COMMENT ON SECOND ROUND RESPONSES RECEIVED BY OFCOM 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

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SUMMARY

The introduction to this report explains its context in the process of consultation regarding the treatment of the BT pension fund in Ofcom's assessment of the cost of capital. At this stage I have been asked to comment on PwC's second response.

PwC uses the build-up method to produce an estimate of the adjustment to the BT Group asset beta which should be made to allow for the DB pension plan. The adjustment from this approach is in the range -0.18 to -0.29. It results in an adjusted asset beta for the BT Group in the range 0.29 to 0.38, as shown in the Table below. PwC claims that this estimate is robust and that it has taken into account all possible measurement problems. However, the adjusted BT Group asset beta is completely inconsistent with other evidence. For instance, it implies that BT Group's business (which consists of unregulated and regulated telecoms) has a lower asset beta than water companies. PwC gives no explanation of how its method can be robust but give such unrealistic results.

PwC's estimates of the adjustment to the asset beta for the pension fund and the resulting adjusted asset beta of the BT Group

	Build-up method	
	Low	**High**
Adjustment for pension fund	-0.18	-0.29
BT Group adjusted asset beta	0.38	0.29

PwC's estimate based on the build-up method is also inconsistent with direct estimation of the adjustment using empirical analysis of actual betas. Based on that approach, in my earlier report I gave my best estimate of the adjustment to the asset beta as -0.05. I also stated that I do not believe that there is any robust method of estimating this adjustment.

The additional PwC analysis has not changed my opinion regarding either my best guess of the adjustment or the high degree of uncertainty about it. In my opinion, PwC's conclusions regarding its estimate based on the build-up method do not take account of:
- Uncertainty and measurement problems concerning the betas of the assets and liabilities of the pension plan;
- Evidence that the link between fundamental determinants of risk and measured stock market betas is not the one its formulas assume;
- Evidence that the financial state of a company affects wage bargaining;
- Uncertainty about the correct way to deal with default risk.

In my opinion, the first of these, uncertainty about measurement of betas, introduces a considerable degree of uncertainty into the estimate. This is not allowed for in PwC's range, which is calculated as if the betas are known with certainty. The other three factors all result in biases which mean that the build-up method gives too large an estimate of the adjustment. I consider all four of these problems to be significant and not addressed by the PwC estimates. In my opinion, they could easily

account for the entirety of the inconsistency between the PwC estimate based on the build-up approach and the evidence from utility company betas and the empirical approach.

Ofcom thus has three pieces of evidence on which it can base an adjustment for the BT pension fund, if any: (1) Evidence from the asset betas of other companies; (2) The empirical relationship between asset betas and pension fund characteristics; (3) Evidence derived from the build-up method. The first two are largely consistent with each other. As discussed above, the third gives an inconsistent adjustment, relies on very strong assumptions, and will be biased if there are any material omitted factors (as I believe there are). In my opinion, Ofcom should place almost all weight on the evidence from asset betas of other companies and the estimate based on the empirical method.

To form its final estimate, PwC uses its own build-up estimate and an empirical estimate. It adopts a "split-the-difference" approach between the low end of its range based on the build-up method (which is -0.18) and my estimate based on the empirical method (which is -0.05). This results in its final estimate of the adjustment as -0.10. PwC does not say why its final estimate lies outside the range estimated using the build-up method even though it maintains that this range is robust. In my opinion this is not the correct way to combine the evidence. In my opinion, since the build-up method gives such implausible results, has such a high degree of uncertainty, relies on such strong assumptions, and contains probable biases it should receive minimal weight in the final judgment of the adjustment.

Regardless of the method used to weigh the evidence concerning the pension fund adjustment, Ofcom must take into account that applying any such adjustment gives only an intermediate figure, the adjusted cost of capital of the BT Group, not the cost of capital of Openreach.

1. Introduction

In September 2009 I produced a report "The effect of defined benefit pension plans on measurement of the cost of capital for UK regulated companies" ("Cooper1"). That report, commissioned by Ofcom, concerned the possibility of adjusting the cost of capital of BT to reflect the existence of its large defined benefit ("DB") pension plan. It was published by Ofcom as part of its consultation regarding estimating the cost of capital for use in regulating BT Openreach.

Cooper1 concluded that although it is likely that BT's pension plan affects its measured cost of capital there is no robust way of adjusting for the effect because the measurement problems are so severe. Ofcom received several responses to this part of the consultation. These suggested two different approaches to the measurement problems: Based on empirical analysis of actual betas, and based on a "build-up" of the various elements which enter a particular formula for making the adjustment.

In May 2010 I produced a second report ("Cooper2") which considered these responses and reaffirmed the conclusion of my earlier report that there is, in my opinion, no robust way of making the adjustment. Even so, I was asked to give my best guess of the size of the adjustment. I concluded, based mainly on the empirical approach, that the adjustment which could be applied to the BT Group asset beta is -0.05. I cautioned that this estimate is highly uncertain and definitely not robust.

I was also asked to discuss the way that Ofcom uses the BT Group cost of capital in its estimation of the cost of capital of Openreach. In 2009 Ofcom estimated the Openreach cost of capital using two benchmarks, the asset betas of BT Group and a range of network utilities. The choice of the estimate of the Openreach cost of capital relative to these benchmarks involved a considerable degree of regulatory judgment.

Ofcom's estimate of the cost of capital of Openreach was significantly below that of the BT Group, involving a judmental downward adjustment for a combination of reasons which were not specified in individual detail. If Ofcom were to now make an adjustment for the effect of the pension fund, it would presumably form an additional element of this overall judgment. It would be one part of a total adjustment to get from the cost of capital of the BT Group to the cost of capital of Openreach.

Ofcom has now received responses to its second round consultation. I have been asked to comment on the PwC response, which concerns estimation of the adjustment to the cost of capital to take account of the DB pension fund.

2. PwC's Report: Overview

2.1 Introduction

Many of the points made in the PwC report concern technical issues to do with estimating particular parameters, which I discuss in section 4 of this report. Before doing that, in this section and the next I discuss some important general issues.

2.2 PwC's estimate of the adjustment

PwC gives its estimate of the downward adjustment to the BT Group asset beta to allow for the DB pension plan (PwC2 §§15-16). The estimate is 0.1, with a range between 0.05 and 0.18. The main sources of disagreement relative to my estimate of 0.05 are: (1) I think that the build-up approach is not nearly as robust as PwC claims and (2) PwC places most weight on the build-up approach and I place most weight on the empirical approach. PwC does not undertake any estimation based on the empirical approach and appears not to have been asked to do any analysis of that approach (PwC2 §§150-151).

Table 1 shows PwC's estimates of the adjustment and the resulting adjusted asset beta. The range of adjustments given by the build-up method is -0.18 to -0.29. Despite PwC's assertion that the range derived from the build-up method is robust, its final estimate of -0.10 is outside that range. The choice of an estimate outside the range estimated by the build-up method is motivated by two main considerations:

- That range gives an adjusted asset beta for the BT Group which is inconsistent with the evidence from the asset betas of utility companies (PwC2 §162);

- That range gives an adjusted asset beta for the BT Group which is inconsistent with the evidence from empirical analysis of the relationship between asset betas and DB pension plans (PwC2 §§142-149).

Hence, although PwC claims that the build-up approach is robust its final estimate of -0.10 is well outside the range estimated by that method. PwC does not say why it still considers the build-up method to be robust while selecting an estimate well outside the range derived from that method. In my opinion, the unresolved inconsistency between the build-up method and other evidence confirms my view that there is no robust method of making the pension fund adjustment.

Table 1: PwC's estimates of the adjustment to the asset beta for the pension fund and the resulting adjusted asset beta of the BT Group[1]

	Build-up method		Final estimate
	Low	**High**	
Adjustment for pension fund	-0.18	-0.29	-0.10
BT Group adjusted asset beta	0.38	0.29	

Table 2 illustrates the extreme level of inconsistency with other data to which the build-up method gives rise. It shows the PwC estimates of the adjusted BT Group asset beta based on the build-up approach embedded in the table of utility of asset betas with which PwC compares them (PwC2 §162). The high end of the PwC estimates implies that BT, which consists of both unregulated and regulated telecommunications businesses, has an asset beta below most of the utility companies in the table. The low end of the PwC range implies that BT has an asset beta below all the utility companies. In my opinion these conclusions are inconsistent with any reasonable analysis of the fundamental determinants of beta (Cooper2 pages 8-10 and 15-17). In my opinion, this inconsistent conclusion confirms the unreliability of the build-up method.

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[1]PwC's estimate of the adjusted asset beta cannot be calculated by subtracting the pension fund adjustment from the unadjusted asset beta, as Table 14 of the PwC report shows. The headline adjustment of 0.18 in the Low estimate gives rise to a total adjustment of 0.26 (=0.64-0.38) and the headline adjustment of 0.29 in the High estimate gives rise to a total adjustment of 0.35(=0.64-0.29). This contrasts with my adjustment of 0.05, which is intended to be the total adjustment required to get from the BT Group asset beta to the adjusted asset beta.

Table 2: PwC adjusted BT Group asset beta using build-up method compared to asset betas for utility companies reported by First Economics (2009)

	Asset beta
Stanstead**	0.61
BT (regulated businesses)**	0.56
Gatwick**	0.52
Electricity DNO's**	0.48
Heathrow**	0.47
Network Rail**	0.46
United Utilities*	0.44
Severn Trent*	0.41
PwC adjusted BT Group asset beta (High)	**0.38**
Pennon Group*	0.37
Northumbrian Water*	0.36
National Grid*	0.35
PwC adjusted BT Group asset beta (Low)	**0.29**

*Estimated by First Economics (Table 3.1 of their report).
**Reported by First Economics based on regulatory reviews (Table 3.2 of their report).

2.3 Uncertainty about the estimate

Regarding the uncertainty of its estimate PwC concludes (PwC2 §§17-18):

> "*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. 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.*"

I agree with PwC that there is considerable uncertainty involved in estimating the size of the pension adjustment. I disagree with its conclusion that there is a close analogy between the uncertainty involved in the pension fund adjustment and the normal uncertainty faced by regulators estimating the cost of capital.

PwC bases its claims that its estimate is robust partly on the contention that the values for β_{PL} and β_{PA} involve "no more uncertainty than for other cost of capital estimates" (PwC2 §11). PwC appears to conclude that the level of uncertainty arising from the build-up approach is consistent with a robust estimate of the adjusted beta. This fails to address the point that typically a cost of capital estimate is the <u>output</u> of the estimation. In contrast, in this case β_{PL} and β_{PA} are <u>inputs</u> to the estimation process rather than the output of the estimation. Because of this, a normal level of uncertainty in these betas translates into a potentially very large degree of uncertainty in the adjusted beta, as I now show.

Table 3 illustrates the issue using the numbers from Table 14 of PwC2. The first two columns (1) and (2) replicate PwC's analysis, which results in a JMB adjustment that is the same in both PwC scenarios. In other words, PwC's analysis assumes that β_{PL} and β_{PA} are estimated without error and gives rise to a JMB adjustment which PwC assumes contains no error. The only uncertainty included in PwC2 Table 14 is uncertainty about the attenuation factor. In columns (3) and (4) I have taken PwC's assumptions and also assumed that β_{PL} and β_{PA} are measured with an error of ±0.1.[2] This standard error would not be unusual for a beta estimate. The effect of this uncertainty is that the JMB adjustment is now in the range 0.20-0.89, rather than being precisely 0.54 as the PwC analysis suggests.[3] Any uncertainty about the estimation of the unadjusted asset beta of the BT Group would add to the uncertainty shown in the table.

This illustration shows that, contrary to PwC's assertion, a reasonable level of uncertainty in the estimation of β_{PL} and β_{PA} does not lead to a normal level of uncertainty about the adjusted BT Group beta. Estimation of the adjusted cost of capital for BT Group involves uncertainty about three betas (the asset beta of the BT Group, β_{PL} and β_{PA}). In the JMB formula these uncertainties combine to generate much greater uncertainty about the final estimate than that for a standard asset beta. Furthermore, even when this process is complete it delivers only an intermediate figure, not the cost

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[2] The top end of this range is less than the possible value of 0.3 assumed by PwC (PwC2 §13).
[3] In this illustration I have simply combined the ranges for the two beta estimates. One could do a more refined calculation which includes their correlations and standard errors, but the basic message would be the same.

of capital which Ofcom requires (i.e. it gives the adjusted cost of capital of the BT Group, not the Openreach cost of capital), as I now discuss.

Table 3: PwC sensitivity analysis including uncertainty of 0.1 about β_{PL} and β_{PA}

		(1)	(2)	(3)	(4)
		PwC Lo	PwC Hi	Low	High
β_{PL}	D	0.17	0.17	**0.27**	**0.07**
β_{PA}	E	0.53	0.53	**0.43**	**0.63**
BT Pension assets	F	29.35	29.35	29.35	29.35
BT Pension liabilities	G	33.33	33.33	33.33	33.33
BT debt	H	7.08	7.08	7.08	7.08
BT equity	I	11.14	11.14	11.14	11.14
BT Asset beta	J	0.64	0.64	0.64	0.64
BT's operating assets	K	22.20	22.20	22.20	22.20
JMB adjustment	L=E*F/(H+I)-D*G/(H+I)	0.54	0.54	**0.20**	**0.89**

2.4 Robustness of the estimate

In its discussion of robustness, PwC makes the following points:

- PwC claims that "there also seems to be acceptance among the commentators that in principle the refined JMB formula is an appropriate approach" (PwC2 §10). I disagree with the following apparent implications of this statement: (1) that experts would agree to use the JMB formula to make adjustments to the cost of capital in practice and (2) that such adjustments are actually made. In fact, I know of no example where the JMB adjustment has been made to a cost of capital which has been used in reality (rather than in the academic literature). None of the submissions, including those of PwC, has put forward any such example of the JMB adjustment being used in practice.

- Also, even if a pension adjustment were to be used PwC appears to claim that there is agreement among experts to use the build-up approach rather than the empirical approach. I do not accept that there is general acceptance that the build-up approach is superior to the

empirical approach or that conclusions about robustness can be derived from an assumed acceptance of the build-up approach.

- PwC follows on to claim that "the robustness of the estimated adjustment using the refined JMB formula relies on the precision and certainty around the inputs" (PwC2 §11). I do not accept that the only possible test is the accuracy of the inputs. The test of robustness must also take into account the plausibility of the outputs. In that regard, two important issues are consistency with the adjustment given by the empirical method and consistency with utility asset betas, as discussed above.

- PwC also claims that "we consider that we have incorporated all key suggestions into our analysis from the responses to Ofcom's consultation and wider commentary" (PwC2 §11). Even apart from the important issues of consistency with the empirical method and consistency with utility asset betas, as discussed above, PwC has not addressed several other important issues which could easily account for the discrepancy between its estimate and the other evidence. I summarise and discuss these in section 5 below.

- PwC then says that "there is no more uncertainty in the estimation of β_{PA} than for other cost of capital estimates" (PwC2 §11). As I have just shown the issue is not the level of uncertainty in β_{PA} but the level of uncertainty in the adjusted BT Group asset beta or the Openreach asset beta. Reasonable levels of uncertainty about the inputs to the JMB formula lead to much more uncertainty than PwC claims.

For these reasons and others discussed above, I disagree with PwC's conclusion that it has provided a robust estimate of the pension adjustment which should be applied to the asset beta of the BT Group. Although PwC presents its argument for the robustness of its estimate in a sequence of steps each of which may at first sight appear to have some degree of credibility, these steps lead to a conclusion about robustness that is, in my opinion, incorrect. In summary, my opinion that the build-up method does not lead to a robust estimate has not been changed by the PwC report.

2.5 Application of the pension adjustment in regulation

Regarding the application of the pension adjustment in the regulatory context, PwC concludes that (PwC2 §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."

Hence PwC appears to accept that any adjustment of the BT Group cost of capital to allow for its pension fund should take account of the general regulatory context in which it is made. PwC appears to advocate that regulatory judgment be applied at an intermediate stage in the regulatory process, to estimate an adjusted cost of capital for BT Group. Presumably this adjusted cost of capital would then be used as an input to another layer of regulatory evidence and judgment to estimate an appropriate cost of capital for Openreach. Thus PwC's approach appears to involve two steps both of which require regulatory judgment: first to get from the BT Group asset beta to an adjusted BT Group asset beta, and second to get from the adjusted BT Group asset beta to the asset beta of Openreach.

Such a procedure would be different to the framework used by Ofcom in 2009, of exercising its regulatory judgment in a single step starting from the unadjusted asset beta of the BT Group (Cooper2 page 4). PwC does not appear to have been asked to address important aspects of the overall regulatory judgment which flow from this method of dealing with the pension adjustment:[4]

- Whether and how the adjusted asset beta for the BT Group would then be adjusted to get the cost of capital of Openreach;
- How to take account of other evidence, such as the evidence about the costs of capital of utility companies, which Ofcom used in 2009 and which was cited by respondents to the first round of consultation (Cooper2 pages 7-10);
- The fact that Ofcom's estimate of the asset beta of BT Openreach in 2009 did involve a downward adjustment of 0.1 to the BT Group equity beta (Cooper2 page 7).

For instance, it is not clear whether PwC is advocating that its reduction of 0.1 to the BT Group asset beta should then be followed by a further adjustment. If it were advocating this, it would be

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[4] PwC2 §31 gives the terms of reference of the report.

important to assess the overall size of the adjustment and the resulting asset beta relative to the evidence of utility company asset betas (Cooper2 page 31).

PwC briefly discusses the use of utility benchmarks (PwC2 §162). As discussed above, it uses the range of utility company asset betas to modify its estimate of the size of the adjustment to the BT Group asset beta. It does not say why it is useful to make a judgment of the adjusted BT Group asset beta relative to these utilities rather than to judge where the Openreach asset beta lies relative to them. In my opinion it makes much more sense for Ofcom to make such a judgment directly about Openreach rather than about an intermediate calculation of the BT Group asset beta adjusted for its pension risk.

3. General points about the build-up approach

3.1 Introduction

PwC places heavy weight on the build-up approach. This involves estimating parameters, such as the attenuation factor and the beta of pension liabilities, and combining them in a formula. The formula assumes that the actual beta of BT observed in share prices can be related in a measurably reliable way to its fundamental determinants. As I have discussed above, this approach leads to an adjustment which is inconsistent with other evidence. In this section I discuss some issues regarding the build-up approach which are not fully addressed by the PwC report, in my opinion.

3.2 Slippage between measured stock market betas and fundamentals

A key assumption of the formula used by PwC is that the share price of BT responds to the "fundamentals" of BT with no lag and no damping of the relationship. There is a considerable literature (Cooper1 pages 16-17) which suggests that this relationship may not be as clean as the build-up method assumes. If there is any such damping the effect will be to make the adjustment derived from the build-up method too large. This is one reason why I give much less weight than PwC to the build-up approach. PwC does not make any adjustment for this but simply asserts that it is not a problem (PwC2 §§99-103).

3.3 Omitted factors

PwC accepts that there may be omitted factors which could attenuate the relationship assumed by the build-up method (PwC2 §17). Such omitted factors would tend to make the adjustment derived from the build-up method too large. Any factor related to the pension fund which is not included in the PwC analysis but affects the actual share price behaviour of BT would be such an omitted factor. As an example, on October 21 2010 the High Court ruled in favour of BT regarding the "Crown Guarantee" of its pension liabilities. According to the Financial Times this means that BT is "in a stronger position to cut the size of its large top-up payments into its pension fund".[5] The ruling led to a 4% rise in the BT share price. In my opinion, the analysis of share price responses (and betas) in the face of such complications is not as simple as the build-up method assumes.

3.4 Measurement of parameters

The build-up method involves combining estimates of stock market parameters (betas) with other capital market parameters (such as the beta of pension liabilities). When performing such analysis it is important that the beta of pension liabilities used is the same as the one which is reflected in the measured stock market beta. This requires consistency between the estimation of the two betas (Cooper2 page 18). PwC uses a 20-year average of 60-month rolling betas to estimate the beta of pension liabilities (PwC2 §55). This is entirely different to the standard method used to estimate the equity beta for the cost of capital, which generally involves a much shorter data window. So PwC's estimation procedure for the beta of pension liabilities is inconsistent with the estimation procedure used for the BT Group asset beta, to which it applies its adjustment.

PwC claims that the approach is justified by "the long-term nature of pension liabilities" (PwC2 §141a). However, equity is also a very long term liability but that is not used as a justification for using 20 years of data to estimate its beta. The choice of the data window for beta measurement is not generally motivated by the maturity of the security whose beta is being measured, which is already reflected in the behavior of the prices which are used to estimate the beta. Thus the method used by PwC to estimate β_{PL} is inconsistent with the BT Group asset beta to which the adjustment is applied.

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[5] Financial Times, Friday October 22, 2010, page 32.

4. Technical issues

4.1 Introduction

In my opinion, the key issues are whether the PwC method leads to a robust and reliable cost of capital estimate and the evaluation of this should be made on the broad considerations discussed above rather than narrow technical grounds. The PwC report also contains discussion of some technical points and I address these in this section in the order they appear in the PwC report.

4.2 Estimation of β_{PL}

After extensive analysis, PwC uses 60-month estimated beta for index-linked gilts as the foundation of its estimate of β_{PL} (PwC2 §§57-8). Rather than use the most recent figure (which appears to be about 0.25 from Figure 1 of the PwC report), it uses a 20-year average of 60-month rolling betas. One justification for this is that a positive beta for index-linked gilts would contradict their use as the riskless rate in the CAPM (PwC2 §54). Regarding this issue, the purpose of the pension adjustment is to correct the asset beta for the actual behavior of the values of pension assets and liabilities, not to make a judgment about capital market equilibrium. So I disagree that this is a justification for a particular choice of β_{PL}. Another reason, which I have discussed in para 3.4 above and disagree with, is that the use of a 20-year window is consistent with the long-term nature of the bond. A third reason is that the use of a 20-year window irons out short term fluctuations (PwC2 §55). As with equity betas, changes in fixed income betas over time may represent changes in fundamental relationships and then it would be wrong to base a current estimate on 20-year old data. In fact, during the 20-year period covered by the PwC analysis both the general bond market and the index-linked market in particular have undergone dramatic changes. The use of a 20-year average has, in my opinion, no more justification for PwC's estimate of the index-linked beta than it does for equity betas.

In my opinion, the PwC analysis of the beta of index-linked gilts is best summarized by Figure 1 of the report, which confirms my view that estimation of this parameter is subject to a great deal of uncertainty.

PwC then applies an adjustment to its estimate of the beta of index-linked gilts (0.16) to allow for variation of real wage growth among current employees who are members of the pension fund. This adjustment raises the estimate of β_{PL} from 0.16 to 0.17 (PwC2 Table 4). This relies on a guess as to the proportion of the pension liability which is affected by real wage growth. If Ofcom decides to pursue this method it could obtain an accurate figure, as PwC says (PwC2 §69). Therefore I make no comment on this calculation.

4.3 Estimation of β_{PA}

As with the proportion of the pension fund which is exposed to real wage growth, the beta of pension assets, β_{PA}, would be best estimated based on data obtained directly from the BT pension fund (Cooper2 page 27). Then it would be unnecessary to guess about the betas of different categories of assets included in the pension fund because the beta of the aggregate fund could be estimated directly by an appropriate regression of its returns on the market index. Since this issue could be resolved as a matter of fact I make no comment on the PwC estimate, other than the following. PwC claims that its estimate is as reliable as standard beta estimates (PwC2 §11). However, its estimate is based on guesswork as to the precise nature of the assets of the BT pension fund. In my opinion, estimating a beta that depends on such guesses must result in an estimate which is less reliable than a typical beta estimate, which is based on a known asset.

4.4 The attenuation factor

PwC bases its estimate of the attenuation factor on a list of possible channels derived from my earlier reports. It dismisses some possible sources of attenuation:

- The evidence that the financial well-being of a company affects wage bargaining;
- Slippage between measured stock market betas and fundamentals (which I have discussed in para 3.2 above)

Regarding the possibility that a pension deficit affects wage bargaining by employees, PwC dismisses the empirical evidence for such a link. Its argument appears to be that labour markets are always in equilibrium (PwC2 §§116-119). Even so it accepts that "a growing deficit can have effects on the present value of future wage growth" but includes no adjustment for this because "the

competitive dynamics of the labour market limits the extent of these impacts" (PwC2 §119). Hence it appears to believe that competitive dynamics limit the extent to zero. In my opinion it is unrealistic to assume that collective bargaining in an organization like BT is unaffected by the size of its pension deficit. Also, the assumption that the labour market is always in competitive equilibrium is inconsistent with reality.

PwC's analysis of other attenuation factors is similar to that contained in its first report, with the addition of an adjustment for default risk. The default risk adjustment is estimated from Moody's calculations of the historical default incidence of BBB debt in the period 1920-2009 (PwC2 §121). This is used to make an adjustment to the attenuation factor. In my opinion if this approach is taken the probability used should be the one which reflects the impact of default on present value. It is the present value of these effects that matters, not the raw probability (Cooper2 pages 14, 20-21). There is authoritative evidence that the probability implied by the present value of BBB debt is up to four times as large as the raw historical probability (Almeida and Philippon (2007) Table III). Technically, the reason is that default is likely to occur in situations where the loss has a high cost. So the risk-adjusted probability of default is significantly greater than the raw probability. If the risk-adjusted probability were used it would lead to much greater attenuation than PwC estimates.

To put it differently, PwC has estimated the beta of BBB debt as lying in the range 0.17-0.26 (PwC2 Table A3). The centre of this range is 0.21. One approach to default risk would be to include the debt spread in the estimate of β_{PL} (Cooper2 page 26). If the PwC estimated beta of 0.21 were added to its beta based on index-linked gilts of 0.17 the total β_{PL} would be 0.38, giving a far smaller adjustment than estimated by PwC.

To illustrate this alternative way of analysing the impact of default risk, Table 4 shows the PwC analysis of the attenuation factor with no default risk included. Columns (1) and (2) replicate PwC2 Table 12 and columns (3) and (4) set the default risk to zero. Table 5 shows the effect of putting the default risk into β_{PL} and then calculating the pension fund adjustment. Columns (1) and (2) replicate PwC2 Table 14 and columns (3) and (4) set the default risk to zero in the attenuation factor but include it in β_{PL}.

Table 4: PwC attenuation factors with no default risk included

		(1)	(2)	(3)	(4)
		PwC Lo	PwC Hi	High	Low
Scheme member attenuation	A	13.5%	30.6%	13.5%	30.6%
Regulator attenuation	B	5.0%	15.0%	5.0%	15.0%
Shareholder pre-tax 1	C=100%-A-B	81.5%	54.4%	81.5%	54.4%
Probability of default	D	7.0%	14.0%	**0.0%**	**0.0%**
Shareholder pre-tax 2	E=0%*D+C*(1-D)	75.8%	46.8%	81.5%	54.4%
Tax	F	28.0%	28.0%	28.0%	28.0%
Shareholder post-tax	G=E*(1-F)	54.6%	33.7%	58.7%	39.2%
Aggregate attenuation	H=100%-G	45.4%	66.3%	**41.3%**	**60.8%**

The attenuation factor is reduced from a range 45.4%-66.3% to a range 41.3%-60.8% by eliminating the default risk element, as Table 4 shows. However, the effect of including the default risk in the debt spread has a much bigger effect, as Table 5 shows. The refined JMB adjustment falls from a range 0.28-0.38 to a range 0.06-0.09.

Table 5: The adjusted asset beta with default risk included in β_{PL}

		(1)	(2)	(3)	(4)
		PwC Lo	PwC Hi	High	Low
β_{PL}	D	0.17	0.17	**0.38**	**0.38**
β_{PA}	E	0.53	0.53	0.53	0.53
BT Pension assets	F	29.35	29.35	29.35	29.35
BT Pension liabilities	G	33.33	33.33	33.33	33.33
BT debt	H	7.08	7.08	7.08	7.08
BT equity	I	11.14	11.14	11.14	11.14
BT Asset beta	J	0.64	0.64	0.64	0.64
BT's operating assets	K	22.20	22.20	22.20	22.20
JMB adjustment	L=E*F/(H+I)-D*G/(H+I)	0.54	0.54	0.16	0.16
Attenuation factor	M	66.30	45.40	**60.80**	**41.30**
Refined JMB adjustment	N=L*(1-M)	0.18	0.30	0.06	0.09
BT Group adjusted asset beta	O=J*(H+I)/K-N*(H+I)/K	0.38	0.28	**0.47**	**0.45**

I am not advocating any particular approach as a definitive method of dealing with default risk. But in my opinion before a claim can be made that default risk has been dealt with in a robust way the

impact of using risk-adjusted probabilities and the debt beta approach should be examined. Both give a much smaller pension adjustment than PwC's method.

5. Conclusions

The PwC build-up method gives an adjusted asset beta for the BT Group which is inconsistent with the evidence from the asset betas of utility companies and inconsistent with the evidence from empirical analysis of the relationship between asset betas and DB pension plans. In my opinion, the unresolved inconsistency between the build-up method and other evidence confirms my view that there is no robust method of making the pension fund adjustment.

PwC claim of robustness is based on the following points with which I disagree:

- PwC claims that the refined JMB formula is an appropriate approach but none of the submissions has put forward any example of this approach being used in practice.
- PwC appears to claim that there is agreement to use the build-up approach but I do not accept that there is any such agreement.
- PwC claims that the appropriate test of robustness is the precision and certainty around the inputs to the JMB formula but in my opinion the test of robustness must also take into account the plausibility of the outputs.
- PwC also claims that it has incorporated all key suggestions into its analysis but I believe that there are material factors which have not been dealt with (summarized below).
- PwC says that there is no more uncertainty in the estimation of β_{PA} than for other cost of capital estimates but this confuses uncertainty about inputs with uncertainty about outputs. A plausible level of uncertainty about the inputs to the build-up method can lead to much more uncertainty about the output than PwC claims.

For these reasons my opinion that the build-up method does not lead to a robust estimate has not been changed by the PwC report.

In my opinion, PwC's conclusions regarding its estimate based on the build-up method do not take account of:

- Uncertainty and measurement problems concerning the betas of the assets and liabilities of the pension plan;

- Evidence that the link between fundamental determinants of risk and measured stock market betas is not the one its formulas assume;

- Evidence that the financial state of a company affects wage bargaining;

- Uncertainty about the correct way to deal with default risk.

In my opinion, the first of these, uncertainty about measurement of betas, introduces a considerable degree of uncertainty into the estimate. This is not allowed for in PwC's range, which is calculated as if the betas are known with certainty. The other three factors all result in biases which mean that the build-up method gives too large an estimate of the adjustment. I consider all four of these problems to be significant and not addressed by the PwC estimates. In my opinion, they could easily account for the entirety of the inconsistency between the PwC estimate based on the build-up approach and the evidence from utility company betas and the empirical approach.

PwC does not appear to have been asked to address important aspects of the overall regulatory judgment which flow from this method of dealing with the pension adjustment:

- Whether and how the adjusted asset beta for the BT Group would then be adjusted to get the cost of capital of Openreach;

- How to take account of other evidence, such as the evidence about the costs of capital of utility companies;

- The fact that Ofcom's estimate of the asset beta of BT Openreach in 2009 did involve a downward adjustment of 0.1 to the BT Group equity beta.

For instance, it is not clear whether PwC is advocating that its reduction of 0.1 to the BT Group asset beta should then be followed by a further adjustment. If it were advocating this, it would be important to assess the overall size of the adjustment and the resulting asset beta relative to the evidence of utility company asset betas.

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