s beta. He focuses on the pension risk estimates (measured using the JMB adjustment) based on two of GMP’s estimates of β_{PL} (0.28 – 0.30)[54]. Professor Cooper judges a β_{PL} of 0.38 (implied attenuation of 90%) to be the upper end of an adjustment to be applied to BT Group’s beta and therefore excludes this from his analysis.

146. The table below illustrates the figures extracted by Professor Cooper from the GMP report. These figures represent a range of reduction to BT Group’s beta of 0.05 to 0.047, based on a β_{PL} of 0.28 and 0.30, respectively. This includes an implied attenuation range of 59% to 66%.

Table 16: Professor Cooper’s adjustment calculations

		β_{PL} 0.28	β_{PL} 0.30
Pension risk measure	A	0.149	0.113
Regression coefficient	B	0.3448	0.4140
Implied attenuation	C = 1 – B	66%	59%
Asset beta reduction	**D = A * B**	**0.051**	**0.047**

Source: ICReport2

147. The way in which the empirical analysis is set out means that the implied attenuation factor is dependent on the level of β_{PL} used in the regression (indeed the lower the value for $\beta_{PL,}$ the higher the implied attenuation). As a result, it is not possible to disaggregate β_{PL} from the attenuation factor. This means that if we want to incorporate results from the empirical assessment into our assessment we cannot simply combine attenuation factors estimated by GMP with our estimate of β_{PA} and β_{PL}. We would have to

[54] Professor Cooper focuses on GMP’s Rogers clustered standard errors analysis stating that “*the Rogers method is generally* better” (ICReport2, page 11) and citing a paper by Mitchell Peterson (2009) who shows that “*both OLS and the Fama-MacBeth standard errors are biased downward…Of the most common approaches used in the literature and examined in this paper, only clustered [Rogers] standard errors are unbiased as they account for the residual dependence created by the firm effect*” (*Estimating standard errors in finance panel data sets: Comparing* approaches, Review of Financial Studies, 22.1, 435-480, 437)

replicate GMP analysis using our estimates of β_{PA} and $\beta_{PL.}$ For this we would need GMP underlying dataset, which we have not sought to replicate.

148. We also note that the empirical approach has its limitations. For instance, the results of empirical analysis may be affected by outliers, omitted variables, the broad definition of β_{PA} and the lack of statistically significant multivariate 'Firm risk' regressions.

149. However, the empirical approach is one of the range of analyses which should be factored into any consideration of the adjustment to BT Group's asset beta (along with the build up approach we have set out above). As we are unable to include our own estimate β_{PL} in the empirical method carried out by GMP, we take Professor Cooper's range of adjustment estimates derived from the GMP analysis and factor this into our consideration of an appropriate adjustment to BT Group's asset beta.

Conclusions

150. We have been asked to provide:

a. Our best estimate of the refined JMB adjustment to BT Group's asset beta by taking account of the available evidence; and

b. Our assessment of the extent to which we consider our estimate robust.

151. Any assessment of the robustness of the estimated JMB refined adjustment needs to consider:

a. The validity of the concept that the risk of a company's pension scheme and the underlying risk of its operating assets are not necessarily the same;

b. The validity of the refined JMB approach for quantifying the impact of the pension risk on the observed cost of capital; and

c. The precision of the inputs used in the refined JMB formula.

152. With regard to (a), most commentators accept that the risk of a company's pension scheme and the underlying risk of its operating assets are not necessarily the same.

153. With regard to (b) there also seems to be acceptance among the commentators that in principle the refined JMB formula is an appropriate approach that can be used to quantify the effect of pension risk on the observed beta. Most commentators consider the likely effect of this adjustment is a downward adjustment to the observed asset beta of BT Group.

154. Given the above, the robustness of the estimated adjustment using the refined JMB formula relies on the certainty attached to inputs. There is most uncertainty around the estimation of β_{PL} and some uncertainty over whether all effects have been captured in the attenuation factor analysis. However, we consider that we have incorporated all key suggestions into our analysis from the responses to Ofcom's consultation and wider commentary. Lastly, there is no more uncertainty in the estimation of β_{PA} than contained in other cost of capital estimates.

155. The assessment of β_{PL} and the attenuation factors is not straightforward and in this sense we agree with many aspects raised by Professor Cooper when posed the same question, which he summarised as:

> *"Although my best guess of the adjustment which should be applied to the BT Group asset beta is -0.05, this is highly uncertain and definitely not robust. The range of estimates in Table 7.2 is wide and takes no account of parameter estimation risk, which makes the range even wider. As I discussed in ICReport1, there is significant uncertainty about β_{PL}, the attenuation factor, and whether stock market betas respond in the perfect way JMB assume. In my opinion none of these issues has been satisfactorily resolved by the new evidence and the size of the adjustment inevitably involves a large degree of judgement."*[55]

156. There is uncertainty around β_{PL} and uncertainty over whether all effects have been captured in the attenuation factor analysis. There is a large degree of judgement required and the two approaches – the build-up method and the empirical method - produce differing results.

157. We do recognise these uncertainties surrounding our estimation and that we have had to make some subjective, but transparent, judgments. Likewise, if Ofcom decides to make an adjustment to account of

[55] ICReport2, page 30

the pension risk, it would need to exercise some judgement as well. However, we consider that regulators make judgements on a range of factors in setting charge controls. Indeed, the calculation of the cost of capital itself inevitably involves some exercise of regulatory judgement, and hence some element of subjectivity. Both Professor Cooper and Ofcom accept the case for a pension adjustment in principle[56] – in these circumstances making no adjustment would appear to be less robust than applying the best available estimate of the adjustment, however uncertain such an estimate may be.

158. Our best estimate of the refined JMB adjustment under the build up approach is in the range of 0.18-0.29. We consider that our build-up approach does take account of a number of the issues raised by Professor Cooper.

159. Professor Cooper's overall assessment relies more heavily on the empirical approach and from this he deduces an overall refined JMB adjustment of a 0.05 reduction to the asset beta, subject to the caveats stated above.

160. To obtain an adjustment figure of 0.05 using our build out approach would require inputs at the bottom end of our reasonable range – a figure for β_{PL} of around 0.3 can be justified from the historical record of beta of index-linked government bonds, but this is significantly above the historic average. A figure for β_{PA} of around 0.43 requires assuming very low asset class betas in property assets and other assets – the more uncertain variables. Finally, the attenuation factor necessary to deliver a reduction of 0.05 is around 60% which is towards the upper end of our attenuation factor range (which drives a lower JMB adjustment).

161. We therefore consider a JMB adjustment of 0.05 to be at the bottom end of a reasonable range.

162. Our build up approach suggests a JMB-adjusted asset beta for BT Group of between 0.29 and 0.38. This places BT towards the lower end of asset betas for other regulated utilities (See: ICReport2, Table 3.1) Although, it should be borne in mind that these comparators are not adjusted downwards for pensions risk, given the benchmark evidence, we place more weight on the lower refined JMB adjustment from our range of 0.18.

163. To pick a point estimate within our resulting range of 0.05 to 0.18 requires regulatory judgement. Such judgement often reflects the risks and consequences of setting the cost of capital too high or too low and regulators tend to err on the side of caution, as the consequences of setting a cost of capital too low can be more damaging than setting the cost of capital too high.

164. Therefore, we estimate our recommended refined JMB adjustment that could be applied to the BT Group beta to take account of the pension risk by taking a point estimate slightly below the mid-point of 0.18 (our low estimate under the build up approach) and 0.05 (Professor Cooper's estimate using the empirical approach). This gives a reduction to BT Group's asset beta of approximately 0.1.

165. We do not consider an adjustment of this size to be immaterial, as it could have a 0.6 percentage point impact on the regulated cost of capital or a 2% impact on regulated prices[57].

[56] Professor Cooper accepts that *"the direction of the adjustment is probably downwards",* and although the attenuation factors he identifies *"generally make the size of the adjustment much smaller"* than the full JMB formula would suggest, implementation of an adjustment would be *"a matter of regulatory judgement"* (ICReport1, page 3)
[57] Calculated by doubling Professor Cooper's estimate which is based upon a -0.05 attenuated JMB adjustment.

Appendices

Appendix 1 – Components of β_{PA}

Fixed-interest securities

Academic and regulator estimates of debt betas

Table A1: Academic estimates of debt betas

Who	Debt beta	Approach
Brealey & Myers (2003)	0.17	Regressed Salomon Brothers' high grade long term corporate bond index (maturity > 20 years) regressed against the S&P 500. Using this method the beta of the bond portfolio in the ten years ending December 2000 was 0.17
Ross & Westerfield (2005)	0	In practice the debt beta is very low, so common place assumption is made that the beta of debt is zero (p. 329)
Cornell & Green (1991)	0.25	For "high-grade bonds" using monthly data for the period 01/977 to 12/1989 they calculate a debt beta of 0.25 by regressing a portfolio of bonds rated BBB or above against the S&P 500 index.
Weinstein (1987)	0.006 – 0.007	Regressions of investment grade / non-investment grade bonds from 1962-1974

Source: Brealey & Myers (2003) *Principles of corporate finance 7th edition*; Ross & Westerfield (2005) *Corporate finance*; Cornell & Green (1991) *The investment performance of low-grade bond funds*; Weinstein (1987) *A curmudgeon's view of junk bonds*

Table A2: Regulator estimates of debt betas

Who	Debt beta	Approach
Ofcom – New Pricing Framework for Open reach (2008)	0.10-0.15	Take their lead as the 0.1 figure used by the Competition Commission, but adjust up to 0.15 to account for debt margins at BT Group
Civil Aviation Authority – Heathrow and Gatwick (2008)	0.10	Based on the decomposition of debt premium, in-line with an approach proposed by Europe Economics. CAA identified a range of 0.10 – 0.19, but recommended a cautious assumption of 0.10
Competition commission (2008)	0.10 – 0.22	Decomposition method = (debt premium – liquidity premium – default premium) * EMRP / 100
Competition commission (2007)	0.09 – 0.19	Decomposition method = (debt premium – liquidity premium – default premium) * EMRP / 100 First inquiry that looked into debt betas, so used a cautious estimate of 0.1
Queensland Competition Authority (2004/05)	0.1	Assumes 0.1, which is a midpoint of range of 0.0 to 0.2, which was the suggested range from an open consultation

Source: CAA (2008) *Economic regulation of Heathrow and Gatwick 2008-2013*, Competition Commission (2008) *Stansted Airport – Q5 price control review*, Competition Commission (2007) *Heathrow and Gatwick – Q5 price control review*, Queensland Competition Authority (2004/05) *Annual Report 2004-05*

Decomposition approach

Table A3: Decomposition method

Who		Low	High	Approach
Debt premium	A	198	198	Based on a 10-year average observed gap between IBOXX BBB rated bonds and UK government bonds from 2000-2010
Liquidity premium	B	74	53	Based on CC (2007) citing a range of academic studies to provide a range for the liquidity premium as 27% - 37% of the Debt premium
Default premium	C	38	14	CC (2007) Based on calculations of the default premium for 10-year BBB-rated corporate debt
Implied default risk premium	D = A-B-C	86	131	
EMRP	E	5%	5%	PwC in-house estimate of EMRP
Debt beta	F = D/F/100	0.17	0.26	

Source: PwC analysis, DataStream, Competition Commission (2007)

Property

The 2009 BTPS portfolio consists of offices, retail and industrial property broken down according to the following:

UK: Offices (£1,452m); Retail (£1,553m); Industrial (£291m)*; and Overseas*: Offices (£57m)

Table A4: Property benchmarks

Name	Sector	Equity beta
Derwent London	Mostly commercial	0.52
Shaftesbury plc	Retail / offices	0.63
Capital shopping centres group plc	Retail	0.67
Capital and regional plc	Retail	0.55
AVG immobilien AG	Offices / storage	0.57
Average of benchmark equity betas		0.58

Source: PwC analysis, Datastream