CAA's price control reference for Heathrow and Gatwick airports, 2008-2013

March 2007

Supporting paper II

Cost of capital – analysis of responses to CAA's initial proposals

Analysis of Responses to CAA Initial Proposals

Report for CAA

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1 INTRODUCTION

1.1 This report contains various self-standing sections on particular issues raised by the respondents to the CAA's Initial Proposal for Q5 price review, published on 5 December 2006, on which the CAA sought our advice. Therefore, it should be read in the context of the Initial Proposals and the relevant Supporting Papers.

General Response

1.2 We would note that the cost of capital reduction implied by the Initial Proposals is neither unprecedented nor unjustified.

1.3 It is well established and proper that the cost of capital for a regulated company is reviewed periodically, typically every five years. If evidence suggests that the factors on which the cost of capital is assessed have moved over time, not updating the estimate used would lead to either under or over compensation in the price limits. Regulatory consistency on cost of capital therefore relates not to the final estimate, but to the consistency of approach (as far as is appropriate due to specific circumstances in each review, and appropriate due to development of best practise regulation).

1.4 Some recent determinations have involved larger changes than those we recommend for BAA. For example, in 2005 Ofcom determined that the pre-tax nominal cost of capital is 10 per cent for BT's copper business, and 11.4 per cent for the rest of BT's business. These compare to the previous determination, in 2001, of 13.6 per cent cost of capital for BT as a whole. The fall from 2001 to 2005 was therefore 3.6 per cent for BT's copper business in nominal terms (with expected inflation in 2005 almost identical to that in 2001).

1.5 The second general point to note is that, contrary to the claim by certain respondents, Europe Economics does not imply that there has been a reduction in the asset risk from Q4 to Q5, or indeed that the market evidence has changed substantially between the reviews. In fact it has been the consistency of the market evidence on BAA's (lower) risk exposure and other parameters, such that it can now be considered reliable rather than extraordinary, that has led to many of the conclusions drawn. This does not imply that the market evidence has been taken into account without consideration of effects on BAA — indeed the proposed figures are well above the most recent market estimates and estimations (e.g. in City analyst reports) of BAA's cost of capital (which will however have been calculated on higher assumed levels of gearing than the notional 60 per cent adopted in the CAA's estimation).

2 GENERAL APPROACH — APPLICATION OF CAPM

2.1 This section first briefly summarises the approach taken in Supporting Paper XIII, and then discusses the implications that some recent evidence of a lack of response of cost of equity to gearing might have on the validity of the approach adopted.

Summary of Approach

2.2 CAPM was chosen as the main method for the cost of capital investigation for several reasons, including an intuitive theoretical base enabling discussion by stakeholders, its track record in regulatory determinations and lack of viable alternatives.

2.3 The main steps of the analysis were:

(a) Estimation of the BAA group equity beta via CAPM;

- the Dividend Growth Model was used to sense check the result.

(b) Estimation of the BAA group debt premium from bond market data, data on other UK airports, and data on BAA bonds;

(c) (a) and (b) lead to the BAA group vanilla WACC estimate as of January 2006;

(d) Calculation of the debt beta via two methods, first, a default risk adjustment to debt premium from (b), and second, estimation from bond data;

(e) Estimation of the BAA group asset beta by combining the equity beta and debt beta;

(f) Re-levering the BAA group pre-tax WACC for the notional 60 per cent gearing, assuming constant asset beta and constant debt beta;

- Tobin's Q was used to sense check the group WACC result against information from the take over.

(g) Estimation of Heathrow's asset beta combining analysis of comparators, modelling of relative systematic risk exposure, and bottom up evidence submitted by OXERA on behalf of BAA, to draw Heathrow out of the BAA group asset beta estimate;

(h) Estimation of Gatwick's asset beta using the modelling of relative systematic risk exposure, and Heathrow and BAA group asset betas; and

(i) Calculation of the pre-tax WACC for Heathrow and Gatwick assuming constant and equal gearing and cost of debt (at the BAA group level) for both airports.

Implications of Some Recent Evidence for CAPM

2.4 This section addresses the applicability of the CAPM framework and the Modigliani-Miller (MM) insights, given certain empirical findings that increased leverage has not always led

to adjustments in the cost of equity. We explore possible explanations for these findings, and argue that, without an alternative fundamental explanation of movements or allocation of asset risks, one cannot predict from such observations how the asset risk, or its allocation, will be affected by changes in gearing for any particular company. This discussion is used to address specific comments made by BA/CEPA. We conclude this section by offering an alternative explanation, consistent with the MM insights, of observed non-response of cost of equity to changes in gearing.

The Modigliani-Miller Theorem

2.5 As discussed in previous working papers, the Modigliani-Miller (MM) theorem employs the insight that, ignoring taxes, if the use of a company's physical assets, human capital and market confidence is unrelated to the way in which the company is capitalized then the cash flows generated by the company's assets must, likewise, be unaffected. All that the capital structure can be affecting is how cash flows are divided between claimants — debt- and equity-holders. Since the amounts of the company's total cash-flows are unaffected, the riskiness of those cash-flows is also unaffected, so the company's cost of capital is unaffected. This leads to the result that, if taxes are ignored, and if the use of a company's assets is unrelated to the capital structure, then the cost of capital will be unaffected by how the company is capitalized — in particular, unaffected by its degree of leverage. So, as leverage increases the cost of equity must rise so as exactly to keep the overall asset cost of capital invariant.

2.6 This MM insight is deep and powerful, and has guided a research programme in corporate finance since it was first published. Among the first points noted was that if taxes could indeed be ignored and the use of assets were unrelated to capital structure, MM suggests that capital structures will be random. But they manifestly are not. Certain industries tend to use more debt, other industries to use more equity, and other industries to finance investment more through internal cash generation. Taxes by themselves are an unpromising source of explanation, since their main implication is that, if debt carries a tax advantage, then companies will be 100 per cent debt financed, and if equity carries a tax advantage firms will be 100 per cent equity financed. But this is no explanation of why, in many industries, the majority (but by no means all) of the firm is equity financed and the rest debt financed, whilst in others the reverse is true.

2.7 Consequently, interest has tended to focus on mechanisms whereby capital structure might be related to generated cash flows — either because the chosen capital structure provides signals as to those cash flows to only-partially-informed investors, or because the management of the assets is affected by how they are capitalized (e.g. through monitoring). This research programme continues, and produces important insights, but as yet there is no comprehensive convincing theory of capital structure.

Riskiness and leverage

2.8 One casual observation is that companies with relatively low riskiness of cash-flows and with physical, re-sellable assets that are a relatively high proportion of the total firm value,

sometimes choose higher levels of leverage. Explanations can be offered for this, but none seems dominantly convincing. An implication might be that, sometimes at least, when something happens to cause the underlying asset risk to fall, firms may respond by issuing more debt — or, equivalently, if firms intend to engage in additional investment that will be at lower risk than the firm's pre-investment average risk, this investment may sometimes be funded through debt.

2.9 Two consequences of this would be: first, that if we were to produce a graph of underlying asset risk versus leverage, it might well turn out that, on average, lower-asset-risk companies have higher levels of debt; and, second, that if we were to consider situations in which companies issue considerable debt, that might often be associated with a fall in asset risk.

Regulatory implications

2.10 Suppose that, indeed, when firms choose higher levels of debt that is often associated with investments that are of lower riskiness than the average for the pre-investment company. Does it follow that regulators should respond to an increase in leverage by assuming that the cost of capital has fallen?

2.11 In a sense, they already do this insofar as they impose price caps on the basis of a pre-tax WACC, since the higher leverage will be associated with higher tax offsets[1] — that is to say, at higher leverage the pre-tax WACC will fall. However, the question is whether we should assume that, in addition to the tax effect, there is some other effect — so that an increase in leverage should be taken as a signal that asset risk (e.g. as represented by the vanilla WACC) has fallen? In our view, although it is appropriate to reflect upon matters such as the Tobin's q in cross-checking the CAPM-WACC result, it would not be a safe assumption for regulatory purposes that increases in leverage are always associated with falls in underlying asset risk. This is for the following reasons:

(a) If it is true that investments with lower riskiness are more often funded with debt, it is not well understood *why* this should be so, with the consequence that we cannot say for sure that, in the case of *this particular* increase in leverage, it belongs to the class of leverage increases that are associated with asset risk reductions. Taking due account of MM's key insight, we must always ask how a change in capital structure will change the cash flows generated by the company's assets? If we do not have an answer to this question, it is not safe to assume that those cash flows have become less subject to systematic risk, and hence not safe to assume that the cost of capital has fallen.

[1] …assuming that there is, in fact a tax advantage to debt — as discussed in our previous papers this is less obvious than it may at first seem.

(b) Presumably the flip side of this rationalisation would be that a reduction in leverage would be taken as a signal that asset risk and hence the cost of capital had risen. In that case, there would be incentives on companies to fund all additional investments with equity (or even simply to engage in gratuitous additional equity-funded investments), even when there was no corresponding increase in asset risk, since by doing so the regulator would reward them with a higher cost of capital allowance.

2.12 In our view, adopting this approach would have the consequence that regulated entities would be biased towards equity funding, as a strategic response to the regulatory regime. But regulators have more typically taken the view that achieving efficient capital structure was a matter best left to companies, rather than best determined (either explicitly or implicitly) by the regulator.[2]

BA/CEPA

2.13 In its February submission, BA argues that the approach adopted in our supporting paper to the CAA's initial proposals, in which we adjusted for the change in the cost of equity as BAA's gearing increased from its level in the period for which we could observe stock market data (finishing at 37.5 per cent) to the new notional figure used for the cost of capital assessment (60 per cent) by employing the MM theory to "re-lever", was "not consistent with market evidence (recently presented by Smithers & Co) on the impact of gearing on equity betas in other regulated companies in the UK".

Smithers & Co

2.14 Charts 10.2 to 10.4 of Smithers & Co (2006)[3] compare equity betas and asset betas to leverage for a sample of eight regulated companies. Chart 10.2 shows equity betas lower for more highly-leveraged companies, rather than higher as MM might seem to suggest. Chart 10.3 shows asset betas lower at higher leverage, and 10.4 breaks down the results by year, to attempt to control for any falls in asset risk over the sample.

2.15 Smithers & Co's interpretation of their results appears to be that higher levels of gearing are indeed associated with lower asset risk, because higher levels of gearing are used by regulated entities to "blackmail" the regulator — at higher levels of gearing the risks of bankruptcy are greater, and the thought is that the regulator would prefer to reopen price limits (and agree higher price caps) rather than see regulated entities go bankrupt. Because of this, expected prices and hence expected returns are higher at higher levels of gearing, so reducing the cost of capital.

2.16 The CAA has been clear and straightforward on this matter: if higher levels of gearing for BAA lead to financial distress, there should be no expectation that the CAA will relax price

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2 This is not to say that regulators have not taken instruments to, e.g. limit gearing to correct for other distortions of incentives (e.g. the incentive to "hold the regulator to ransom"). But the intention in such cases was to strive for *neutrality*, not for bias!

3 *Report on the Cost of Capital provided to Ofgem*, 1 September 2006.

caps. Given this, the mechanism Smithers & Co propose, if it has applicability at all, would not seem to have applicability in the case of BAA.

2.17 So, the conclusion here is that the Smithers & Co work offers us no reason to suppose that (*pace* MM), the direction of causality for its results runs from capital structure *per se* to the cost of capital.

Further responses to BA

2.18 BA believes

> "that a strong argument can be made that the equity beta should not be greater than 1.0, which would imply, other things being equal, that the estimated cost of equity post-tax would reduce to 6.5% which is closer to CEPA's central estimate of the cost of equity."

2.19 As we understand BA's case, it consists of three elements:

(a) First, BA argues that the MM theorem does not hold, calling in aid the Smithers & Co data and other analogous empirical results. — *As we have set out above, we do not agree with this interpretation of the Smithers & Co data, nor is it the main explanation that the authors themselves advance.*

(b) Second, BA argues straight from comparator data on the cost of equity that the equity beta for other regulated entities is unlikely to exceed 1.0. — *But the relevant comparators are not the costs of equity, but the asset costs of capital (the comparator data we have employed in our previous published supporting paper). The cost of equity is a reflection of the asset cost of capital, not a driver. If the cost of equity were independent of leverage, then as leverage changed the asset cost of capital would change. But, we ask again: how will this change in capital structure change the cash flows generated by the company's assets? If these cash flows are not so affected, then the cost of capital will be unaffected, and comparisons of the cost of equity between companies with different financial structures and circumstances will not be relevant to the task of deriving an estimate of the cost of capital.*

(c) Third, BA's view is that, in the absence of other data, the correct "prior" to have is that the equity beta will be equal to the market average — i.e. 1.0. — *We disagree. In our view the correct "prior" to have is that the asset cost of capital will be equal to the market average. If a firm has a level of leverage, or a rating on its debt, significantly different from the market average, assuming that the equity beta is 1.0 will give an overall asset beta considerable different from the market average — but, in our view, the correct prior assumption to have is that a firm is typical of the market, not that just its equity is typical of the market.*

Changes in financial technology

2.20 Although we believe that we have addressed the points BA raises, and that relevering according to the MM theorem continues to be appropriate in the kind of setting faced by CAA in this price review, BA's contentions might still be pointing to something potentially important. Specifically, we believe that the evidence to which BA points will be relevant in

the CC's assessment of whether there has been a change in the Market Risk Premium (MRP) (and also, perhaps to a lesser extent, in its considerations of the risk-free rate).

2.21 As we have noted in previous published supporting papers, detailed analysis of how the MRP might have changed in recent years has been outwith the scope of Europe Economics' advice. The CAA has taken the view that, because changes in the MRP would affect cost of capital assessments across the regulated sectors, detailed analysis of this variable was properly a matter for the CC. The only analysis Europe Economics has done has related to comparison with MRPs from other recent regulatory judgements.

2.22 The next section sketches some of the considerations we believe might enter into the CC's detailed thinking. But here it is appropriate to note a particular sort of intuition and how it relates to BA's submission.

2.23 Suppose that there had been a change in the financial "technology" of funding capital investment, such that whilst, in the past, having incentives for efficient monitoring of the management of assets required a moderate level of equity (so that increasing leverage above this level caused the quantity of expected future cash flows to fall or their riskiness to rise), now such monitoring could equally well be achieved through certain kinds of debt (e.g. structured debt). Then, since the cost of debt is typically lower than the cost of equity, using this new form of capital structure, it will become more efficient to fund companies with higher levels of debt. We then might observe, in the marketplace, that a number of companies increased their leverage considerably but their costs of equity did not rise in line with the MM theorem (indeed, they might even fall). How would this be reflected in the CAPM-WACC approach Europe Economics' adopted in its advice to CAA? Is this not precisely the sort of effect to which BA is pointing?

2.24 Because such an improvement in the technology of providing capital would lead to a fall in the cost of capital for a large number of companies — not just for BAA — one would expect it to be reflected by a fall in the Market Risk Premium. It is not a threat to the MM theorem, which focuses on the allocation of asset risk rather than its level, and does not necessitate abandoning the re-levering approach. It is, rather, captured within the model we have employed, but within a parameter we have not examined in detail. Therefore, we turn to consider effects that the Competition Commission might wish to reflect in its advice to CAA on the Market Risk Premium.

The Market Risk Premium

2.25 In this section we shall offer some considerations the Competition Commission (CC) might wish to reflect upon in providing its advice to CAA on what level to determine for the Market Risk Premium (MRP).

2.26 We emphasize that the material in this section is not at all a comprehensive consideration of the issues that might motivate changing the assessment of MRP. Rather, we aim simply to raise some issues, the deeper consideration of which by the CC may be of interest to the CAA.

Definition of the MRP

2.27 In the CAPM, for any security, *i*, its return is given by

$$r_i - r_f = \beta_i * MRP$$

where

- r_f is the return on a risk free asset
- and β_i reflects the correlation between the risk in that security's returns and returns on a perfectly-diversified portfolio (often referred to metaphorically as "the market" — if anything is perfectly diversified, surely the whole market is?)

2.28 Then, if we term $r_i - r_f$ the "risk premium" on security *i* and note that β_i is identically 1 for a security in a perfectly-diversified portfolio, we see that *MRP* is equal to the risk premium on a perfectly-diversified portfolio, often called the "Market Risk Premium" (hence, MRP).

2.29 A perfectly-diversified portfolio is a conceptual ideal, and for practical calculation purposes one requires a reasonable proxy. In developed economies with well-functioning stock markets, the standard such proxy to use is an index of shares. For this reason the MRP is sometimes also known the "Equity Risk Premium" or ERP.

Factors Affecting Measured MRP

2.30 The MRP itself is simply a taste parameter, reflecting the market's appetite to bear risk. Since society tends to become wealthier over time, and since wealthier people are more able to absorb risk inter-temporally[4], one might expect the aggregate taste for risk gradually to be rising, and hence this factor tending, over time, to drive a gradual decrease in MRP.

2.31 However, in addition to changes in taste for risk, other factors can affect measured proxies for the MRP. These include[5]

(a) Changes in how well the market(s) reflected in the proxy can be used to diversify risk (i.e. how close to a fully-diversified portfolio it is possible to get using, say, the shares in the equities market index being used as a proxy) — this can fall as well as rise. If it

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[4] We note that the point of systematic risk is that it cannot be diversified away *within* a given time period. Of course, a portfolio that was "fully diversified" *across* time periods would be perfectly riskless.

[5] Aside from the particular issues mentioned here, the measured ERP has been long the subject of an extensive research program in to the so-called "Equity Premium Puzzle". The puzzle is that, according to the theory, the market risk premium exists as a result of risk aversion — it is compensation for taking on risk of investment in the market rather than the risk free return. However, the magnitude of the measured equity risk premium is generally thought much too high (under other standard assumptions and axioms) to be explained by risk aversion alone. On the other hand, the statistical significance and robustness of the measured ERP estimates giving arise to the puzzle have also been called into question.

becomes possible to diversify away more risk using just the equities market, then the ERP proxy will fall.

(b) Changes (typically improvements) in the ability to diversify risk (i.e. how close to a fully-diversified portfolio it is possible to get per se). Suppose that there is no change in how much risk can be diversified away using just the equities market, but that it becomes possible to diversify away more residual equities market risk by using the bonds market. Then the ERP proxy for MRP will, again, fall.

2.32 It may seem paradoxical to change one's regulatory determination of MRP on the basis of a change in how good a proxy one has. For example, if, say, actual financial markets offer us increased ability to diversify, so that our measured proxy for MRP falls, does that really mean that MRP falls?

2.33 There are two responses. First, unless we were aware of how the market was imperfect before, the improvement in market functioning may have been a surprise — so, indeed, in this sense it wasn't that MRP fell, but, rather, that previously we had a less good estimate of it. Taken alone, the implication of this might be that we should then use this MRP estimate (or related estimates incorporating any identifiable taste changes, also) in considering the past cost of capital as well as the future.

2.34 However a second, rather more fundamental response is that the CAPM model assumes that a fully diversified portfolio is available. Insofar as such a portfolio is not available, that is a way in which the world differs from CAPM. In a world in which full diversification is not possible, and the degree of diversification that is possible changes, CAPM reflects that as a change in MRP. Consequently, once we take this point into account as well, we see that CAPM's practically-implemented MRP parameter can be affected by improvements in financing technology that enhance investors' ability to diversify away risk.

Issues for Consideration by the CC

2.35 Given the above, among the issues it would be of interest for the CC to reflect upon are included:

(a) Has investors' taste for risk increased in recent years? — e.g. perhaps with increasing longevity people are more able to absorb risk over time? Might the performance of the Stock Market from the late 1990s onwards, and of the housing market more recently, be evidence of this?

(b) Has the advent of private equity and structured debt represented an enhancement in the technology of risk diversification?

2.36 As discussed above, these effects could perhaps work towards explaining some of the recent observations of relatively low equity returns required from highly leveraged companies.

3 DEBT BETA

3.1 That the return required on corporate bonds reflects, inter alia, the systematic risks to which corporate debt is exposed (and hence that there is a potentially non-zero debt beta), is an integral part of corporate finance theory. It gives rise to models such as CAPM that have been the basis of many past regulatory determinations.

3.2 In most previous UK regulatory determinations (and many academic applications), the debt beta has been set at zero for calculation purposes. This should not be interpreted to mean that previous decision makers and academic authors really *believed* that the debt beta was actually zero. It was not zero — it was merely not sufficiently material to affect the results of the calculation and hence could be set at zero. If it had been relevant, it would always have been necessary to estimate its value.

3.3 In the set of circumstances faced by the CAA during the Q5 price review, the debt beta is relevant, and therefore we needed an explicit estimation of its value.

Necessity of "Innovation"

3.4 The CAA is in a highly unusual situation in that it is faced by four circumstances not typically simultaneously present during past UK regulatory determinations. These are:

(a) Large step change in gearing;

(b) Absence of observable equity data after the step change in gearing;

(c) Relatively low equity beta before the change in gearing; **and**

(d) Relatively high debt beta.

3.5 The first two circumstances mean that historical observations of the group equity beta have to be adjusted to take into account the new level of gearing without the ability to observe the equity beta at the higher gearing level. The tool used for this adjustment in the corporate finance framework is the asset beta equation.

3.6 The latter two circumstances meant that, as set out in Supporting Paper XIII paragraph 2.88, undertaking this calculation assuming zero debt beta would have led to a significant over adjustment of the equity beta due to the large step change in gearing. This in turn would have lead to partial double counting of actual systematic risk and hence over compensation in the allowed return.

3.7 In addition to the above circumstances, a method had to be devised to estimate the separate "project" costs of capital for Heathrow and Gatwick airports. The primary top down method for this was the allocation of the BAA group systematic risk between the two airports and the rest of BAA group. This required as robust as possible a measure of the BAA group systematic risk exposure — the asset beta. Ignoring the systematic risk debt holders are exposed to would have resulted in an underestimate of the asset beta (as discussed in Supporting Paper XIII and below), and therefore non-robust figures for the costs of capital of the separate airports.

3.8 Thus, the estimation of the debt beta and including it in the calculations may seem more like an "innovation" than it actually is. Estimation of a non-zero debt beta is just a consistent application of the tried and tested framework for regulation, with one fewer simplifying assumptions — that assumption being atypically inappropriate in the circumstances faced.

Measurement of Debt Beta

Our estimates

3.9 We estimated the debt beta in two ways. First, our primary method was to derive the debt beta from the observed debt premium, removing the effect of default risk and associated costs, by manipulating the fundamental theoretical equations and obtaining values for the relevant parameters. Our answer was that the debt beta is 0.21.

3.10 Our second method was to estimate the debt beta from the relative variations in BAA bond yields and the FTSE All Share index, in a similar way to the method used for the equity beta. The answer was 0.17, and statistically indistinguishable from the value derived via our primary method.

Other evidence

3.11 Debt beta has been previously estimated in the financial literature. For example, Fama and French (2003) give the following debt beta estimates for securities ranging from high to low-grade corporate bonds, measured from 1963 to 1991.

Table 3.1: Fama-French estimates of the debt beta 1963-1991

	Aaa	Aa	A	Baa	Below Baa
OLS beta	0.19	0.20	0.21	0.22	0.30
t-stat	7.53	8.14	8.42	8.73	11.90

Source: Fama and French (2003)

3.12 The estimated coefficients are all statistically significant, and also their magnitude (for bonds rated at investment grade of at least Baa) is remarkably close to our estimate of the BAA debt beta.

Response to BAA commentary

3.13 In addition to criticism of the attempt to estimate and use a non-zero debt beta value, particularly BAA has argued that:

> The CAA's proposals have ignored important factors in estimating debt betas such as the presence of the liquidity premium, the non-systematic risk component in the risk premium on debt, and the need to estimate the expected (rather than nominal) return on debt.

3.14 First, the methodology employed in Supporting Paper XIII explicitly adjusted for an element of insurance against default on the debt in the observed spreads, regardless of

whether the default occurs for systematic or idiosyncratic factors. Second, the same adjustment was indeed devised utilising the concept of expected return on debt, explicitly recognising that the required return on debt does not equal the expected return. Third, as the debt premium is measured as the difference between two nominal measures (observed corporate bond yields and Government bond yields) it does not contain inflation.

3.15 Second, the debt premium is measured as the corporate spreads over government benchmark. Therefore, the debt premium would contain a factor for liquidity only if a) corporate bonds are illiquid, and b) corporate bonds are significantly less liquid than government bonds.

3.16 There is some evidence suggesting that a proportion of the observed debt premium is due to liquidity risk, though the literature is yet to provide a definite answer. Application of measured liquidity premium would have to take into account potential differences in liquidity of the bonds the premium is measured on, and the expected liquidity of the bonds relevant to BAA. Also, several academic studies have found a decreasing importance of the liquidity premium through time. Therefore, though liquidity premium is relevant in principle, we would not expect it to account for a large proportion of the current observed spreads. In the case of BAA we would expect limited, if any, impact on the debt beta estimate — and find no reason to amend our estimate at this time.[6]

Past regulatory decisions

3.17 BAA refers to Ofcom as the only UK regulatory precedent on estimation of a debt beta values.

3.18 The Ofcom method of deriving debt beta values was to *assume* that the first 100 basis points of the debt premium would be consumed by the various factors not reflecting systematic risk exposure of debt, and therefore not factoring in the expected returns of the creditors. Further, each subsequent 100 basis points of debt premium was assumed to correspond to a debt beta factor of 0.2 (such that a debt premium of 3 per cent would imply a debt beta of 0.4).[7] This strikes us as an expedient and reasonable approach to deal with a non-crucial issue within a regulatory determination. However, its value as a regulatory precedent of a robust estimation of the debt beta is questionable.

3.19 It should be noted that the actual value of the debt beta was not crucial in Ofcom's analysis. Ofcom stated that were the value to have a more significant impact on results then it would consider the issue more closely.[8] In contrast, the value of the debt beta is

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6 For example, Driessen (2003), *Is default event risk priced in corporate bonds?*, quotes data in which, on average from 1991 to 2000 around 15 per cent of debt premium on Baa rated corporate bonds is attributable to liquidity premium. However, we note that this falls away to close to zero in the more recent years of the sample.

7 We were not able to locate a discussion of details behind this approach, therefore we regard it as an adhoc pragmatic assumption.

8 http://www.ofcom.org.uk/consult/condocs/mobile_call_termination/wmvct/annexb/

important in the circumstances CAA is faced within the BAA Q5 review. Therefore we had to devise a robust method of quantifying it.

3.20 Incidentally, there have been a number of regulatory decisions outside the UK involving estimation of debt beta notably in Australia. For example, the Australian communications sector regulator[9], Essential Services Commission of Victoria[10], and the Queensland Competition Authority[11] have all considered the estimation of debt beta values, subsequently utilising them in determinations.

Effect of the Zero Debt Beta Assumption

3.21 BAA contends that the estimation and application of the debt beta in the calculations itself accounts for half the estimated reduction in BAA's cost of capital.[12] It is informative to undertake the calculations necessary for the determination, assuming that the debt beta is zero throughout the analysis. We go through the steps in the analysis of Supporting Paper XIII below for the CAA estimates of the parameters including equity beta value of 0.9.

BAA group cost of capital

3.22 The first step in the analysis is the calculation of the group cost of capital. The debt beta does not come into this analysis, such that the Table 3.2 is unchanged from Table 2.6 in Supporting Paper XIII.

9 http://www.aer.gov.au
10 http://www.esc.vic.gov.au/public/
11 http://www.qca.org.au
12 Paragraph 43 of Appendix 1 in the BAA response

Table 3.2: BAA Group WACC: Historical January 2006

	Low	High	CAA Estimate	Basis for range
risk-free rate	1.65	2.25	2.0	See Section 2
debt premium	0.8	1.1	1.05	See Section 2
pre-tax cost of debt	2.45	3.35	3.05	Calculated
equity risk premium	3.5	5	4.5	See Section 2
equity beta	0.5	0.9	0.9	See section 2
pre-tax cost of equity	4.86	9.6	8.64	Calculated
post-tax cost of equity	3.4	6.8	6.05	Calculated
corporation tax rate	30%	30%	30%	Marginal rate of corporation tax
gearing	38%	38%	38%	Calculated from CAA data
pre-tax WACC	**4.0**	**7.3**	**6.5**	Calculated
"vanilla" WACC	3.0	5.5	4.9	Calculated

The lower estimate of 4.0 could be unrealistic due to an unlikely combination of lower end figures on all the parameters.

Source: Copied from Supporting Paper XIII and amended according to zero debt beta assumption and CAA's preferred assumptions.

3.23 Assuming that the debt beta is zero does, however, change the estimate of the BAA group asset beta, as in Table 3.3 below.

Table 2.7: BAA group asset beta

	Low	High	CAA Estimate
Equity beta	0.50	0.9	0.9
Debt beta	0.0	0.0	0.0
Gearing	0.38	0.38	0.38
Asset beta	**0.31**	**0.56**	**0.56**

Source: Copied from Supporting Paper XIII and amended according to zero debt beta assumption and CAA's preferred assumptions

3.24 Taking account of the debt beta we estimated the asset beta to be in range of 0.39 to 0.64, with CAA's preferred estimate being the 0.64. Assuming that the debt beta is zero, and simply calculating the asset beta from the equity beta gives instead a range from 0.31 to 0.56: the CAA's preferred estimate of 0.64 would be transformed through this calculation to 0.56. Below we will refer to this estimate as "un-levered equity beta" to avoid confusion with the asset beta concept.

3.25 The next step in the analysis was to gear up the historical cost of capital estimate to the assumed 60 per cent level. Here taking into account the debt beta reduced the extent to which cost of equity was assumed to respond to gearing, keeping the response in line with the Modigliani Miller theorems. The original range for the forward looking pre-tax

WACC for BAA group was from 3.7 to 7.0 per cent, with CAA's preferred estimate of 6.3 per cent.

Table 3.4: Forward looking BAA Group WACC: 60% gearing

	Low	High	CAA Estimate	Basis for range
risk-free rate	1.65	2.50	2	See Section 2
debt premium	0.8	1.1	1.0	Increased from range in Section 2 due to gearing
pre-tax cost of debt	2.45	3.60	3.00	Calculated
equity risk premium	3.5	5	4.5	See Section 2
equity beta	0.78	1.41	1.41	See section 2; calculated due to gearing
pre-tax cost of equity	6.26	13.62	13.62	Calculated
post-tax cost of equity	4.38	9.53	8.33	Calculated
corporation tax rate	30%	30%	30%	Marginal rate of corporation tax
gearing	60%	60%	60%	Assumption
pre-tax WACC	**4.0**	**7.6**	**6.6**	Calculated
"vanilla" WACC	3.2	6.0	5.1	Calculated

The lower estimate of 4.0 could be unrealistic due to an unlikely combination of lower end figures on all the parameters.

Source: Copied from Supporting Paper XIII and amended according to zero debt beta assumption and CAA's preferred assumptions.

3.26 The table above shows that the effect of assuming a zero debt beta has increased the preferred estimate of the BAA group vanilla WACC from 4.9 to 5.1 per cent, and the pre-tax WACC from 6.3 to 6.6 per cent.

3.27 The calculations above suggest that the adoption of a non-zero debt beta makes a material but not overwhelming contribution to the overall fall in the estimated group WACC.

Disaggregation

3.28 The debt beta was utilised further in Section 3 of the Supporting Paper XIII, in the analysis of the disaggregation of the group estimate.

3.29 Here the first point to note is the lower group asset beta (or un-levered equity beta) estimate, on which the disaggregation is based. We only carry out this analysis as a demonstration of its effect — as by assuming a zero debt beta, which effectively ignores part of the systematic risk faced by BAA, it is clear that the result cannot be robust.

3.30 The first stage of the disaggregation carried out involved comparator analysis. For each comparator asset beta estimate, Supporting Paper XIII aimed to take into account the fact that the comparator asset betas were estimated with the zero debt beta assumption also, and therefore add a correction factor to them. This was also taken into account by the CAA in drawing their preferred estimates. Here such a correction, of course, is not

necessary. Again, we refer to these betas as "un-levered equity betas" rather than asset betas to avoid confusion.

3.31 Fraport, the airport identified as a possible comparator for Heathrow, has an un-levered equity beta of 0.42 against the domestic equity index in Table 3.1 of the Supporting Paper XIII. Ignoring the pure water utilities, the comparator un-levered equity beta estimates for utilities range between 0.24 and 0.40. Similarly the evidence quoted for a wider set of utilities also put water company un-levered equity betas in the 0.2 range and electricity distribution between 0.2 and 0.4.

3.32 As recognised in Supporting Paper XIII, however, Heathrow does have significant retail, property and construction functions that should distinguish it from the traditional network utilities. The paper finds construction companies have un-levered equity betas in the range from 0.3 to 0.6 and retail companies from 0.5 to 0.7.

3.33 Assigning similar weights to these un-levered equity beta estimates as to the asset beta estimates in Supporting Paper XIII, the resulting un-levered equity beta range for Heathrow would lie between 0.4 and 0.5. To bring this in line with the higher end of the group beta preferred by the CAA, for illustration purposes we use an un-levered equity beta range from 0.49 to 0.54 for Heathrow to distinguish it from the estimate of 0.56 for BAA group as a whole (surely Heathrow is less exposed to systematic risk than the group overall).[13] (Incidentally, the fact that OXERA bottom-up methodologies come up with similar Heathrow asset beta estimate as the approach by Europe Economics (paragraph 3.45 of Supporting Paper XIII) could be taken as a further indication of the validity of not assuming a zero debt beta in the analysis.)

3.34 Disaggregating the Heathrow estimated range from the BAA group estimate 0.56 gives a rest-of-BAA un-levered equity beta estimate between 0.59 and 0.67. Further disaggregating this according to the methodology adopted leads to estimate from 0.57 to 0.64 for the un-levered equity beta for Gatwick.

3.35 These give a range from 6.1 to 6.4 per cent pre-tax WACC for Heathrow, and from 6.6 to 7.1 per cent pre-tax WACC for Gatwick, using the CAA's preferred scenarios. These compare to the CAA's preferred range of 5.9 to 6.2 per cent pre-tax WACC for Heathrow and from 6.3 to 6.7 per cent for Gatwick. It appears the assumption of zero debt beta would make a significant but not dominant impact on the quantitative results (though of course making the analysis less robust).

[13] The CAA used a range of 0.575 to 0.625 as for the Heathrow asset beta, compared to the estimate of the BAA group asset beta of 0.64. The implied differences of 0.07 and 0.02 were used directly as the basis of the illustrative numbers here.

4 COST OF DEBT

Overall Approach to Cost of Debt

4.1 The BAA response on debt premium estimates asserts that a) incorrectly using data for utility comparator spreads has led to a reduction of 50 basis points in the cost of debt, and b) short (5 year) maturities of debt instruments were used as the basis of the estimate. To address these points, it is helpful to recount the actual method employed, as set out in the Supporting Paper XIII.

4.2 Supporting Paper XIII used three primary sources of information on the likely debt premium for companies with similar credit ratings to BAA:

(a) Reuters spreads of corporate bonds, with a high level division into utility and transport groupings;

(b) BAA actual historical spreads, as reported by OXERA; and

(c) The spreads of unregulated UK airports with similar credit rating to BAA.

4.3 In the event we placed less weight on the transportation comparators than utilities comparators for various reasons, including:

(a) The transportation group is likely to include companies (such as airlines, trucking companies etc.) with substantially higher systematic risk exposure than would be reasonably expected of a regulated monopoly airport;

(b) The utilities sector is likely to include various suppliers, generators and other companies involved in the utility sector, all of which probably have a higher systematic risk exposure than the traditional regulated network utilities;

(c) The actual BAA spreads on recent issues, as reported by OXERA, proved more akin to the figures for the utilities set figures than the transportations set of Reuters; and

(d) The spreads, as reported by E&Y, of non-regulated UK airports with similar credit rating as BAA proved more akin to the figures for the utilities set figures than the transportations set of Reuters.

4.4 Given the above, placing a high weight on the general transportation sector comparator spreads would seem overly generous. Therefore the Reuters utilities spreads, evidence on BAA actual spreads and evidence on the spreads of other UK airports were combined to produce the historical debt premium estimate, varying between 0.8 and 1.1 per cent.

This estimate was then slightly adjusted downwards for the CAA's preferred credit rating assumption for the Q5 period.[14]

4.5 The approach to cost of debt in Supporting Paper XIII is in line with the decision of the Competition Commission in the 2002 BAA cost of capital analysis.[15] In 2002 the CC took into account "interest rates over the medium term", with reference to debt spread over a range of maturities. In its analysis the CC referred to BAA's actual spreads as well as transportation comparator spreads. Supporting Paper XIII builds on this taking into account additional available information, i.e. the spreads relevant to debt of some non-regulated UK airports and general utility sector spreads.

4.6 The approach is also in line with the Ofgem and Ofwat 2004 determinations, where both regulators investigated the spreads on publicly traded debt, involving a mix of maturities.

4.7 Further, it should be noted that the CAA has not sought to use the BAA actual post-takeover implied debt premiums for the forward-looking determination. These could reasonably be expected to be lower than the historical BAA debt premium given the premium paid by the Ferrovial consortium, which, as set out in the Tobin's q analysis in Supporting Paper XIII, would imply a cost of capital below the level proposed by CAA.

Transportation comparison

4.8 The above recounting of the method clarifies that the estimated debt premium was not based only on comparisons to utilities, much less regulated network utilities. We did, however, not place much weight on the transportation comparators, for the reasons given.

4.9 Were we to keep other aspects of the analysis the same (including maturity structure, see below), but include the Reuters transportation comparators with approximately equal weight to the other evidence in to the analysis, the upper end of the implied spread might move to 1.2 per cent.[16] Only if we were to ignore all other available evidence except the transportation sector spreads, weighted according to the methodology in Supporting Paper XIII, would the implied debt premium rise to 1.5 per cent for BAA's credit rating as of January 2006.

Maturities used

4.10 BAA response further implies that the debt premium used has been unduly linked to securities of short maturities. As explained also in Supporting Paper XIII, this is not the case.

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[14] As discussed in the CAA's Initial Proposals document, CAA used notional gearing and credit rating assumptions to acknowledge the higher level of gearing than within its cost of capital estimates in 2003, yet consistent with maintenance of investment grade credit quality.

[15] http://www.caa.co.uk/docs/5/ergdocs/ccreportbaa/chapter4.pdf , from paragraph 4.66.

[16] Calculated as the average of the utilities estimate, transportation estimate, and the upper bounds of actual BAA recent spread estimate and the upper bound of the UK airport estimates.

4.11 First, the Supporting Paper XIII acknowledges that companies typically use a mixture of long term and short term debt. Further, we calculated the figure of 150 basis points, quoted from Supporting Paper XIII by BAA, by weighting the Reuters spreads for different maturities in the transportation sector according to the maturity structure of BAA's debt. Indeed, as discussed in Supporting Paper XIII, the calculation of the 1.5 per cent for transports and 1.0 per cent for utilities might have placed undue weight on very long-term bonds due to the nature of the underlying Reuter's data.

4.12 Thus, the figures used are not based mainly on yields of short-term instruments. Of course it might not be safe to assume that the maturity structure of BAA debt was efficient at the time (we only take it as an example of a *credible* maturity structure). However, the respondents so far have not suggested an alternative, possibly more efficient, maturity structure to be used — we would be interested to receive arguments in support of some particular such structure.

4.13 The resulting 150 basis points spread for the transportation sector is in line with spreads on medium term bonds at the time. Had short term (five year or less) spreads been used as the basis for the figures, the result would have been between 55 to 115 basis points for the transportation sector, and between 40 and 104 basis points for the utilities sector, using January 2006 figures and BAA credit rating at that time.

4.14 Second, the spreads on recent BAA bond issues quoted by OXERA also generally related to bonds with maturity of five years or longer.

Update on Reuter's corporate spreads

4.15 It is relevant at this stage to inspect recent evidence to see whether it warrants a change in the forward-looking debt premium estimate. For practical reasons, however, this is limited to one of the three methods used — the Reuter's corporate spreads of transportation and utilities sectors. Given the update concerns only one third of the evidence base used for the debt premium estimate, any changes to the debt premium based on it would have to be made with caution.

4.16 The latest monthly data relates to the spreads at the end of February 2007, shown in Table 4.1 below. CAA considers the use of a comfortable investment grade credit rating to be consistent with the gearing assumption used. Supporting Paper XIII showed the Transports spread to lie between 65 basis points for the A- rated short-term instruments and 230 basis points for BBB+ rated long-term instruments. The figures for the utility sector ranged from 37 basis points to 141 basis points respectively. The weighted averages drawn were 150 basis points for the transportation sector and 100 basis points for the utilities sector. Supporting Paper XIII combined these with evidence on BAA actual spreads and spreads of UK airports with comparable credit rating to draw the forward looking debt premium estimate of 100 basis points for the assumed A-/BBB+ rating, as also discussed in paragraph 4.2 above.

4.17 Table 4.1 shows some movement in the data since Supporting Paper XIII, though less in the Transports sector. The spreads on Utilities bonds have fallen slightly for all maturity

groups, such that the weighted average is now around 80 basis points as compared to 100 basis points previously. The short-term Transports spreads are slightly higher, but the long-term Transports spreads are slightly lower, such that the weighted average for the Transports spreads is currently around 150 basis points as previously.

Table 4.1: Transports and Utilities spreads February 2007

	Transports			Utilities		
Rating	Short	Medium	Long	Short	Medium	Long
Aaa/AAA	32	72	105	10	28	50
Aa1/AA+	37	80	115	12	35	60
Aa2/AA	42	88	125	15	39	70
Aa3/AA-	50	101	140	18	47	90
A1/A+	58	115	160	23	53	94
A2/A	67	130	178	25	61	99
A3/A-	**75**	**145**	**193**	**28**	**68**	**116**
Baa1/BBB+	**83**	**155**	**203**	**35**	**84**	**134**
Baa2/BBB	93	163	225	46	98	144
Baa3/BBB-	108	188	235	57	103	154
Ba1/BB+	138	197	260	282	202	225
Ba2/BB	168	263	300	275	233	310
Ba3/BB-	195	288	340	253	253	320
B1/B+	213	328	415	330	292	330
B2/B	235	365	445	407	340	350
B3/B-	272	385	495	490	393	370

Source: Europe Economics calculation using Reuter's corporate spreads data from Bondsonline.com

4.18 Previously, and in this paper, we have argued for a limited weight to be put on the Transports spreads. The weighted average of the Utilities spreads has fallen closer towards the range from BAA's actual data reported in Supporting Paper XIII, though it still lies within the range estimated previously.

4.19 Against this background, we do not see the change in spreads as warranting a reduction in the forward looking debt premium estimate at this time. We note, however, that the latest data would indicate a higher weight on the lower end of the range estimated in Supporting Paper XIII, and as such suggest the use of 100 basis points forward looking debt premium is more conservative than before.

Refinancing Costs

4.20 BAA has correctly observed that the cost of debt in the Initial Proposals does not include allowance for embedded debt. This is a clear and consistent implication of the regulatory system — the company is responsible for making financing decisions the risk of which (positive or negative) is borne by the company.

4.21 The five year price review period does not, however, require BAA to plan its finance for five years at a time. It is a framework used for the determination, and, as stated above BAA is free to benefit (or lose) from decisions it makes within that framework. The five year framework does not necessarily encourage short term financial planning, as contended by BAA. There are numerous ways in which regulated companies can borrow. For example, if BAA expected that cost of debt is now at historically low levels and can only rise, it can commit to longer term finance at the current favourable terms (and benefit if rates do rise). Alternatively, BAA can seek to insure against market movements through other, index linked, instruments.

4.22 Therefore, it should be clear that the analysis does not carry an assumption that BAA will refinance every five years.

4.23 BAA further implies that the cost of debt should include an allowance for costs of refinancing its existing debt. These are the transaction costs incurred issuing debt or equity, or refinancing existing instruments.

4.24 The cost of capital used in the RPI-X price formula should reflect the costs the company bears in raising the capital it needs to invest. Investors will need to have net returns sufficient to compensate them for the risk they take on by investing (e.g. in BAA). In an efficient capital market this will include the organisational/administration costs that the company bears in raising finance — e.g. in the case of equity, the costs of flotation; in the case of debt, the costs of organizing the initial debt issuance or of subsequent refinancing. Equity holders own the company, and so ultimately bear all such costs. Thus, financing costs appear in the required rate of return on equity and would be captured in CAPM through the Equity beta x MRP calculation.

4.25 It is sometimes argued that these organisational/administration costs include a significant fixed cost element, with the consequence that when the amounts of finance raised are relatively small — e.g. in the case of a small company — the total cost of equity, including both the required return for risk borne and the organisational/administration costs, will be higher than that calculated from averaging across market returns for both small and large companies. This means that there is argued to be a “small company premium”.

4.26 As remarked in a number of our previous papers, BAA as a whole, and even its component airports, are far larger than the usual upper threshold at which any small company is usually recommended.[17]

Past regulatory decisions

4.27 Allowance of refinancing costs in the cost of debt would be a break with regulatory precedent in the UK airport sector. Previous price determinations, including the advice

given by Competition Commission, did not refer to BAA's transaction costs of organising finance as a part of the estimated cost of debt. In contrast, in the 2005 NATS determination CAA seems to have included a category of "expected fees on debt" in the cost of debt figure.[18]

4.28 It has been rare, in past UK regulatory decisions, for refinancing and issuance costs to be referred to explicitly. In the Ofwat 2004 price review calculations on behalf of the water and sewerage companies added such costs explicitly into the cost of capital. Ofwat stated in response that the use of values towards the high end of the range captured any such costs, though it did was not specific as to the quantity of the costs referred. Also it is not clear whether part of the range was drawn to accommodate these costs, or whether the implication is that the costs were already captured in the estimate.

4.29 Other UK precedent we are aware of is from the Competition Commission, which stated in relation to Mid Kent Water and Sutton and East Surrey Water reviews in 2000 that cost of debt should include both interest payments and fees.[19] For the small water companies in question, the Competition Commission judged that most efficient fees would relate to bank financing. Although it did not provide public estimates of such costs, some estimate of the costs seemed to have been incorporated into the bank rate margin estimated above the LIBOR. The consideration of the size of the companies also seemed to have been a factor in the decision, and particular reference is made to small companies not being able to finance through issuance of long maturity bonds. The value of this precedent is perhaps limited by the more recent Competition Commission assessment of BAA cost of debt in 2002, and by the fact that the issue was particularly of small companies financing costs.

Bank of England Interest Rate Decisions

4.30 The question of whether movements in the rate set for monetary policy purposes by the Bank of England should feed through to the cost of capital has been raised. Our answer is that, in the present regime, evidence shows that short term changes do not feed through to the cost of capital.

4.31 The Bank is set a target for inflation, and for policy purposes has a two-year forecast horizon. This implies, consistently with the evidence that monetary policy works with a lag of up to two years, that the Bank can be thought of as making changes to hit a two year rolling target. At and beyond the two year horizon inflation is expected to be in the target range. This is reflected in the Bank's "fan charts" of inflation forecasts.

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[17] We note, for the record, that we are not, by this comment, conceding that we would recommend the use of a small company premium below this threshold in any case. It is sufficient for our purposes here that the issue does not arise.

[18] NATS Price Control Review 2006-2010: CAA's Firm Proposals, May 2005, Supporting Paper on cost of capital, slide 6

[19] CC (2000) "Mid Kent Water Plc: A report on the references under Sections 12 and 14 of the Water Industry Act 1991", and "Sutton and East Surrey Water Plc: A report on the references under Sections 12 and 14 of the Water Industry Act 1991"

4.32 This in turn imparts stability to rates beyond that horizon. The reason for this is that the observed, nominal, rate at any point on the yield curve is by definition the real rate of interest plus the expected rate of inflation (or minus the expected rate of deflation).

4.33 The stability comes from the fact that the long term real rate of interest has in the past been very stable, combined with the stability imparted to the expected inflation rate by the combination of the Bank's mandate and its so far successful achieving of the mandate. Further, even if the long rate should for reasons unforeseeable at the moment become less stable than in the past, there is certainly no reason to believe that whatever reduces this stability will be correlated with movements in the monetary policy rate. Hence under a successful inflation-targeting regime movements in the short (policy) rate are not expected to feed through to the cost of capital. It is inflation expectations rather than short term interest rates that determine long term interest rates.

4.34 In summary, when inflation expectations are well anchored, so are long term interest rates, and short-term interest rate movements that maintain (or validate) inflation expectations, will leave the cost of capital unaffected.

5 TAX

5.1 This section considers the comments made by respondents (in particular, BA and Virgin) on the issue of taxation.

Comments by Respondents

5.2 The two stakeholders that have made the most substantive comments on tax in their most recent submissions are BA and Virgin. The views expressed by these airlines are summarised below, although we would refer readers to the original responses for more detail.

BA's views

5.3 BA argues that BAA's revenues should be set to cover actual tax payments. It argues that the current approach allows BAA to benefit from:

(a) The NPV benefit of the differences between the statutory rate and the effective rate;

(b) The tax benefits of increasing gearing above the level of 60 per cent assumed in the calculation of the WACC.

5.4 BA argues that the CAA overstates the complexity of projecting actual tax liabilities. It also suggests that the danger of double payment can be avoided by treating new assets added during Q5 differently from assets added in earlier periods.

5.5 BA welcomed the CAA's intention to consider an adjustment to take account of the NPV impact of the difference between statutory and effective rates, although it viewed this as second best to using an actual tax approach.

Virgin's views

5.6 Virgin's response argues that the revenues allowed for tax under the current pre-tax approach to the cost of capital may differ from actual tax payments for two reasons:

(a) *Differences between regulatory depreciation and capital allowances*. Virgin present charts showing the scale of this effect for different types of assets (eligible for different types of capital allowances), different regulatory depreciation periods, and different rates of annual growth in CAPEX. Virgin state that "in some circumstances, the effective rate of tax on regulatory profits (operating profits after regulatory depreciation) may even be higher than the headline rate of 30%".

(b) *The fact that the tax shelter applies to the nominal cost of debt (including the inflation component), and not just to the real cost of debt*. Virgin asserts that this effect "is ignored in the conventional CAPM computation of the cost of capital." It presents calculations which purport to show that this leads to a lower pre-tax WACC than contained in the CAA's initial proposals (even after allowing for a slightly higher effective enterprise tax rate).

Commentary

5.7 Below, we briefly respond to these comments under a number of headings:

(a) The theoretical case for using a pre-tax approach to the cost of capital;

(b) The treatment of tax benefits from gearing above 60 per cent;

(c) Virgin's calculations of the effect of differences between regulatory depreciation and capital allowances; and

(d) Virgin's argument on the tax benefits relating to the inflation component of the nominal cost of debt.

The theoretical case for using a pre-tax approach to the cost of capital

5.8 While we recognise that arguments can be made on both sides, we continue to recommend the use of a pre-tax cost of capital, computed using the statutory tax rate. As set out in our policy framework paper (December 2006), the reasons for this include:

(a) It preserves the structural incentives for investment designed by the Chancellor by the system of capital allowances;

(b) It avoids the complexity of computing actual tax liabilities, thus preserving a light-touch approach to regulation;

(c) It avoids the danger of double payment for tax liabilities that would arise if the approach to taxation were to change between regulatory periods;

(d) It ensures consistency with past CAA and Competition Commission conclusions.

5.9 The case for a pre-tax approach presupposes that it is applied consistently through different regulatory periods, so that periods in which the effective tax rate is below the statutory tax rate are offset by other periods in which the reverse is true. Hence, use of a pre-tax approach during Q5 (when it may over-compensate BAA for actual tax liabilities) needs to be combined with a firm and credible commitment to using a pre-tax approach in the future when it may under-compensate BAA for actual tax liabilities.

The treatment of tax benefits from gearing above 60 per cent

5.10 In our policy framework paper (December 2006), we suggested, "CAA could determine a system for recovering at a future determination the tax benefits associated with gearing above the level used in modelling for Q5."

5.11 The CAA has indicated that it does not wish to claw back any of the benefits associated with the tax shield if the company gears up above 60 per cent. We understand that this is on the grounds that if users share in the financial upside of the arrangements, they might be expected to share in any accompanying downside risks.

Treatment of new investment vs. old investment

5.12 It would not be appropriate for the CAA to change the tax treatment of existing investment, for example by calculating and adjusting for the NPV tax benefit from existing investments. Doing so might be seen as opportunistic, and could increase the regulatory uncertainty regarding investment decisions, ceteris paribus, reducing investment incentives.

5.13 Also, an issue of double counting the tax benefit of old investments could arise. Under the pre-tax approach BAA has been able to enjoy capital allowances on its investment while being compensated for the full statutory tax rate. Change to allowing actual tax costs after investment is complete could potentially allow these tax costs again in later periods.

Virgin's calculations of the effect of differences between regulatory depreciation and capital allowances

5.14 We accept that there can be differences between the statutory and effective tax rate due to differences between regulatory depreciation and capital allowances. Virgin's calculations of the possible magnitude of this effect appear to be based on the assumption that CAPEX increases by a constant percentage year-on-year. This seems unrealistic given the nature of BAA's proposed CAPEX programme. However, the principle of the calculations could be useful for CAA, as applied to new investment.

5.15 A quantification of the NPV tax benefit from new investment, based on actual BAA projections, has not been incorporated into this report. In the light of the changes to the capital allowances system proposed in the 2007 Budget (22 March 2007), such a calculation would be premature.

Virgin's argument on the tax benefits relating to the inflation component of the nominal cost of debt

5.16 We agree that that since nominal interest payments are tax-deductible, companies benefit from a tax shield on the inflation component of interest payments, as well as on the real cost of debt. However, we do not consider that it is correct to say that "is ignored in the conventional CAPM computation of cost of capital".

5.17 We suggest the following thought experiment is a useful way to think about this issue:

(a) First, consider the use of a nominal cost of capital for regulatory purposes (i.e. the application of a nominal cost of capital to an asset base calculated in constant prices, in contrast to the current approach of applying a real cost of capital to an asset base which is uplifted each year for inflation). Clearly, when calculating the nominal WACC under this approach only the nominal cost of equity would be uplifted to account for tax liabilities. This implicitly recognises that the company benefits from a tax shield on the nominal cost of debt — including in relation to the inflation component of the nominal cost of debt. Hence, use of nominal cost of capital would directly take into account the tax benefit which Virgin refers to.

(b) Second, it should be recognised that nominal and real approaches to the cost of capital simply represent different ways of accounting for inflation within the regulatory framework, and should give the company an equivalent amount of revenue in present value terms if they are applied correctly. A nominal cost of capital remunerates the company for inflation through the cost of capital, whereas a real approach to the cost of capital provides equivalent remuneration through inflationary uplifts to the RAB. This implies that a real approach to the cost of capital must also take into account the tax benefits relating to the inflation component of interest payments.

5.18 In support of the second step, the Ofwat/Ofgem paper on financing networks[20] recognised that a nominal cost of capital should (if correctly applied) give an equivalent answer to the current approach used by regulators:

> "An alternative to the current approach would be to apply a nominal cost of capital to an asset base calculated in constant prices. In order for this to be ***equivalent to the current approach in present value terms*** for individual assets the depreciation charge would need to remain in constant prices with no further adjustments for inflation." (added emphasis)

5.19 Quite apart from the above discussion, it is worth noting that Virgin ignores the effect of personal taxation on the value of the tax shield. A robust estimate of the actual value of the debt tax shield for a company would have to take into account all taxes paid on the income from the company, and as such would have to take account of at least the following:

(a) Some investors (e.g. pension funds, a very important class of investors) are tax exempt;

(b) The company might not make a profit, in which case any value of tax shield becomes redundant;

(c) Different legal persons are liable for different tax rates, or are just better at planning their own tax and avoiding the full marginal rates;

(d) Taxation of equity income differs depending on whether it is paid out in dividends or retained as capital gains, so that a company's dividend policy has an effect on tax shield value; and

(e) The marginal rate of corporation tax might be different from the statutory one due to non-debt tax effects (notably, capital allowances).

5.20 If personal taxes are ignored, the tax advantage of debt is indeed positively related to inflation, because the marginal effective rate of corporation tax saved is positively related to inflation. However, allowing for personal taxation, inflation has an opposing effect on tax advantage of debt — it increases the effective rate of income tax on real interest and

[20] Ofwat/Ofgem, "Financing Networks: A discussion paper", February 2006

equity income. The exact quantitative impact is therefore uncertain before detailed calculations of the relevant effects. Some commentators suggest that the overall tax effects of inflation are small if inflation is low.[21]

5.21 Given the above discussion, we would not endorse the calculations on the Heathrow cost of capital put forward by Virgin. In the light of the discussion here and previously, use of the statutory rate as employed in the Initial Proposals seems to be a reasonable way forward, and also consistent with previous regulatory determinations.

[21] For example, Seth Armitage: "The Cost of Capital — intermediate theory", Cambridge University Press, 2005, page 232.

6 RISK FREE RATE — UPDATE

6.1 In the December 2006 Initial Proposals the CAA indicated that it would seek to take into account new information on the risk free rate during the various stages of the price review. This section provides first of such updates to the inspection of risk free rate in Supporting Paper XIII. As with the original discussion, we do not investigate the matter in great detail, but update the previous discussion with the latest market data and published UK regulatory decisions.

6.2 Table 6.1 shows the range of estimates of the risk free rate that have been applied in recent UK regulatory decisions. Ofgem published the Final Proposals for the Transmission Price Review in December 2006, including Ofgem's final view on the applicable risk free rate. Based on the analysis in the Smither's & Co (2006) report, Ofgem concluded that the applicable risk free rate over the long term is 2.5 per cent. We note that this figure comes from the earlier Smither's & Co (2003) paper, a result of analysis of equilibrium real risk free rate over long term, and as such does not necessarily reflect the more recent relatively stable market evidence of low risk free rate.[22]

6.3 Regulatory estimates of the real risk-free rate, including the update on Ofgem figures for 2006, have ranged between 2.0 and 3.0 per cent since 1999. Regulators have remained reluctant to move the estimates in line with prevailing lower market rates.

[22] We note that the December 2006 assessment of cost of capital by the Competition Commission in the Classified Directory Advertising Services uses a real risk free rate of 2.06 per cent. However, this figure relates to a backward looking assessment of level of profitability, and as such is not directly relevant to CAA's price setting for Q5.
http://www.competition-commission.org.uk/rep_pub/reports/2006/fulltext/521_app_7-2.pdf

Table 6.1: Regulatory decisions: real risk-free rate

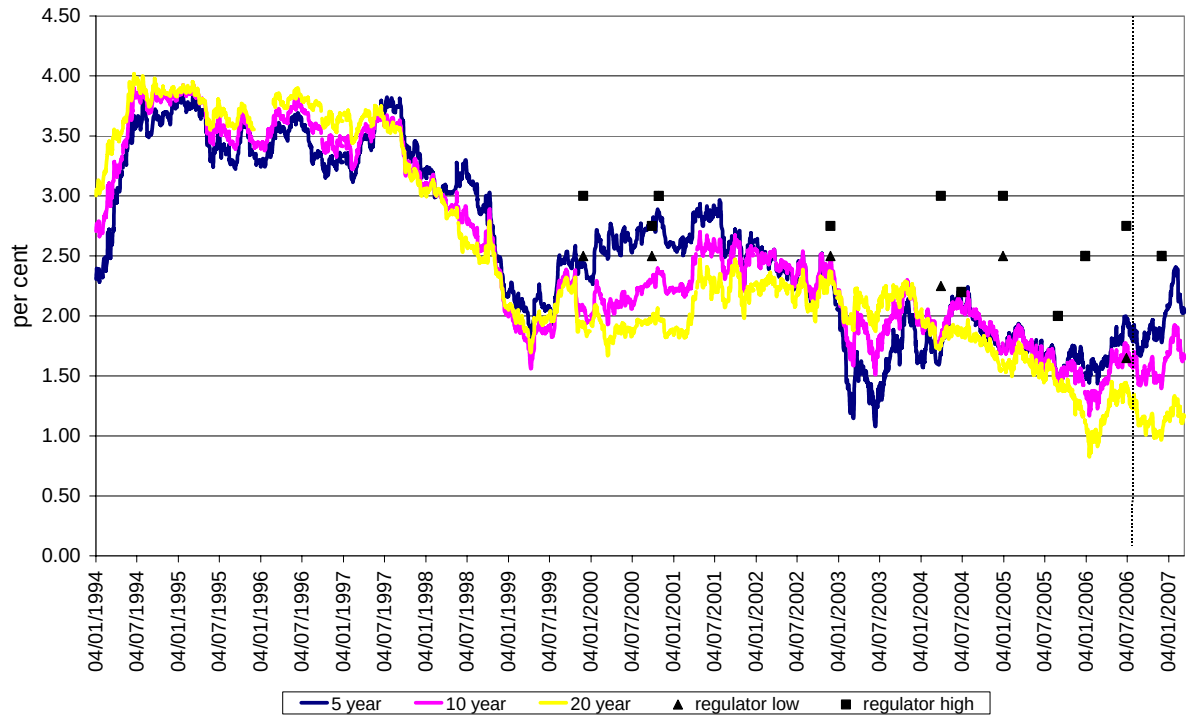
Regulator	Case	Real risk-free rate (%)
Ofgem	Transmission (2006)	2.5
Ofcom	General approach – applied to BT (2005)	2.0
CAA	NATS (2005)	2.5
Postcomm	Royal Mail (2005)	2.5
Ofwat	Water and sewerage (2004)	2.5 - 3.0
Ofgem	Electricity distribution (2004)	2.25 – 3.0[a]
Competition Commission	BAA (2002)	2.5 - 2.75
ORR	Access charges (2000)	3.0
Competition Commission	Mid Kent Water (2000)	3.0
Ofgem	Transmission (2000)	2.5 – 2.75
Ofwat	Water (1999)	2.5 – 3.0
Lowest figure		**2.0**
Highest figure		**3.0**

a These figures were reported in the provisional report.

Source: compiled by Europe Economics.

6.4 Chart 6.1 updates the relationship observed between the return on UK government bonds and the risk free rate used in regulatory decisions with data up to 12 March 2007. The additional run of data is identified in the chart. Previously we argued that ignoring consistent market evidence of a low risk free rate might be seen as giving a windfall to the regulated companies. The current levels shows the market expectation of what the rate will be in the future, and the rates could fall as well as rise from the present level in Q5.

Chart 6.1: Real risk free rate vs. regulatory decisions



6.5 Given that such spot rates are forward-looking, the most relevant data are the latest. Compared with 14 August 2006, the previous end-date for Supporting Paper XIII, as at 13 March 2007 the rates are virtually unchanged. The five-year rate has increased slightly (from 1.87 to 2.03), whilst the ten-year rates are almost exactly the same (now 1.64 compared to 1.66) and twenty-year rates have fallen slightly (now 1.16 versus 1.29 last August). We do not consider the falls in the twenty-year rate to merit a reduction in our estimate of the risk-free rate.

6.6 Although carrying less weight than the latest point estimate, the graph also illustrates for us the developments in the data since August 2006. Short-term rates increased briefly from Autumn 2006 to February 2007, presumably reflecting expectations of tighter interest rates in the short term (perhaps due to cyclical effects). Longer rates moved less, presumably indicating continued expectations of low interest rates in the longer term (due to more structural effects).

6.7 Low long-term rates suggest expectation of further falls in the short-term rates. We do not see, based on this admittedly superficial inspection, a reason to alter our point estimate of 2.0 per cent. We note that the CAA's chosen range — 1.65 to 2.5 per cent, continues comfortably to encompass all recent movements in rates.

6.8 We remain inclined to discount the higher end of the figures used in the previous UK regulatory determinations, while recognising the CAA might wish to maintain a buffer against future rate rises.

7 OWNERSHIP AND JOINT FINANCING

7.1 This section briefly comments on the implications that possible separate ownership of Heathrow and Gatwick airports could have on the cost of capital, particularly as compared to the results derived from the BAA group cost of capital in Supporting Paper XIII.

Possible Sources of Group Financing Benefit

7.2 There is a limited set of possibilities that might give rise to a financing benefit due to a group holding of assets as compared to separate company holdings, some of which we have discussed on previous occasions. The possibilities include:

(a) Small company premium;

(b) Arguments based on "coinsurance" against volatility of cash flows; and

(c) Greater reliance on external finance.

7.3 It might be argued that for separated airports, by the virtue of the fact of their being smaller companies, the cost of raising finance will increase due to some element of fixed costs. However, as previously discussed, and without accepting the existence of the small company premium in principle, all the BAA London airports are far larger than the threshold at which small company premia are usually argued to apply.

7.4 The "coinsurance" argument is based on potentially increased volatility of cash flows relative to the size of the business as a result of separation. The relevant question is, *if* volatility of cash flows increases, does systematic risk exposure increase? The answer in general is "not necessarily" but there are some possible effects:

(a) Bankruptcy risk / debt coverage ratios — The cost of capital does reflect the risk of non-payment or bankruptcy to the extent this is a systematic risk. If the size of the cash and/or equity buffer is reduced to an extent that the risk of bankruptcy due to systematic shocks increases significantly, the cost of capital could react. However, this would also imply that the company could reduce its cost of capital by reducing the level of financial gearing.

(b) Size of investment program relative to size of business — the conclusions of our report on this factor stand also in the context of fully separated airports: Investment programs should not matter unless they lead to a change in operational gearing, or if the nature of the business is transformed.

7.5 In addition to the above discussion, we have discussed in Supporting Paper XII why there should not be inherent financing benefits from "pure conglomerate mergers". Therefore, the potential separation of the airports would not lead to an inherent increase in the relevant cost of capital, and, by the same argument, could in principle lead to *a fall* in the cost of capital, although the magnitude of any such effect would need to examined against the specifics of any particular transaction.

7.6 The argument about greater reliance on external finance is based on the thought that companies prefer to finance first via cash, second via debt and via equity only as a last resort. Therefore, if full separation reduced the scope for using cash as a financing tool, the overall cost of financing investment might be argued to increase for the company. It is doubtful, however, how relevant this line of thought is for companies operating at the scale and financing requirements of the separated airports.

7.7 We note that BAA or other respondents have not offered any quantification of the possible financing benefits of common ownership. We also have not to date undertaken research to quantify the possible benefits, but would note once again that we do not expect these to be significant for the size of the businesses that stand alone Heathrow, Gatwick and Stansted airports would remain.

8 ADDITIONAL RISK FACTORS

8.1 The CAPM framework has been used as the main method for estimating the cost of capital for Heathrow and Gatwick airports. It is sometimes argued that CAPM ignores some relevant systematic risk factors that can explain the required return on company equity. In particular the responses bring attention to the Fama French model, and the effect of catastrophic risks on cost of capital. This section considers each in turn.

The Fama-French Model

8.2 The CAPM model estimates the cost of equity using only the Market Risk Premium (MRP) as an explanatory factor of equity returns. However, it has been argued that there could be additional factors that affect the cost of equity not taken into account in the CAPM. The Fama-French Three Factor Model incorporates two such factors in addition to MRP: the "size factor" and the "book-to-market factor." The size factor is represented by "SMB", which stands for Small Minus Big, and the book-to-market factor is represented by "HML", standing for High Minus Low.

8.3 SMB is defined as the return on small-firm stocks less return on large-firm stocks. Inclusion of this factor in the investigation reflects a tendency that Fama and French observed of owners of the smallest market capitalisation stocks to make a substantially higher return than those with the largest capitalisations.[23]

8.4 Similarly, the HML factor is calculated as the return on stocks with high ratios of book value to market value less return on low book-to-market ratio stocks. This factor controls for the historical trend of "value stocks" (those with high book-to-market ratios) providing a higher long-run return than so called "growth stocks" (low book-to-market ratios).[24] Intuitively, a high book-to-market ratio could indicate that the public value of a company has fallen because of hard times or doubt regarding future earnings. Given that these companies have probably experienced some sort of difficulty, it seems plausible that they would be exposed to greater risk of bankruptcy or other financial troubles than their more highly valued counterparts.[25]

8.5 The Fama-French Model is specified mathematically as:

$$r_E = r_f + \beta_A (r_M - r_f) + s_A SMB + h_A HML ,$$

where the $(r_M - r_f)$ term is MRP.

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[23] Brealey, Myers and Alan (2006) *Corporate Finance*, New York: McGraw Hill.
[24] Brealey, Myers and Alan (2006) *Corporate Finance*, New York: McGraw Hill.
[25] Womack, Kent and Zhang, Ying (2003) "Understanding Risk and Return, the CAPM, and the Fama-French Three-Factor Model" Tuck School of Business, Dartmouth University.

8.6 By rearranging and adding a constant term, we arrange the equation so we can regress actual excess fund returns linearly against historical market data:

$$r_E - r_f = \alpha + \beta_A (r_M - r_f) + s_A SMB + h_A HML .$$

8.7 The analytical or theoretical objections to the Fama French model are well known and have been discussed with the CAA previously. We do not reiterate these, as the focus of this note is the empirical estimation of the model.

8.8 While it might seem that the Fama-French Model with its increased explanatory power in cross section analysis of portfolio returns would inevitably have greater explanatory power than CAPM (in the sense that the total amount of variation explained by the model will be higher), this is not necessarily so. The model gives rise to the question of using different modelling permutations related to selecting which risk factors to include, whether to use historical or cross-sectional data to measure the risk factors, how to select the period under consideration, and how to measure the risk-free rate. Although some of these issues are also present in the CAPM, adding two additional explanatory factors subject to different interpretations on how they should be calculated makes matters more problematic.

8.9 The most important empirical objection to the Fama French model is that the increased number of variables has not necessarily improved the accuracy of the estimates. For example, according to the OXERA paper on behalf of BAA, in time-series analysis that express the ability of the model to explain changes in stock returns, the size factor is not statistically significant, and the book-to-market factor is significant but just over certain time periods. Cross-sectional analysis finds all three risk factors to be significant across a range of specifications — only the sign on the size factor was negative. This, of course, contrasts with the thought behind the model that smaller stocks have higher risk premia than large ones.

8.10 Another reason to question using the Fama-French Model relates to the present context. According to a report written for Ofgem by Smithers & Co. on the cost of capital (2006), the book-to-market factor may in fact not be at all relevant to regulated companies, since they are not in a state of permanent financial distress — the economic rationale of the "value effect" is not certain.

8.11 Finally, Petkova (2006) postulated that the SMB and HML variables may be a proxy for "news" other than size risk or book-to-market risk, i.e. interest rates, term spreads, or dividend yields. She picks up on an idea actually first put forth by Fama and French (1993) suggesting that the risk factors may be a proxy for state variables which describe intertemporal variation in the investment opportunity set — recall the difficulty Fama-French exhibits with time-series data. Using Merton's risk-based Intertemporal-CAPM (ICAPM) as foundation, Petkova runs empirical tests of this theory. Indeed, her specification including variables for aggregate dividend yield and term spread, default spread, and one-month Treasury Bill yield explains the cross-section of average returns better than the Fama-French model.

8.12 Similarly, it has been argued that the Fama French additional factors simply proxy for value placed on higher moments of the returns distribution (noting again that CAPM considers only the first two moments — mean and variance — as significant).

8.13 Thus, it is necessary to take an element of precaution when interpreting Fama-French estimates.

RISK-STYLE Database for Fama French Estimation

8.14 Europe Economics has used the Fama-French variables estimates provided in the Exeter Enterprises Risk-Style database, TM RISK-STYLE. The database gives monthly estimates for the three factors, MRP, SMB, and HML, from July 1975 through December 2005. It is the only database known to us with UK estimates of the Fama French factors, and has also been used by the recent OXERA and Smither's & Co investigations.

8.15 The SMB and HML factors have been constructed following the approach to factor construction adopted for the US by Fama and French.[26] The "big versus small" cut off point has been set at the point where firms comprise a cumulative 80 per cent of market capitalisation, and the book-to-market cut offs were set in three lots — top 30 per cent of "high value", middle 40 per cent, and bottom 30 per cent of "growth". This produces six value-weighted portfolios on the risk factors (s/h, s/m, s/l; b/h, b/m, b/l). The HML and SMB factors include the universe of UK stocks for which market capitalisation, returns and book-to-market ratios can be constructed from any source.

8.16 The market risk premium is calculated as the difference between the monthly total return on FTSE All Share index and the monthly return on UK Treasury Bills. As discussed below, this seems to have been based on the last trading day of the month.

8.17 The estimates of the SMB and HML factors are presented in Table 8.1, based on the averages of annualised monthly data provided in the dataset.

Table 8.1: Fama French factors in the RISK-STYLE database

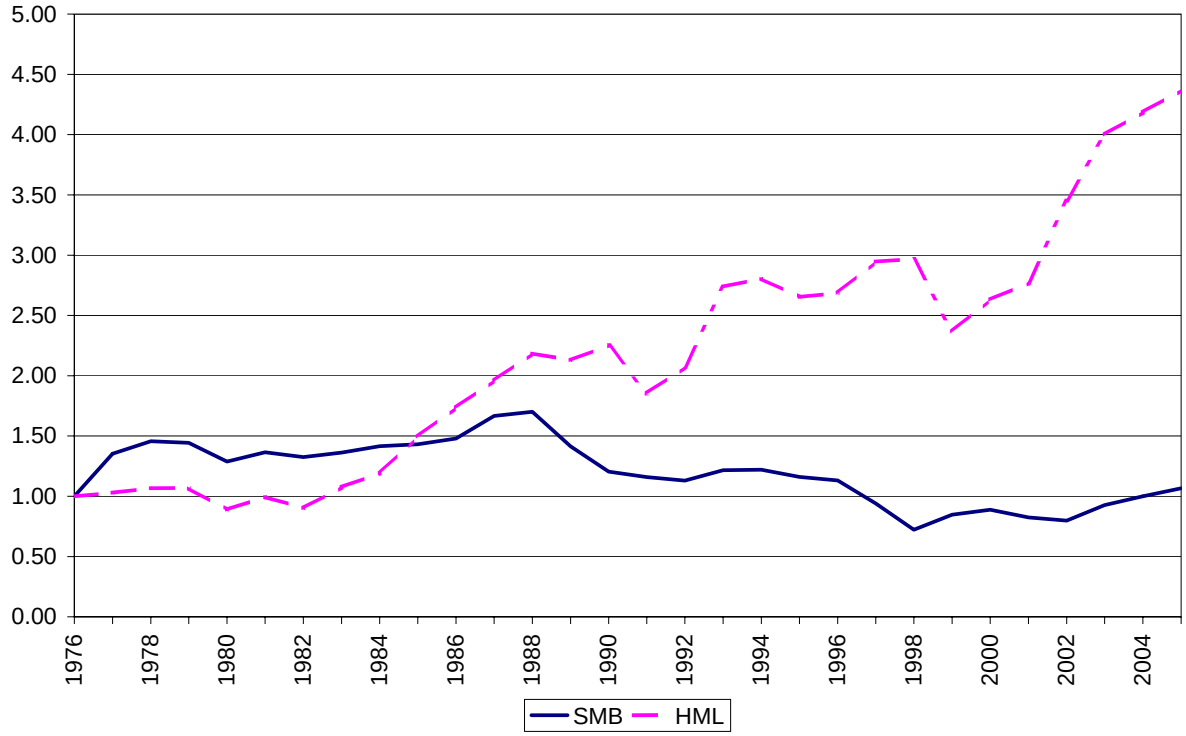
Period	SMB	HML
1975-80	5.5%	-0.4%
1981-85	2.2%	11.6%
1986-90	-2.7%	8.7%
1991-95	-0.6%	4.7%
1996-2000	-4.1%	0.5%
2001-05	4.0%	10.9%
1975-2005	0.7%	6.0%

Based on annualised averages in TM RISK-STYLE database

[26] Details of this can be found on: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

8.18 It is evident that both of the factors vary substantially through time. The premium on small companies seems particularly dependent on the period under consideration. Also, while the HML is positive in most periods, and namely from 2001 to 2005, it too shows considerable variation with the range of these annualised averages reaching zero in the period 1996-2000. The same can be seen in Chart 8.1 below, which shows the cumulative increase in SMB and HML factors over the sample period (with 1976 as the base year of 1). The SMB performance is around one, implying that even over the longer term small companies have not outperformed larger companies. The HML line is increasing as expected, though there is some irregularity in the annualised series.

Chart 8.1: Cumulative behaviour of the SMB and HML measures



8.19 Considering the variation evident in the data, it becomes relevant to ask how reliable statistically speaking have the measured SMB and HML factors been through the sample.[27] The thought behind the use of the factors is that they should always be positive, whereas, as evident from Table 1 and Chart 1, they have not been so in every year. The way of investigation is to calculate average of the monthly observations, including the confidence interval at the conventional levels of significance. Table 8.2 below shows the results for the different time periods — a "p-value" of 0.05 or less is

[27] As highlighted in Smither's & Co (2003) this sort of investigation is often omitted in application of Fama French. This includes their 2006 paper for Ofgem and the OXERA paper on behalf of BAA.

usually taken as a reliable indication of significant difference from zero, reported in the parenthesis.

Table 8.2: The average monthly Fama French factors

Period	SMB	HML
1975-80	0.40% (0.25)	0.07% (0.78)
1981-85	0.19% (0.42)	0.91% (0.01)
1986-90	-0.26% (0.39)	0.70% (0.00)
1991-95	-0.02% (0.95)	0.30% (0.30)
1996-2000	-0.39% (0.38)	0.07% (0.90)
2001-05	0.41% (0.50)	0.97% (0.14)
1975-2005	0.06% (0.70)	0.50% (0.00)

8.20 In contrast to the reasoning behind the use of Fama French, based on the monthly observations, the SMB factor is not significantly different from zero in any of the periods analysed. Also the HML factor is not significantly different from zero in some of the sub periods, and notably not in the period 2001-2005. This means that the variation in the monthly observations for both variables SMB and HML is large enough (and both positive and negative) that the average cannot be reliably said to be different from zero. This is consistent with the averages in the U.S. data, reported in Smither's & Co (2003), where the HML measure was found to be significant from 1964 to 2002, but more so in the beginning of the period, whereas the SMB was not found significant.[28]

8.21 The underlying factors, as measured in the RISK-STYLE database, meant to explain an additional risk factor on top of CAPM beta are themselves not reliably different from zero in the period under investigation for Supporting Paper XIII.

Fama French Estimation and Results

8.22 In addition to the data from the RISK-STYLE database, we require for the estimation data on the monthly total return on BAA equity during the period. We have such data from 1 January 2001 to 31 January 2006, as obtained for the purposes of the Supporting Paper XIII. We also have the FTSE All Share total returns index for the same period. Combining these with the available data on the Fama French factors, we are able to estimate the Fama French three-factor model for BAA from 2001 to 2005.

8.23 The monthly nature of the data raises some issues, namely:

(a) What day has been used as the basis for calculating the monthly return? Usually the convention is to use either the first day or the last day of the month. However, the

[28] Smither's & Co (2003), page 73, Table 3.2.

choice of the day could introduce significant differences in the estimation, which is one of the reasons why beta estimation on daily data is generally preferable.

(b) There are far fewer observations in a sample of monthly data to draw upon, therefore the model cannot be reliably estimated for shorter windows than three years (giving 36 observations).

8.24 Smithers & Co. also expressed concern that monthly data is less reliable than daily data, and that the two can give different Beta estimates.[29]

8.25 Finally, there is a choice to be made of how to measure to risk free rate used in the calculation of the excess returns. The market risk premium estimate in the RISK-STYLE database uses the monthly Treasury Bill return. The other alternative is using the monthly LIBOR return. We investigated the use of both risk free rates. The effect on the results, however, was minimal.

8.26 To recap, the model to be estimated, using the same Newey-West estimation as in Supporting Paper XIII, is:

$$r_E - r_f = \alpha + \beta_A (r_M - r_f) + s_A SMB + h_A HML + \varepsilon$$

Results

8.27 First we investigated whether the beginning of the month or end of month data had been used in the MRP of the RISK-STYLE database, by calculating the BAA total excess returns on both basis, estimating the model looking for consistency with the results when using the MRP measure used in the database. The results clearly indicated that at least the MRP in the RISK-STYLE database has been constructed with end of month data points. We therefore used measurements on end of month basis for all subsequent estimations.

8.28 Still, there was some, though very little, difference in the results between using the MRP from the database (titled “rmrf in the results below) and the FTSE All Share excess return calculated by Europe Economics. The results over the whole sample of available BAA total returns data, from 2001 to 2005, using the RISK-STYLE MRP are shown below.

[29] Wright, Stephen, et al “Report on the cost of capital provided to Ofgem” Smithers & Co Ltd. (2006) London

```
. newey  baate rm smb hml, lag(3)

Regression with Newey-West standard errors          Number of obs  =        59
maximum lag: 3                                      F(  3,    55)  =      3.28
                                                    Prob > F       =    0.0276

------------------------------------------------------------------------------
             |             Newey-West
       baate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        rmrf |   .5795851   .1963683     2.95   0.005     .1860543    .9731159
         smb |  -.0594893    .173684    -0.34   0.733    -.4075599    .2885813
         hml |   .1273093   .1035336     1.23   0.224    -.0801768    .3347954
        cons |   .0012053   .0054436     0.22   0.826    -.0097039    .0121145
------------------------------------------------------------------------------
```

Source: Europe Economics estimation on data from RISK-STYLE database and Thomson Financial

8.29 The same using the MRP calculated by Europe Economics, as the total excess return on FTSE All Share index:

```
. newey  baate ftsete smb hml, lag(3)

Regression with Newey-West standard errors          Number of obs  =        59
maximum lag: 3                                      F(  3,    55)  =      3.55
                                                    Prob > F       =    0.0202

------------------------------------------------------------------------------
             |             Newey-West
       baate |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ftsete |   .5809818   .1890105     3.07   0.003     .2021963    .9597672
         smb |  -.0638394   .1744233    -0.37   0.716    -.4133914    .2857127
         hml |   .1252042   .1025061     1.22   0.227    -.0802226    .3306311
        cons |   .0011124   .0054035     0.21   0.838    -.0097164    .0119413
------------------------------------------------------------------------------
```

Source: Europe Economics estimation on data from RISK-STYLE database and Thomson Financial

8.30 The coefficients of the variables are given in the second column and can be interpreted similarly to the CAPM beta — they are the scaling coefficients of the company relative to the market averages. The fifth column gives the p-value of the coefficient Again, a p-value of 0.05 or less is usually taken as indication that the coefficient is significantly different from zero. The same can also be inferred from the last two columns, which give the 95 per cent confidence interval for the point estimate of the coefficient (if it includes zero, the estimate cannot be distinguished from zero by the estimation).

8.31 As illustration only, the implied cost of equity for BAA group from the above estimates for the 2001-2005 period is 4.7 per cent, post tax (2 + 0.6 * 4.5).

8.32 We should note straight away that over the period from January 2001 to December 2005 the Fama French factors are not significantly different from zero — they do not hold significant explanatory power over the BAA group equity returns. The constant also is zero, as expected. The coefficient on the SMB factor is -0.6 and on the HML factor is

0.13. However, as the p-value indicates they cannot be statistically distinguished from zero.[30]

8.33 Notably, the coefficient on the market return above is lower than the CAPM beta estimates for based on daily data in Supporting Paper XIII. This is likely to be due to the monthly nature of the data used: The CAPM beta (leaving out the Fama French factors) is also in the same region using the month end measurement of monthly returns. However, using the first trading day of the different months as the basis of measurement of the monthly returns produces higher CAPM beta estimates for the period, in the region of 0.8. Also, the confidence intervals around these monthly estimates are much wider, and indeed include the CAPM beta estimate in Supporting Paper XIII.

8.34 We further investigated the significance of the Fama French factors over sub periods in the available sample. The method employed was to rolling monthly estimation based on the previous three years of monthly data. This gives us 36 observations per estimation, which results in degrees of freedom just above the generally accepted minimum for reliable estimates. This allows us to report the rolling estimates from December 2003 onwards.

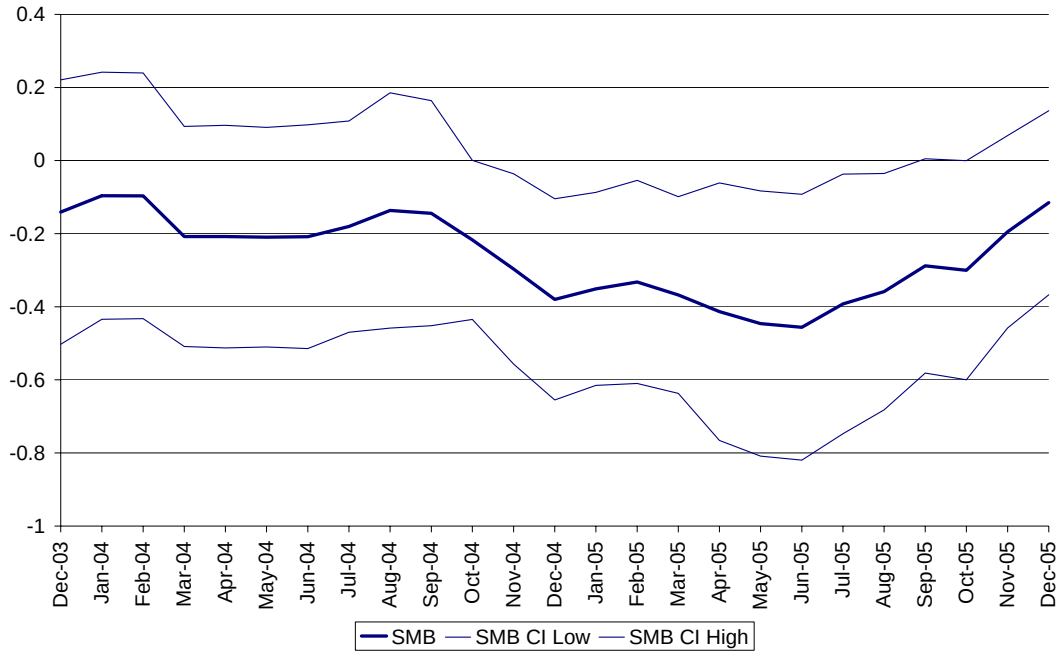
8.35 The HML factor was not significant in any of the sub periods estimated. Perhaps surprisingly, the SMB factor is found weakly (at the 10 per cent level) significant in the some of the sub periods, namely for the three year rolling estimates from November 2004 to August 2005. In all those periods, however, the coefficient on the SMB factor is negative, which, with positive average observation of SMB over the period, would imply that BAA cost of equity is *lower* than that estimated by one factor model such as CAPM.

8.36 Charts 8.2 and 8.3 below show the rolling estimates of the SMB and HML coefficients from December 2003 respectively, with a 90 per cent confidence interval around the point estimate. The variation in the estimates is evident.[31] Chart 2 shows the period in which the SMB coefficient is estimated to be weakly significant, roughly from October 2004 to September 2005.

[30] Were the HML factor statistically significant with the estimated coefficient, this would imply, using the average HML for the period, an increase of 0.13*10.9 = 1.4 per cent increase in the post tax cost of equity. This addition, however, is not relevant, given the clear insignificance of the estimates.

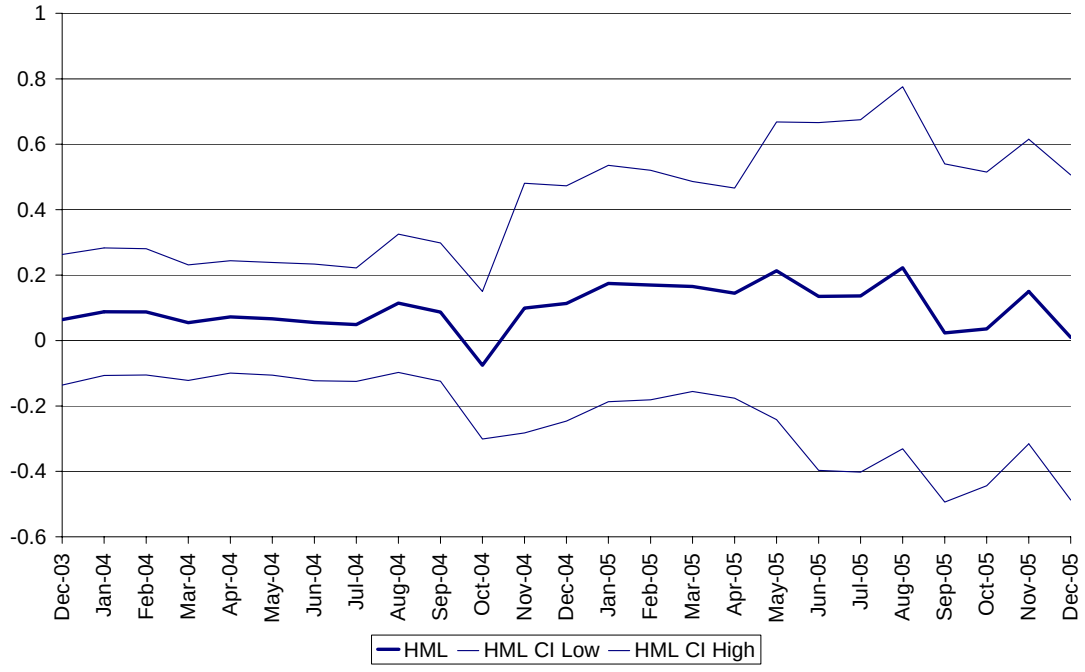
[31] As a further sensitivity check, we investigated the differences in the coefficient estimates based on using LIBOR and TB as the risk free rate, and also using the RISK-STYLE market risk premium and the Europe Economics calculated market risk premium (resulting in four permutations). The results between the permutations are very similar.

Chart 2: Rolling three year SMB coefficient estimates for BAA



Source: Europe Economics estimation on data from RISK-STYLE database and Thomson Financial

Chart 3: Rolling three year HML coefficient estimates for BAA



Source: Europe Economics estimation on data from RISK-STYLE database and Thomson Financial

8.37 The estimation has been carried out on monthly data. If daily data becomes available in the future, the reliability of the estimates might improve. Also, we have estimated the model using data from January 2001 to December 2005 for the equity return of a single company. Using different time periods could produce different results, as might cross sectional analysis of portfolios of securities.

Previous Evidence on Fama French

8.38 Two previous reports that used Fama French estimates in identifying cost of capital include a report by Oxera and one by Smithers & Co.

8.39 The OXERA report describes the dataset used with the following averages of annualised monthly figures.

Table 8.3: OXERA average for MRP, SMB, and HML factors, 1975-2005 (%)

Period	**MRP**	**SMB**	**HML**
1975-80	13.5	7.0	3.6
1980-85	12.4	0.8	8.0
1985-90	10.0	-0.8	7.8
1990-95	4.7	-2.3	6.0
1995-2000	11.1	-4.0	-2.9
2000-05	-3.5	4.3	13.3
1975-2005	**7.9**	**0.8**	**5.9**

Note: Averages are based on annualised monthly data.

Sources: TM RISK-STYLE Database, Datastream and Oxera calculations.

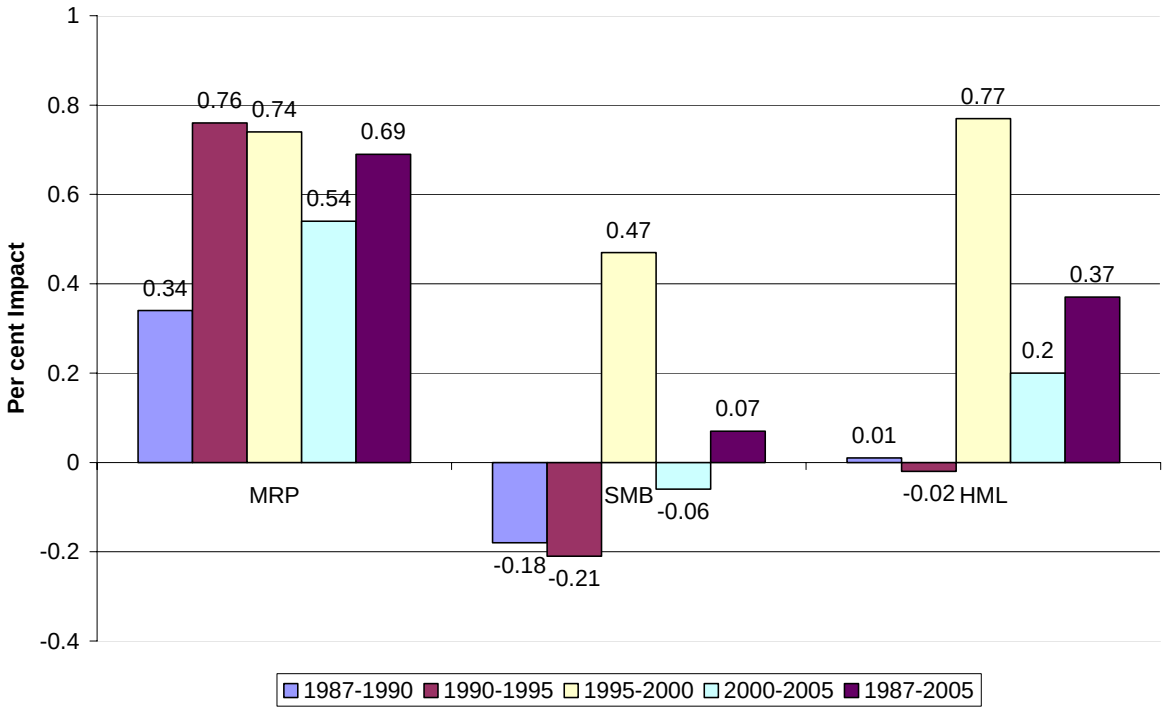
8.40 This data description, though of the same dataset, does not match the description drawn in Table 8.1 above. For example, we were not able to draw an average HML factor of 13.3 per cent from the dataset with any of the various slightly different methods of averaging — the figures for that period, based on the annualised data provided in the database, are always in the region of 11 per cent. It is possible that the data has been updated or re-estimated since the OXERA description was produced.

8.41 The overall conclusions of the description by OXERA, however, are in line with our own — the SMB factor has not had a consistent impact, whereas the HML has been somewhat more consistent. Neither OXERA nor Smither's & Co (2006) report on investigation of the significance of the SMB and HML factors through time, as done in Table 8.2 above.

8.42 The estimation results of Smither's & Co (2006) are consistent with our results above, whereas the OXERA results on BAA are not necessarily so.

8.43 OXERA finds that the most important factor is MRP, that SMB has negligible impact, but the HML factor is relatively important, at 0.37 from 1987 to 2005. Furthermore, only the MRP and HML terms are significant. See chart 8.4 below.

Chart 8.4: OXERA MRP, SMB and HML factor loadings for BAA since 1987



Sources: TM RISK-STYLE Database, Datastream and Oxera Calculations.

8.44 The finding of significance on the HML factor is in contrast with our finding of consistent non-significance. OXERA, however, has used a longer timer period overall for the estimation — from 1987 to 2005 — which could be the cause of this difference. Our estimation period was limited to 2001–2005 due to data, and for consistency with the equity beta estimation in Supporting Paper XIII. OXERA does not report during which sub-period the factor was found significant, and during which it was not (if any). Inspection of the above chart would suggest that the most likely candidate period of particular significance is from 1995 to 2000. Also we note that although OXERA put the final estimates at 0.69, 0.07, and 0.37 for MRP, SMB and HML respectively, we observe a very large variation in the estimates of the two additional Fama-French factors, pointing at (admittedly) unstable estimates over time.

8.45 Smither's & Co (2006) report significant coefficients on the Fama French factors for five out of nine companies in their sample, as replicated Table 8.4 below. Finding of non-significance of the factors on any one company, such as BAA, is therefore consistent with their results.

Table 8.4: Smithers & Co. Fama-French factor Betas

Firm	MRP (CAPM)	MRP	SMB	HML
SPW	0.78*	0.75*	-0.08	0.39*
		(0.00)	(0.63)	(0.02)
SSE	0.68*	0.65*	0.04	0.43*
		(0.00)	(0.84)	(0.01)
VRD	0.42*	0.41	-0.25	-0.11
		(0.01)	(0.15)	(0.49)
CEN	0.80*	0.80*	-0.22	-0.12
		(0.00)	(0.19)	(0.43)
IPR	2.15*	2.13*	0.05	0.24
		(0.00)	(0.85)	(0.25)
NGT	0.57*	0.57*	-0.43*	0.04
		(0.00)	(0.00)	(0.73)
UU	0.56*	0.56*	-0.10	0.22*
		(0.00)	(0.38)	(0.05)
KEL	0.55*	0.55*	-0.09	0.31*
		(0.00)	(0.55)	(0.02)
SVT	0.44*	0.44*	-0.09	0.29*
		(0.00)	(0.55)	(0.02)

Note: CAPM MRP estimation uses OLS. Fama French factors use seemingly unrelated regression estimates. Figures in brackets show "p-values"; i.e., the probability that the relevant coefficient is zero. Starred coefficients indicate p-values less than or equal to 0.05.

Source: Smithers & Co. (2006)

8.46 Smithers & Co. note that, while all of the market return betas are significant, few of the Fama-French factors are. Furthermore, when comparing Fama French MRPs to CAPM market beta estimates, the differences are small. Smithers & Co. note two possible reasons for this: first, the database uses monthly data; second, multifactor models that provide evidence in support of Fama French typically use a portfolio of many stocks.

8.47 Smithers & Co. argue further that there is weak statistical evidence to support the existence of risk premia associated with the two Fama-French factors. They argue, using data from FT All Share from the last thirty years, that the size factor tracks essentially no recognizable risk premium. Furthermore, they argue against the book-to-market factor as well, claiming that the pattern of an associated risk premium is statistically weak, and that the relationship would have been less evident had the report been written at another point in time. As evidence in support of this, they show that the segment of the book-to-market trend line is on the decrease during the time period around 1980. This is consistent with the discussion surrounding Table 8.2 above.

Effect of Catastrophic Risk

8.48 BAA has in its response argued that catastrophic risk faced by BAA is ignored by the CAA's Initial Proposals.

Effect of Catastrophic risk — Theory

8.49 Catastrophic events occur at a low frequency, but can have a major impact on BAA's business, as demonstrated for example by Figure A1.1 in Appendix 1 of the BAA response depicting passenger volume changes. BAA argues that the risks manifest themselves in two measures of which CAA should take account: volume forecasts and systematic risk. Here we consider the latter — categorisation of catastrophic risks as systematic, and their possible effect on the cost of capital.[32]

8.50 It is possible that catastrophic risks have a systematic component to the extent that the events affect "the market" as a whole. 11 September 2001 is a good example of this — markets as a whole fell substantially, and the stocks related to aviation particularly so. Therefore, these risks could at least in part be considered systematic.

8.51 In thinking about the effect on cost of capital of a company we must recognise that what matters are the market expectations of a) the probability of a catastrophic event, and b) the effect that event will have on the airports relative to the market as a whole. For example, after a particular catastrophic risk event the market is able to observe the effect that event had on the airports, and adjusts expectations about the effect of future catastrophes accordingly. As expectations adjust, the cost of capital of airports could even fall a) the businesses are shown to be more robust to catastrophic type events, or if b) the extent to which the events affect the market as a whole is reduced.

8.52 The question of the effect of catastrophic risk on the cost of capital of the airports is therefore an empirical one.

Effect of Catastrophic risk — Evidence

8.53 Catastrophic events typically occur with low frequency but can have a high impact. Figure A1.1of the BAA response shows an apparent impact of recent shock events on passenger volumes of the BAA South East airports. BAA response further argues that:[33]

> …CAA's approach to systematic risk is unlikely to provide adequate remunerations for several reasons. First, since betas proposed by the CAA are estimated on the basis of historical data, they are unlikely to be an accurate reflection of future catastrophic risk. Second, catastrophic events are relatively infrequent, and the period being analysed may underestimate the true beta if it does not include a catastrophic event. Moreover, the

[32] In addition, there could also be effects on operational and security costs due to new requirements, but these do not fall under cost of capital, and as such are not considered here.

[33] BAA response to CAA initial proposals, Appendix 1, paragraph 56.

> asymmetry (skewness) of catastrophic risk may have an additional impact not captured by the CAPM…

8.54 First, it is true that historical evidence is not a perfect predictor of the future. This is however a criticism that can be applied to many parts of the price determination process and to empirical estimation in general. Predictions based on historical data are often the best one can do. The reliability of the past as a predictor of future can also be judged from the consistency of the historical evidence as balanced against reasons why the future might be different.

8.55 Second, the period of estimation does include several catastrophic events. For example Figure A1.1 in BAA response highlights the September 2001 attacks, the March 2003 start of the Iraq war and July 2005 London bombing. In addition, the SARS scare occurred in 2003 and 2004. As BAA states, investors *are* acutely aware of these risks.[34]

8.56 The effect of these catastrophic risk events on the BAA group beta, if any, can be read in Chart 2.2 of the Supporting Paper XIII, showing rolling daily two-year betas from 1 January 2003. The daily nature of the data used means that impact events such as 11 September 2001 are captured in the estimation. The evidence in Chart 2.2 shows only a marginal and temporary impact of 11 September 2001 attacks on the BAA group equity beta, and no discernible upward impact of the other several events within the period.

8.57 The data therefore consistently show no lasting upwards effect on the BAA group equity beta resulting from the several catastrophic events in the past, including 11 September 2001.

8.58 It is true that CAPM does not reflect possible asymmetry of risks. For this reason Supporting Paper XIII investigated the use of an augmented model, so called Third Moment CAPM. However, as explained in the paper, it was decided not to proceed further with the investigation of the model at this stage due to remaining theoretical and practical uncertainties.

Conclusions

Fama French

8.59 The purpose of this section was to investigate the evidence on Fama French models as it could relate to BAA in the Q5 price review. The model had been kept in reserve, but need had arisen to investigate the evidence arising from the model in more detail, and to advise CAA whether and how to use it in the Q5 review.

8.60 The results of the investigation are not encouraging for the use of the Fama French model in regulatory price review setting.

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[34] BAA response, Appendix 1, paragraph 53.

8.61 First, as discussed on previous occasions, the Fama French model is based on empirically observed relationship in portfolios of assets. Without a fully established theoretical foundation behind it, it is difficult to predict for certain how the factors would translate to the required returns on equity of particular companies, especially through a five-year price review period. It is also not clear what exactly the measured effects, if significant, are indicators of.

8.62 Second, the additional risk factors themselves vary considerably and on average are not significantly different from zero, particularly in the later part of the available sample (Table 2).

8.63 Third, the estimated coefficients on the SMB and HML for the period 2001-2005 varied considerably within the period, and were not significant overall. This is consistent with the evidence in Smither's & Co (2006), but in contrast with the OXERA paper on behalf of BAA. The reason for this could be the potentially different estimation windows (OXERA conclusion might be based on the whole period 1987-2005), and possible revisions in the data since OXERA estimation as indicated by the by the different average SMB and HML factors drawn for the same period in the time by OXERA and Europe Economics.

8.64 Nevertheless, the results indicate non-reliability of the Fama French through time and when applied to a single stock, as opposed to a portfolio of stocks in cross-sectional estimation — an area where the model has proved more reliable in the literature. Given that the Fama French model is based on purely statistical relationship, the absence of statistical significance means that for BAA the factors are not significant and do not warrant further consideration as additions to the cost of capital.

8.65 These empirical results reinforce our previous position that it would be inappropriate to use the Fama French model as a tool for regulatory price determination, at least for the time being. Certainly, the empirical results here and elsewhere imply that it would not be likely to produce consistent regulatory decisions through time.

8.66 We therefore recommend that CAA refer to the investigation in this note as consideration of the use and evidence of the Fama French three factor model with regard to BAA cost of equity, but does not change its cost of capital recommendations based on it, for the conceptual reasons discussed previously and the empirical reasons discussed throughout this note.

Catastrophic events

8.67 The risk of terrorists and catastrophic events could in principle increase the cost of capital of the BAA airports. Indeed, this was one of the Competition Commission's stated reasons in the Q4 determination for adding an additional buffer to the equity beta estimate used.

8.68 As also argued in Supporting Paper XIII to the initial proposals, we can now observe the effect that previous terrorist attacks and other catastrophic events have had on the BAA beta. The evidence, in Supporting Paper XIII, shows that the beta has been quite stable

throughout the estimation period, and in particular has not increased. The estimation period includes several such "catastrophic" events.

8.69 We conclude that investors are indeed aware of the risks of terrorist attacks or other catastrophes on BAA's business. Investors have also been able to observe the effect of such catastrophes, such that the developed expectations would be reflected in the beta estimates. However, the several past catastrophic risk events that were in the data set used for the empirical work have not increased BAA beta significantly. We have no basis to assume that the (lack of) effect on cost of capital would be different for events during the Q5 period.