Defined Benefit Pension Plans, the Cost of Capital and the Regulatory Allowed Rate of Return

A Report for BT

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SUMMARY

The Ofcom pensions review Consultation Document 1/12/2009 raises questions concerning the impact of the BT defined benefit pension fund upon the assessment of the regulatory allowed rate of return (the *AROR*), the cost of finance used in price cap and control computations. The key issue is whether the current methodology used by Ofcom for assessing the *AROR* is biased because possible pension effects are ignored – and if so – whether some explicit adjustment should be made. The Consultation Document includes a report by Professor Ian Cooper which discusses the theory and evidence for making such an adjustment to the *AROR*. Professor Cooper's overall conclusion is that 'there is no robust procedure' for determining the appropriate extent of the adjustment, and that the empirical evidence for a pension effect is weak. He concludes that no adjustment should therefore be made. Cooper considers, however, that in making no adjustment for pension effects, if there is any bias at all, it tends to be toward setting 'too high' an *AROR*.

This report (a) reviews the Cooper report and more generally the theory and evidence behind 'pension fund effects' on the firm's cost of finance and (b) presents, in the light of this, my conclusions on the key issues raised by Ofcom.

My overall conclusion is that Professor Cooper is correct in proposing that no adjustment should be made to the *AROR* and I provide further evidence in favour of this conclusion. I also show that, it is entirely possible, in particular cases (for example, the BT pension fund), that the net systematic risk of the pension fund can be negative. That is, ignoring possible pension risk effects does not <u>necessarily</u> lead, even in theory, to a degree of under-estimation in the firm's cost of finance. In so far as there is a theoretical bias, it is possible this can go either way and in 2008 it is possible that BT's *AROR* should have been above that which Ofcom would have set using the standard CAPM formula. This arises from the fact that the BT fund has been significantly de-risking its asset portfolio and also because the fund liabilities probably have higher systematic risk than has normally been assumed.

While Professor Cooper's Report is both thorough and persuasive, one issue which is not addressed concerns the extent to which any directional bias from pension effects should affect uplift of the *AROR* from a central estimate. In the final section of my report, I discuss the rationale for 'headroom', why it should be retained as a matter of economic principle – and why it would be a mistake to reduce it because of pension risk effects.

1. Introduction

1. This paper addresses the question of whether the estimate of the firm's cost of finance, and hence the allowed rate of return (*AROR*) set by the regulator, should be adjusted to take account of possible risk spillovers from the firm's pension fund assets and liabilities. A recent paper by Jin, Merton and Bodie [2006] (JMB hereafter) suggests that it should. The question is raised in Ofcom's Condoc (Dec., 2009) and examined in detail in a report by Professor Cooper. The Cooper report outlines the basic theory and reviews the evidence that underpins it.

2. The purpose of this paper is to provide an assessment of the Cooper report, along with providing additional (UK) evidence not cited in that report which is in favour of his general conclusion, that no adjustment should be made for pension effects. If regulators do conclude that no adjustment should be made, they may nevertheless take the view that in doing so they are being 'generous' to the regulated firm, and hence use this as a rationale for reducing the level of 'headroom' when setting the *AROR*. Accordingly, the final part of my report discusses the rationale for headroom, and why it would be a mistake to reduce it.

3. The rest of this section gives an overview of the issues. Section 2 gives a short exposition of the JMB theory for pension risk adjustments; this facilitates discussion of both the JMB paper and the Cooper report and minimises the need to continually cross reference materials. Section 3 examines the findings and implications of the Cooper report; specifically section 3.1 outlines Cooper's assessment of the weakness in the JMB theory and evidence, section 3.2 provides a commentary on this, section 3.3 identifies and discusses other empirical evidence that further strengthens Cooper's conclusions. Section 4 then briefly examines the merits of allowing 'headroom' when setting the *AROR* and why this headroom should not be dissipated.

4. Why might the existence of a defined benefit pension fund affect a firm's cost of finance? UK regulators, including Ofcom, increasingly subscribe to a 'build up' approach to the assessment of the cost of finance in which it is assumed that systematic risk matters, the CAPM holds, and leverage adjustments can be made

using a Modigliani-Miller (or possibly Miles-Ezzell) capital structure framework.[1] Using this framework, a recent paper by Jin, Merton and Bodie [2006][2] has shown that, if one accepts the extended balance sheet view of the firm, the systematic risk of both the pension fund liabilities, the pension fund assets, and the extent of any imbalance in the overall pension deficit/surplus -all may have an impact on the estimate of the firm's operating risk (and hence the estimate of the firm's cost of finance). The JMB paper provides a simple method for adjusting the estimate of the operating asset beta to take account of this pension effect, and shows, through some numerical examples, that if the theory holds in practice, the magnitude of the bias could be substantial.

5. Ofcom commissioned Professor Ian Cooper to review the JMB paper and to assess whether it provides the basis for making a pension risk adjustment to the estimate of the regulatory allowed rate of return (*AROR*). Professor Cooper makes a thorough assessment of the extent to which JMB theory holds in practice – and finds that the academic literature and, in particular, the econometric evidence in favour of 'flow through' from pension fund risk is weak and highly dependent on modelling assumptions. Overall, he finds that, whilst there may be some limited pension risk 'flow through', and whilst ignoring it tends toward some degree of under-estimation of the *AROR*, the JMB adjustment is neither robust nor reliable. In particular, he finds that if the JMB adjustment is applied, it tends to lead to significant over-adjustment in the estimate of the *AROR*.

6. In my view, the Cooper report provides a convincing case for NOT making an adjustment to *AROR* to account for pension risk. It is hard not to agree with this conclusion, taking account the naivety of the conceptual framework (in that it ignores so many critical factors – these are discussed in section 3 below) and the fact that the

[1] Two merits of the CAPM approach are worth emphasising

(i) Transparency (the methodology is straightforward and easy to understand)
(ii) Consistency (it facilitates a consistent approach across firms and sectors (concerning values to be used for key parameters).

There continues to be debate over the merits of the CAPM (and the extent to which beta affects expected return) and also whether leverage adjustments are empirically justified.

[2] See also Merton [2006], [2007].

econometric evidence, particularly on UK data, suggests ANY flow through effect is at best severely attenuated and most likely, not significant at all (again, see section 3 below).[3]

7. Historically, regulators have tended to build 'headroom' into the assessments of the *AROR*. If, following the present consultation, and as seems likely, regulators choose to make no adjustment for pension risk when estimating the WACC, there is clearly a possibility they may choose in the future to build 'less headroom' into their assessment of the *AROR* simply because they are 'already being generous' in not making any pension risk adjustment. Section 4 addresses this issue and I argue there that reducing headroom would not be an appropriate response.

2 The Theoretical Basis for JMB's Pension risk adjustment

8. The Jin, Merton and Bodie (JMB) analysis focuses on the expected return on the firm's operating assets (R_{OA}). This is the discount rate the firm supposedly uses for evaluating projects in its 'normal' line of business.[4] In the absence of the pension effect, this is simply the weighted average cost of capital (*WACC*). It is this value on which regulators typically base the allowed rate of return (*AROR*).

9. JMB argue that when there is a sizeable defined benefit pension plan, R_{OA} may well deviate from *WACC*. The JMB analysis ignores the impact of corporate and personal taxes, default risk (and hence the pension protection fund and Government guarantee), and further assumes the *CAPM* holds, such that the beta of any asset or portfolio determines its expected return (*R*) according to the formula

$$R = R_f + (R_m - R_f)\beta \qquad (1)$$

[3] I understand similar conclusions were found by other consultants commissioned by Ofcom to review this matter in the recent past.
[4] Actually, in theory at least, this is not true for projects with significantly different levels of systematic risk from the normal line of business, and it is not true for projects that have flexibility – see section 3 below.

where R_f denotes the risk free rate, R_m denotes the expected return on the market as a whole and β denotes the beta of the asset.

10. In the absence of a defined benefit pension scheme, the balance sheet identity is that the firm's liabilities (equity plus debt) equal its assets (operating assets). Given the identity, the risk of the former is equal to the risk of the latter. When deciding whether to make investments in the normal line of business for the firm (through adding to its operating assets), the risk of this investment will be the same as that of the firm's operating assets as a whole, and this can be measured by the observed risk of the firm's liabilities, its debt plus equity. The *WACC* measures the expected return required by these asset-holders. Hence the *WACC* is the appropriate rate to use to discount new investments which have the same risk as the average for the firm's operating assets.

11. However, this ignores the risk in the pension scheme. According to JMB, the balance sheet identity should include both pension assets and pension liabilities. Let *A* denote the firm's assets; this is equal to its operating assets (*OA*) and its pension assets (*PA*). The liabilities (*L*) for the firm are its equity (*E*) and debt (*D*) but also its pension liabilities (*PL*). As an equation,

$$A = (OA + PA) = (E + D + PL) = L \qquad (2)$$

It follows that

$$OA = E + D + PL - PA = E + D - S \qquad (3)$$

where $S = PA - PL$ (4)

is the pension surplus. At the time of writing, most UK defined benefit pension schemes are in deficit – such that $S<0$.

12. If it is assumed that equation (3) holds at each moment in time, then a standard analysis of systematic risk can be implemented. Given that the beta of a portfolio of assets is equal to the weighted average of the betas of its individual components, it follows from (3) that

$$OA\beta_{OA} = E\beta_E + D\beta_D + PL\beta_{PL} - PA\beta_{PA} \qquad (5)$$

Rearranging this,

$$\beta_{OA} = \frac{E}{OA}\beta_E + \frac{D}{OA}\beta_D + \frac{PL}{OA}\beta_{PL} - \frac{PA}{OA}\beta_{PA} \qquad (6)$$

or, using (3) again, as

$$\beta_{OA} = \frac{E}{D+E-S}\beta_E + \frac{D}{D+E-S}\beta_D + \left(\frac{PL}{D+E-S}\beta_{PL} - \frac{PA}{D+E-S}\beta_{PA}\right) \quad (7)$$

13. Finally, the discount rate for the firm's operating assets, *OA*, or for investments with similar risk to the firm's existing operating assets is, from the *CAPM*,

$$R_{OA} = R_f + (R_m - R_f)\beta_{OA} \quad (8)$$

This makes clear that, theoretically, the estimate for β_{OA} and hence R_{OA} (on which the value for *AROR* is based) requires estimates of not only E, D, β_E, β_D but also $PL, PA, \beta_{PL}, \beta_{PA}$. By contrast, the conventional *WACC* is calculated as (recall there are no taxes in the JMB analysis)

$$WACC = \frac{E}{E+D}R_e + \frac{D}{E+D}R_d \quad (9)$$

which using the *CAPM*, implies

$$\begin{aligned} WACC &= \frac{E}{E+D}\left(R_f + (R_m - R_f)\beta_e\right) + \frac{D}{E+D}\left(R_f + (R_m - R_f)\beta_d\right) \\ &= R_f + (R_m - R_f)\left(\frac{E}{E+D}\beta_e + \frac{D}{E+D}\beta_d\right) \end{aligned} \quad (10)$$

14. In this conventional measure of *WACC*, the risk is measured simply as the weighted average of the risk of its equity and its debt. That is, the measure of the firm's asset beta, denoted in what follows as β_{E+D} (as per JMB, to distinguish it from the correct measure, β_{OA}) is measured as

$$\beta_{E+D} = \frac{E}{E+D}\beta_e + \frac{D}{E+D}\beta_d \quad (11)$$

Compare this with the correct measure for β_{OA} in (7). Two types of error arise; firstly, (11) does not correct the measure of assets for any imbalance in the pension surplus (it assumes *S*=0). However, notice that even if the pension scheme is in balance (*S*=0), there is an error if there is any difference between the beta of the pension scheme assets and its liabilities. For example, if *S*=0, (7) becomes

$$\beta_{OA} = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D + \left(\frac{PL}{D+E}\beta_{PL} - \frac{PA}{D+E}\beta_{PA}\right) \quad (12)$$

Thus, even with zero pension surplus, only if the risks for pension assets and liabilities

are also the same ($\beta_{PL} = \beta_{PA}$) is there, in this model, a zero pension impact on the estimate of the beta of the operating assets.

15. Essentially then, according to the JMB analysis, the firm's cost of finance, and hence the regulatory *AROR* should be set using equations (7) and (8) rather than (9), (10). It is easy enough to insert the relevant estimates into these formula, and hence to compute the impact that pension fund risk has on the estimate of β_{OA} and hence the cost of finance. Illustrative calculations of this type are presented in both JMB and in the Cooper report. Numerically it can be shown that the primary drivers of the quantitative magnitude of the pension impact on *WACC* in the JMB formula are the size of the pension scheme and the difference between the beta of the pension asset and the beta of its liabilities. Whether there is a pension surplus or deficit is rather less material. That said, it is important to note that the estimate of the pension surplus/deficit is itself contentious and is also prone to fluctuate sharply over time.[5]

3 The Cooper Report

16. Professor Cooper's report reviews the JMB argument for adjusting the estimate of operating asset beta (and hence the estimate of the firm's cost of finance) and considers whether it is a robust procedure or not. He finds that the procedure is neither robust nor reliable and that it is preferable to make no adjustment for pension risk effects when estimating the *AROR*.

17. In my professional opinion, the Cooper report provides a thorough and fair examination of the evidence for pension 'flow through' effects on the cost of finance to the regulated firm and his conclusions are valid. My aim in this section is to draw out the main points and discuss their implications (section 3.1), comment on omissions and other literature which further buttresses the Cooper assessment (section 3.2) and finally discuss whether the bias is necessarily always toward setting an *AROR* that is too high (section 3.3).

[5] For example, BT's 2008 pension deficit of £4Bn has now risen to £10Bn based on IAS19. Furthermore, the estimate of the deficit is highly sensitive to the assumed level set for the discount rate when valuing the pension liability stream.

18. In this latter sub-section (3.3), I illustrate the naïve computation of the JMB adjustment for the case of BT's pension fund and show that, under sensible assumptions concerning the beta of the pension assets and liabilities, in ignoring the pension effect, the bias could easily go the other way. This is of some importance, because the Cooper report does suggest that, in so far as there is any pension risk flow through at all, the bias in ignoring it will tend to be toward setting a cost of finance that is slightly too high. Section 3.3 illustrates that this is not necessarily the case – particularly for pension asset portfolios, such as BT's, that have been significantly de-risked.

3.1 Key elements in the Cooper report

19. Relating first to key assumptions behind the JMB procedure, Cooper observes

> "The important assumptions underlying this approach include:
> - Changes in the pension surplus or deficit "belong" entirely to the financial claimholders (equity and debt) of the firm, and not to pensioners or employees.
> - There are no other stakeholders in the pension surplus or deficit.
> - Pension risk does not change the beta of the operating assets of the firm.
> - The share price and equity beta of the firm immediately and fully reflect changes in the pension deficit or surplus.
>
> Each of these assumptions has been examined in the literature and the conclusions regarding all of them are ambiguous. In combination, doubt about how to deal with them raises serious questions about the robustness of the JMB method as a practical approach to adjusting the cost of capital." (Cooper report, p. 10).

20. Professor Cooper also notes the following important factors which are relevant, but which are ignored in the JMB model:

> (i) "The degree to which credit risk of the firm is passed to pensioners;
> (ii) The way in which the pension plan affects the operating costs, wage-bargaining, and other features of the operating strategy of the firm;
> (iii) The degree to which the tax system absorbs part of the pension risk;
> (iv) The way that the value of pension liabilities responds to changes in the stock market via, for instance, changed expectations about real wage growth;
> (v) How to reflect their very long duration in the estimated beta of pension liabilities;
> (vi) How to include in the adjustment the possibility that regulation will operate to pass part of the pension risk to customers;
> (vii) How to allow for possibility that the short-term share price fluctuations, on which measured betas are based, may not immediately and fully reflect the short-term fluctuations in the pension plan." (Cooper report, p.2-3).

21. Professor Cooper explains in some detail in his report why these factors will tend to attenuate the amount of pension risk passed through from the pension fund to the observed share price, and there is little point in my restating these explanations here. The point is that the evidence in the academic literature shows fairly clearly that there is

- " sharing of pension risks between pensioners and the firm,
- sharing of pension risks with the government through taxes,
- sharing of pension risks with pension insurance schemes,
- sharing of pension risk with employees through the labour bargaining process,
- slippage between the measured pension risk and its impact on the share price." (Cooper, p. 19).

All of these are totally ignored in the JMB model but will act to significantly attenuate the pension effect. I agree with this assessment – and would merely particularly emphasise the last point, point (vii). This is discussed further in section 3.2 below.

22. Cooper concludes "There is no definitive conclusion regarding any of these in the literature. All of them give rise to significant measurement problems" and finally suggests that, in his opinion, the only sensible way to estimate the asset beta of a company with a large DB scheme would be to look for a 'pure play' – that is, a company in the same line of business, but one which does not have a DB scheme. In the absence of such a pure play, he comments "the above difficulties apply."

23. Cooper also gives numerical illustrations of the naïve application of the JMB formula and shows that the resulting operating asset beta estimates are often implausibly low. The implication is that the JMB formula cannot be trusted.

24. That said, Cooper does agree with JMB that, although it is likely to be significantly attenuated, and extremely difficult to measure, the pension fund impact on the estimate of *WACC* is likely to be, if anything, downward. That is, he agrees that, if there is any effect at all, ignoring it is likely to give a *WACC* estimate that is slightly 'generous' to the regulated firm. I do not disagree with this as a general observation, but it is worth remarking that it would be wrong for regulators to draw any strong inference from it. That is, it would be wrong for regulators to assume that, in ignoring pension risk adjustments when estimating the *AROR*, they are necessarily being in some sense 'generous' to the firm. The point is that the direction of the theoretical adjustment depends on estimates of the pension fund deficit and on the risk in pension fund assets and liabilities. For companies like BT, where the pension fund asset portfolio appears to have been de-risked in recent years, it is possible the risk impact could even go the other way. This point is discussed in more detail in section 3.3 below.

25. The Cooper report, in my opinion, provides a very thorough assessment of evidence for making a JMB formula adjustment in *WACC* estimation for regulatory purposes. His report exposes the underlying assumptions of the model and points out that these are empirically very questionable. His report outlines a range of factors that are totally ignored in the model but which are likely to mitigate the overall impact of pension fund impacts on the regulated firm's operating asset beta, and shows that an naïve application of the JMB adjustment will often lead to estimates for operating asset beta which are simply not credible (they are implausibly low).

26. Cooper is thus arguing that the JMB procedure should not be used; his preference is to look for a 'pure play' firm in the same line of business (which has no significant DB scheme) with the idea that the estimated operating asset beta of such a firm can be used as the operating asset for the regulated firm under scrutiny.

27. The drawback with Cooper's suggestion of finding a 'pure play' lies with (i) finding firms that are sufficiently similar, and (ii) the inherent 'noisiness' of the pure play procedure itself It is also true that one of Cooper's criticisms of the JMB procedure also affects the validity of the 'pure play' procedure (or at least significantly complicates it); as he notes, the operating strategy of the firm, and hence the operating asset beta, may be affected by the very existence of a sizeable pension scheme.[6]

28. The natural conclusion to draw from the Cooper report is thus that the JMB procedure should not be utilised as a 'routine' adjustor in a simple *WACC* computation – because it is not robust and is likely to give an implausibly low estimate for the regulated firm's *WACC*. The pure play procedure is likewise limited in scope and only really useful as 'background information' when assessing the allowed rate of return. The overall conclusion thus appears to be 'business as usual'; that is, regulators should continue with the standard *CAPM* based approach to the assessment of the firm's *WACC*, with NO adjustment made for pension fund effects.

[6] Recall that the JMB procedure assumes that the firm's business risk, and so its operating asset beta, are unaffected by the existence of the pension fund.

3.2 Omissions/Additions to Cooper's critique of the JMB Model

29. In this section, I make a few additional comments on the JMB model and the way in which JMB attempted to validate it empirically.

30. A recent paper, not referenced or discussed in the Cooper report, by McKillop and Pogue [2009] (M&P hereafter) is highly relevant to the assessment of pension risk effects in the UK (JMB's results are based on US data). M&P attempt to replicate the JMB analysis on the FTSE100 companies (using 2002-6 data). The empirical results in the paper strongly support Cooper's position that: (a) the evidence for pension risk impacting the firm's cost of finance is already likely significantly attenuated by countervailing factors; (b) it is not robust;, and (c) it is highly sensitive to modelling assumptions - in particular concerning the assumption made for the pension liability beta. Indeed, if a higher, more realistic value is used for β_{PL}, the 'flow through' effect is not significantly different from zero.[7]

31. Another point worth considering is that JMB report that (for their US data) the pension effect is qualitatively present only for firms with a sound augmented balance sheet - for financially distressed firms, the relationship disappears. This leads to a further question – of whether any given regulated firm faces significant default risk. The magnitude of the

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[7] JMB define net pension risk, $\beta_{Pension} \equiv \left(PA/E+D\right)\beta_{PA} - \left(PL/E+D\right)\beta_{PL}$; using this and (11), equation (6) can be written as $\beta_{E+D} = \beta_{Pension} + \left(OA/E+D\right)\beta_{OA}$. This suggests a cross section regression of the form $\beta_{E+D} = a + b\beta_{Pension} + error$ with the idea of testing whether the estimated coefficient *b* is significantly different from 1. M&P use a panel data approach in which the estimating equation follows that in JMB and takes the form

$$\beta_{E+D} = a + b\beta_{Pension} + [Controlvariables] + [Error] \quad \text{(i)}$$

They also look at the impact on credit rating of corporate debt (denoted *CR*): that is

$$CR = a + b\beta_{Pension} + [Controlvariables] + [Error] \quad \text{(ii)}$$

As in JMB, it is assumed that ALL firm debt betas are = 0.175 in the β_{E+D} measure and that β_{PL} is a constant for ALL firms on the RHS. As with JMB two values for β_{PL} are considered (at 0.28 and 0.38, compared to JMB's 0.175 and 0.45). The 'flow through' effect (the *b*-coefficient in equation (i) above) is found to be around 0.2-0.4 (and not 1.0 as the JMB theory predicts), but the results are only significantly different from zero at the lower β_{PL} value. Cooper argues (and I agree) that higher β_{PL} values are more likely to be realistic (see main text discussion below). On this basis, there is no significant 'flow through'; *b* is not significantly different from zero.

debt premium, faced by a given regulated firm reflects, amongst other factors, this default risk. This risk, along with the market value of the firm's equity, is, at least to some extent, 'controlled' by the regulator. That is, regulatory policy has a direct impact on these variables.

32. As Cooper notes, there is a significant academic literature that argues that investors and analysts at best only partially take account of pension fund issues. Additional references supporting this include McKillop and Pogue [2009] (discussed above), Gold [2005] and Coronado et al [2003, 2008], who all suggest that even the information about pension assets and liabilities that is available is not taken correctly into account by the market.[8]

33. In the JMB analysis, the quantitative extent of bias in the estimate of the discount rate/regulatory allowed rate of return is driven primarily by (i) the relative size of the pension scheme *vis a vis* the firm's Debt+Equity, and (ii) from the difference in systematic risk in the pension fund assets *vis a vis* its liabilities. The extent to which there is a pension funding imbalance, whether a surplus or a deficit, is of relatively little concern.[9] For this reason, I now focus in more detail on the beta for pension fund liabilities and the beta for pension fund assets. This provides the basis for the argument presented in section 3.3, that, for the BT pension fund, the naïve JMB quantitative adjustment is likely to be small in magnitude – and even whether the effect is positive or negative is uncertain.

The Beta for Pension Fund Liabilities

34. The discussion presented of the beta of the pension fund liabilities in the Cooper report all speaks to the idea that it is likely to be closer to the higher value (0.45) than the lower (0.175) in the JMB work. McKillop and Pogue also proxy β_{PL} using betas estimated on market price data for 30 year Treasury bonds; on that basis, they suggest a range of 0.28-0.38 for β_{PL}. However, as Cooper points out, the 30 year Treasury bond is a rather imperfect proxy for pension fund liabilities, and as with JMB, M&P make no adjustment for the factors discussed by Cooper (that would tend to significantly raise the pension

[8] The point is that the balance sheet identity fundamental to the JMB analysis is likely to hold, if at all, only at points in time when investors are made aware of valuations.

[9] It is of course of concern to the firm more generally, given that excessive deficits have to be made up over time. However the focus in this report is on the extent to which the DB pension scheme impacts on *WACC* estimation.

fund liability beta). Because of the sensitivity of results to this estimate for β_{PL}, it is worth discussing the issues involved in more detail. Cooper comments:

> "Regarding the fact that pension liabilities have a very long duration, JMB note that such claims do not necessarily have a beta of zero, even if they are default-free. In fact, a surprisingly high level of beta for long-duration fixed income securities has been noted by Cornell (1999). The alternative higher estimate which JMB use, 0.46, is based on a regression of returns from a 30-year Treasury Bond on the equity market using five-years of monthly data. In other words, for the period they look at, even if the pension liabilities had been considered to be default free and just like long term Treasury Bonds, they would have had a beta of 0.46. This result fluctuates widely over time, as both Cornell and JMB note." (p. 28)

> "Thus even if the pension liabilities are considered to be default-free and even if there is no other risk-sharing in the risk of the pension fund, it is difficult to estimate the beta of the pension liabilities in a way which takes account of their very long duration. This difficulty is complicated further by the fact that the present value of DB pension liabilities will rise in value when expectations of longevity rise unexpectedly and when expectations of real wage growth rise unexpectedly. Both of these are likely to be correlated with the level of the stock market. There is, to my knowledge, no simple way of adjusting the beta of pension liabilities for this effect." (p.28-9)

35. In sum, the beta of the pension fund *liabilities* is a critical number – and there is no way of pinning it down with any degree of accuracy. I would concur with this assessment – but would incline to the view that it is likely that the overall effect of the omissions is to increase the magnitude of β_{PL} in comparison with that estimated using 30 year Treasury bonds. Because it is so important, I discuss the rationale for this view in more detail.

36. Valuation of pension fund liabilities, and the associate systematic risk, depends critically on whether a narrow or broader version of the pension fund liability is taken. The narrow version can be defined as the present value of the vested benefits for the current work force; that is, the liability you would incur if all the employees quit (or lost their jobs on bankruptcy). It is the present value of payments one would have to make for all current pensioners and current employees. Black [1989] argues that although there is some mortality/longevity and disability uncertainty, this tends to 'average out', such that the principal uncertainty concerning the value of this narrow liability is interest rate uncertainty. On this view, the systematic risk of a long duration fixed income asset can be used as a reasonable proxy for β_{PL}. The only comment that might be added to this is that there is undoubtedly greater systematic risk emanating from uncertainty over longevity now than when Black was writing, this tending to raise the value for β_{PL}.

37. The broad version of the pension liability is the present value of ALL benefits to be paid by the plan. This counts not only benefits to current and past employees but all future employees too. This pension liability must account for future salary/wage increases and changes in benefits, as well as changes in the work force over time. As Cooper points out, salary growth (and labour productivity) tends to correlate with the performance of not only the firm but also the economy as a whole, and hence with the stock market. The size of the work force may likewise be correlated. That is, the growth in pension liabilities over time is likely to correlate with growth in the economy as a whole and the stock market in particular.

38. It can be argued that the broad view of the pension liability is the correct one to take – and, as Black [1998] points out, this suggests that the liability systematic risk may be significantly higher than that of a long duration Treasury bond. For example, Khorasanee [2008] suggests that a 0.5% increment in the discount rate is warranted because of systematic risk arising from salary growth uncertainty. Taking an equity risk premium of 5%, this would correspond to an increment of 0.1 in the estimate of β_{PL}. This is a significant uplift; for example, it would raise the M&P interval for β_{PL} from [0.28,0.38] to [0.38,0.48]. I make use of this adjustment when illustrating the net effect of BT's pension fund on the estimate of its WACC in section 3.3 below.

The Beta for Pension Fund Assets

39. Even in the absence of 'active portfolio management', the recent large changes in equity market values will have undoubtedly had a significant impact on portfolio composition (it would be interesting to study the extent to which de-risking arises from 'active management' *vis a vis* 'passive management'). This, along with increased transparency arising from recent accounting changes in the way pension deficits are reported may have lead to some de-risking of pension asset portfolios (see Paraskevi and Peasnell [2009]). To illustrate this point, Table 1 gives my calculations of the Beta for BT's pension asset portfolio, based on the asset beta values used in the Cooper report (namely 1.0 for UK equities, a slightly reduce figure of 0.9 for overseas equities, 0.175 for nominal and index linked bonds, 0.1 for property, 0.006 for cash and other assets), and the portfolio proportions as given in BT's annual report and accounts.

Table 1: An Illustration of the extent of Pension asset Portfolio de-risking

BT Pension Fund Asset Portfolio	
Year	**Portfolio Beta**
2000	0.768
2001	0.751
2002	0.670
2003	0.731
2004	0.723
2005	0.632
2006	0.611
2007	0.485
2008	0.423

40. The extent of de-risking manifest in 2007 and 2008 is striking. A case can thus be made that the pension asset beta in 2008 lies below the beta for the scheme's liabilities. What this means is that the impact of pension fund risk, as calculated using the naïve JMB adjustment, is by no means *necessarily* 'one way'. Section 3.4 below demonstrates this point through sensitivity analysis.

3.3 Illustrative Calculations of the naïve JMB adjustment for BT

39 Table 2 below illustrates calculations of the estimated beta for BT's operating assets and its vanilla *WACC* (that is, with no tax adjustments) and how they depend on the value used for the pension fund debt beta. In considering this numerical illustration, it is important to be clear that the extent to which pension fund risk impacts on β_{OA}, R_{OA} in this naïve JMB model is not sensitive to assumptions concerning the risk free rate, the equity risk premium, or the assumed debt premium.[10]

[10] This point can be established through sensitivity analysis, but is not the focus of the present analysis.

Table 2 - Illustrative computation of JMB model pension effects on BT's Vanilla WACC

General Parameters	
Rf	4
ERP	5
Firm Specific Parameters	
Debt Premium	2.5
Implied Non-systematic Debt Premium	1.25
Equity Beta	0.88
Rd	6.5
Debt Beta	0.25
Re	8.4
BetaPL	0.45
BetaPA	0.42
Net pension beta	-0.15
R(PL)	6.25
R(PA)	6.1
E	11.14
D	7.08
D+E	18.22
PA	29.35
Deficit	4
PL	33.35
Implied Beta(OA)	0.64
Implied Beta(D+E)	0.64
WACC	7.662
R(OA)	7.606
WACC-R(OA)	0.056

40 Table 2 uses the same values for BT's equity, debt, pension asset and liabilities values and the same equity and debt betas as in Cooper's Table 2. It then uses the 2008 estimate of BT's pension asset beta from Table 1 along with the higher JMB value of 0.45 for the pension liability beta. Notice that this results in no error in the estimate of the beta for operating assets and only a small error in the estimate of *WACC* (of around 0.05%). The latter arises from the impact of the pension deficit (of £4Bn).

41 The discussion of β_{PL} in section 3.3 above suggested that a higher value was probably more appropriate. For example, a case was made that, relative to the M&P range of [0.28,0.38], a more realistic range for this parameter might be [0.38,0.48].[11] Table 3 below illustrates the extent of bias in β_{OA}, R_{OA} vis a vis $\beta_{E+D}, WACC$ and how this varies

[11] The extent of uplift in β_{PL}, compared to the estimated beta of long dated Treasury bonds, would in theory depend on the detailed nature of the pension scheme – whether/when the scheme was closed to new members, the age distribution of members and the proportions of employees relative to retired members, and so on.

with the value used for β_{PL}. As the value is increased from 0.38 through to 0.48, the bias switches direction (as one would expect).

Table 3 – Effect of varying Beta(PL) on R(OA) and Beta(OA)

Beta(PL)	*WACC*	R(OA)	Difference	Beta(D+E)	Beta(OA)	Difference
0.175	7.66	5.54	2.12	0.635	0.229	0.406
0.28	7.66	6.33	1.33	0.635	0.386	0.249
0.38	7.66	7.08	0.58	0.635	0.536	0.099
0.48	7.66	7.83	-0.17	0.635	0.687	-0.051
0.55	7.66	8.36	-0.69	0.635	0.717	-0.081

39 Table 4 keeps all figures as before, but assumes that the pension liabilities are now aligned with the value for pension assets (so there is no 'pension deficit'). This merely makes more emphatic the extent of the switch in bias.

Table 4 – Effect of varying Beta(PL) (Zero deficit case)

Beta(PL)	*WACC*	R(OA)	Difference	Beta(D+E)	Beta(OA)	Difference
0.175	7.66	5.69	1.97	0.635	0.241	0.395
0.28	7.66	6.53	1.13	0.635	0.410	0.226
0.38	7.66	7.34	0.32	0.635	0.571	0.064
0.48	7.66	8.14	-0.48	0.635	0.732	-0.097
0.55	7.66	8.71	-1.05	0.635	0.764	-0.129

40 To spell this out, at the 2008 estimated pension deficit of £4Bn, taking the range of pension liability beta as [0.38,0.48], the error in the estimate of the operating asset beta is from 0.099 through to -0.051, whilst the error in the cost of finance is 0.58% through to -0.17%. That is, depending on the estimate for the pension fund liability beta, the effect could go one way or the other. It is important, in considering the above sensitivity analysis – to remember that this is assuming full flow through from pension risk to the estimate of the risk of the operating assets. In fact, the flow through is rarely estimated at anything like 100%; for example, M&P find figures of around 20-40% flow through. Taking this into account, the differences in the above tables would be only 20-40% of the above figures in the 'difference' columns. That is, if a flow figure of 20% is taken, the error in the cost of finance in Table 3 would be, for β_{PL} in the range [0.38,0.48], from +0.12% to -0.03%.

41 Further, the coefficient for flow through in JMB and M&P is most significant only if it is assumed that β_{PL} is relatively small. For example, M&P find the coefficient is not significantly different from zero if they assume β_{PL}=0.38. Given that a case can be made for the liability beta being higher rather than lower, it is therefore unclear whether there is any effect at all.

42 To sum up, my view is there are probably trends toward pension funds de-risking their asset portfolios, and that the beta of pension liabilities is likely to be higher than estimated by JMB and by M&P (for the reasons explained above and in the Cooper report). This combination suggests the extent of adjustment under the naïve JMB adjustment is substantially mitigated. More importantly, if the pension liability beta is set at a more realistic (higher) level, the evidence in favour of a flow through effect, in UK data, is extremely weak (in the M&P paper, the relevant coefficient in the estimating equation is not statistically different from zero).

4 Does ignoring Pension Fund Effects mean the regulator should offer less 'Headroom' when setting the Allowed Rate of Return

43 The evidence in favour of a significant pension fund effect on the firm's cost of finance is weak. However, the evidence does suggest that, for most firms with defined benefit schemes, the bias, in not making a pension adjustment, is to slightly over-estimate the true cost of finance. It would thus seem reasonable for regulators to take the view that, in not making any adjustment for pension fund risk effects, they are being 'generous' to the regulated firm. A natural question then is whether this should motivate some reduction in the amount of 'headroom' that regulators typically build into their assessment of the *AROR*. This section briefly discusses this issue with an Annex providing greater technical detail.

44 UK regulators have often accepted the argument for setting an *AROR* above the expected cost of finance, the mean of the *WACC* distribution (see for example, Ofcom [2005], Ofcom [2009, para 12.41, 12.111], Competition Commission [2007], CAA [2008]). That

is, regulators have often biased upward to some extent the values used for one or more of the key parameters in order to induce some uplift in the final *AROR* determination.

45 The rationale for 'headroom' when setting *AROR* revolves around the idea that the welfare losses that arise from setting 'too low' an *AROR* tend to be significantly greater than the welfare losses that arise from setting too high an *AROR*. The welfare losses arising from setting *AROR* too high lie with the fact that the price caps are set too loose and there is some degree of 'over pricing', whilst the welfare losses that arise from setting *AROR* too low lie with the fact that this induces too little new investment (too little innovation, too little *R&D* etc.)., A simple model that illustrates this point is given in Wright et al [2003] and the argument is explained in further detail in Dobbs [2008]. One way of accommodating this asymmetry in the welfare loss function is to set the *AROR* at a higher percentile of the *WACC* distribution.

46 The extent of 'headroom' allowed is obviously a matter for regulatory judgement, although the adjustment is often material (of the order of 0.5-1%). By contrast, the extent of 'generosity' implied by ignoring the pension fund effect on the estimate of cost of capital, at least in the case of BT, appears to be non-material. In my opinion, it would be a mistake to make any significant reduction in the level of 'headroom' built into the *AROR* 'because of general pension fund considerations' without examining in detail the specifics of the pension fund effect. For example, in the BT case, on the 2008 figures, the case for any flow through effect appears to be minimal.

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ANNEX The Logic for setting the regulatory allowed rate of return above the mean of the WACC distribution

1 It can be argued that the regulatory cost of finance should be set above the expected value of the *WACC* distribution, given that there is uncertainty over the estimate to be used in the regulatory review period. There is uncertainty in that the initial estimate used by the regulator may not coincide with the view of it taken by the regulated firm. There is also uncertainty because the cost of finance may deviate further, through the regulatory review period, from the initially set rate. This has implications for existing (sunk) investment and for potential new projects that may be undertaken in the regulatory review period.

2 Consider first a hypothetical situation in which the *AROR* is set and then the actual cost of finance turns out to be less than this figure and does not change over time. Other things equal, this will lead to some degree of over pricing for existing services and products, along with a tendency to induce excessive investment. By contrast, if the actual cost of finance turns out to be higher than the set *AROR*, then prices of existing services will tend to be capped too low, and too little new investment will take place. The welfare losses arising from mis-pricing tend to be roughly symmetrical, whilst welfare losses arising from errors in investment can be highly asymmetric (a marginal project from the firm's perspective may generate substantial economic welfare, and if such a marginal project is not undertaken, all of this is lost).

3 A simple model that illustrates this point is given in Wright et al [2003] and the argument is explained in further detail in Dobbs [2008]. One way of accommodating this fact is to set the *AROR* at a higher percentile of the *WACC* distribution. UK regulators have often accepted this argument for setting an *AROR* above the expected cost of finance, the mean of the *WACC* distribution (see for example, Ofcom [2005], Ofcom [2009, para 12.41, 12.111], Competition Commission [2007], CAA [2008]). That is, regulators have tended to bias upward to some extent the values used for one or more of the key parameters in order to induce some uplift in the final *AROR* determination.

4 The same observations apply if the cost of finance evolves over time as a stochastic process, if new investment is always of a 'now or never' type. A further complication

when the cost of finance is a stochastic process lies in the fact that projects once implemented are to some extent irreversible and are rarely of the 'now or never' variety. The firm typically has the option not only to choose the start date and initial scale, but also the rate of subsequent expansion. This project flexibility gives rise to option value, and gives the firm an incentive to delay investments and reduce the initial scale and pace of roll out of new investment.[12] The decision making of the firm can often be characterised in terms of its using a higher effective discount or 'hurdle' rate for its investment decisions (see e.g. Ross [1995], Dobbs [2009]). To induce optimal investment, it then would seem that the *AROR* should also be set higher by the regulator to reflect this fact.

5 This situation presents difficulties for regulators. If the only control the regulator possesses is that of a price cap, then the choice of that price cap does need to take account of these real options effects – or, welfare sub-optimal under-investment will result. However, regulators inevitably do not wish to be seen to be rewarding firms for their possession of monopoly power (the power to be able delay investments without needing to worry that competitors might steal the opportunity). Indeed, Ofcom is on record as being concerned that real option value that arises from monopoly power should be disallowed.[13] Yet it is in the nature of a regulated firm to have such investment opportunities – and it is precisely for products/ services for which the firm has some degree of monopoly power that are the proper subject for regulatory control. This of course is a debate about instruments and controls. In the absence of other instruments (such as lump sum profit taxes, or mandatory investment requirements), some headroom is socially desirable if new investment is not to be unduly delayed (Hausman [1999]).

6 The point is that it is new investment that delivers the lion's share of consumer benefits over time – the level of welfare loss that might arise through some degree of over-pricing of sunk investments is, relative to this, a second order effect. On this view, regulators should not be unduly concerned about short run welfare losses that

[12] Even in a competitive industry, the uncertainty has an impact on decision making – the greater the uncertainty, the lower the level of investment that firms will wish to make (see e.g. Dobbs [2004]).
[13] Ofcom [2005, para 9.54] states that an uplift is valid only if the real option effects are industry wide and would be manifest in a competitive market (i.e. real option effects should not be the result of a dominant firm's market power).

might arise from some degree of over-pricing (when some uplift is given to the set *AROR*, relative to the mean of the firm's *WACC* distribution) as the longer term benefits are likely to greatly outweigh them. Unfortunately, regulators tend to be over concerned with the short term (their own performance tends to be judged with respect to short term criteria – such as whether regulated firms appear to be earning excessive profits - the welfare losses that arise from long term under-investment do not impact on this – it is 'over the horizon' and not directly observable).

7 Ofcom [2005] proposes that option effects are to be dealt with on a case by case basis, with the onus being on the regulated firm to show that the effects are material, are relevant, and are not due to monopoly power. However, for large regulated companies that are often undertaking a myriad of projects through time, the policy seems to be misguided and essentially unworkable. It is not possible for the regulator to pronounce on each and every potential project that the firm may be considering. A less intrusive, more arms length approach seems preferable – and it seems that the simple adjustment (headroom) when setting the *AROR* is probably the simplest way forward.

8 There has been some recent debate concerning the merits of indexing the *AROR* so that it better tracks the true cost of finance over the regulatory review period (see First Economics [2007], CEPA[2007] and Brealey and Franks [2009]). The idea is for the *AROR* to be adjusted whenever there is a change in the underlying risk free rate (or cost of debt and cost of equity. In so far as the firm's view of the overall cost of finance is likely to change with evolving market conditions through the regulatory review period, some form of indexation might help to reduce the extent of error and hence might reduce the extent of uplift required. Indexation does not, of course, address the intrinsic uncertainty concerning the regulated firm's management's view of the cost of finance *vis a vis* the view taken by the regulator. Nor does it address the issues that arise because of project flexibility (real option effects). Finally, indexation for costs of finance is only partial indexation – it is also possible to consider indexation for price changes (inflation). To date, regulators have not embraced these indexation possibilities, so the argument for headroom is clear-cut. What I am suggesting above is that, even if some form of partial indexation is implemented, the rationale for 'headroom' is still very much alive and kicking.

9 To sum up, there are a range of factors that suggest that some degree of headroom is desirable when setting price caps, and the natural place to introduce this headroom is when setting the *AROR*, the allowed rate of return. There is significant regulatory precedent for setting the *AROR* at the 70^{th}, 80^{th} or 90^{th} percentiles of the *WACC* distribution.