

Cost of capital

Introduction

1. This appendix sets out our analysis of the cost of capital. It begins with an overview of our methodology and a summary of the proposals that were put to us by interested parties. The subsequent sections set out our position on the individual parameters in the calculation and our approach to choosing a single point estimate from the range that emerges from our analysis.
2. We have estimated the cost of capital for a stand-alone Stansted, based on an augmented building block price-cap-setting mechanism. If the price cap was set using a different mechanism, the cost of capital we have estimated may not be appropriate.

Approach

Weighted average cost of capital and the capital asset pricing model

3. As in previous inquiries, the return that we have allowed, when calculating the price cap that should apply at Stansted, is based on a forward-looking estimate of the airport's cost of capital. The cost of capital is a weighted average of two components: the cost of equity (K_e); and the cost of debt (K_d), where the weightings (gearing or g) reflect the relative importance of each type of financing in a firm's capital structure.

Equation 1: WACC

$$WACC = K_d \cdot g + K_e \cdot (1 - g)$$

4. The cost of debt is directly measurable for many firms in the UK economy, and in the analysis that follows we explain how we have used empirical evidence to benchmark the appropriate values for K_d for Stansted. The cost of equity, by contrast, cannot be directly observed and we have instead modelled the returns that we would expect a shareholder to demand in exchange for holding shares in the airport. The primary tool that we have used in our analysis is the CAPM, which relates the cost of equity to the risk-free rate (R_f), the expected return on the market portfolio (R_m), and a firm-specific measure of investors' exposure to systematic risk (beta or β):

Equation 2: Cost of equity (K_e) under CAPM

$$K_e = R_f + \beta \cdot (R_m - R_f)$$

5. Equations 1 and 2 together show that our cost of capital calculations are based on our estimates of five parameters: g , K_d , R_f , R_m and beta. In this review we have been fortunate in that we have been able to draw on a substantial body of evidence compiled during the 2007 Heathrow and Gatwick review to help us estimate these parameters. In addition, we have also been careful to consider the ways in which Stansted's risk profile is different from the other London airports and to take account of the changes that have occurred in world financial markets since August 2007 and which continue to provide a challenging background both for companies raising capital and regulators attempting to measure their cost of capital.

6. We were assisted in our work by the CC's Cost of Capital Panel. The Panel comprises seven of the CC's members, five of whom were not themselves part of the Stansted review group, who brought academic or practical understanding of the workings of debt and equity markets. During the course of the review we asked the Panel to investigate a number of issues of principle and to give us their views on the values of each cost of capital parameter. The advice that we received is reflected in much of the discussion that follows; however, the conclusions are those of the Stansted review group alone.

Split cost of capital

7. The only new methodological issue that we considered in this review was the concept of a split cost of capital as recently developed by Professor Dieter Helm of the University of Oxford. Professor Helm had last year been critical of our decision to use a single rate of return in the calculation of price caps for Heathrow and Gatwick airports,¹ arguing that it is better for a regulator to apply different rates of return to the RAB and to ongoing opex and capex. His proposition, in its original form, is that a regulated income stream combines two very different types of cash flow:²
 - (a) the return of and on the RAB, where risk is (very) low so long as the regulator commits to including the costs of historical investment in future price controls; and
 - (b) payment for ongoing opex and capex, where risks are considerably higher.
8. In Professor Helm's view the RAB has a low cost of capital and the capex and opex have a high cost of capital, and these distinct costs of capital should be reflected in a regulator's price cap calculations via a split rate of return.³
9. Members of the CC's Cost of Capital Panel met with Professor Helm during our review to make sure that they had properly understood Professor Helm's ideas and to discuss with him some of the questions that they had about his proposals. The main difficulty that they had with the split cost of capital framework was the idea that Stansted's revenues could somehow be separated into two component parts with very different risk profiles. In practice, airlines pay one set of regulated charges, capped according to a formula set by the CAA, and an airport delivers one overall profit to one set of investors—a return that, by definition, varies according to all the risk factors that Professor Helm has identified.
10. This regulatory design means that the return that investors earn on historical investment (as reflected in the RAB) is inextricably linked to the demand at the airport, the cost of operating, maintaining and renewing built assets, and the ongoing service quality provided to customers. The convention of using the RAB as an input into the calculation of price caps gives investors the opportunity to recoup their investments, but deliberately puts that return at risk (ie it is conditional upon the efficient and competent operation of the assets that are built). As such, it is entirely conceivable (and, indeed, desirable) that the actual return on the RAB will turn out to be higher or lower than the expected return seen in the WACC x RAB calculation.

¹Helm (2007), *How Not to Regulate Airports: BAA, the Competition Commission and Regulatory Reform*.

²A fuller description of Professor Helm's split cost of capital proposition can be found in Helm (2006), *Split Cost of Capital, Indexed Cost of Debt and Longer Periods: A Reply to Critics*.

³In subsequent papers, Professor Helm has gone on to argue that the opex/capex activities should be put to competitive tender. This proposition is beyond the scope of this review and we do not consider it further.

11. Professor Helm was not able to persuade Panel members that the return of and on Stansted's RAB is somehow 'safe' and capable of being disentangled from an airport's performance against its price cap, or that the financiers of historical investment included in the RAB would not see the value of their capital increase or diminish in line with the fortunes of the regulated business. As a consequence, it was not appropriate for us to use a split cost of capital in this review.
12. The analysis that follows is for a single rate of return which is to be applied to both the existing RAB and new capex.

Views of interested parties

13. The only party to provide us with a substantial submission on the cost of capital was BAA, which submitted a report prepared by the economic consultants Oxera. The report contained two scenarios for the cost of capital at Stansted under a standard RAB-based price cap:⁴
 - (a) one which used our September 2007 estimates of Heathrow's and Gatwick's asset betas to act as anchors for the estimate of Stansted's asset beta (the base case); and
 - (b) the other in which Stansted's asset beta was not constrained by our Heathrow and Gatwick analysis and could instead be anchored to Oxera's original May 2007 estimates of the Heathrow and Gatwick betas (the alternative case).
14. Table 1 sets out the individual parameters that BAA proposed we should use.
15. The CAA told us that its March 2008 price cap decision document for Heathrow and Gatwick contained the CAA's latest thinking on the generic inputs into the cost of capital calculations. The CAA also referred us to the evidence submitted to us last year on the relative riskiness of Heathrow, Gatwick and Stansted, which the CAA said it would be reviewing when it had received our price control recommendations from this review.
16. For ease of comparison, Table 1 puts BAA's submission alongside the cost of capital assumptions used by the CAA and us in our respective Heathrow and Gatwick price cap calculations, as well as our Q4 recommendations for Stansted.

⁴Oxera's report also contained a third scenario relating to the cost of capital under a market-led price cap. Because we have decided not to adopt this form of price control approach, we do not consider this scenario in this appendix.

TABLE 1 The components of the WACC: estimates provided by BAA compared with earlier CAA and CC analysis

	<i>per cent</i>									
	<i>BAA proposals for Stansted</i>				<i>CC Q4 Stansted</i>		<i>CAA/CC Q5 Heathrow/Gatwick</i>			
	<i>Base case</i>		<i>Alternative case</i>		<i>Low</i>	<i>High</i>	<i>Heathrow</i>		<i>Gatwick</i>	
<i>Low</i>	<i>High</i>	<i>Low</i>	<i>High</i>	<i>High</i>			<i>High</i>	<i>Low</i>	<i>High</i>	
Gearing	50	50	50	50	30	30	60	60	60	60
Pre-tax cost of debt	3.39	4.30	3.39	4.30	3.40	3.95	3.55	3.55	3.55	3.55
Risk-free rate	1.75	2.25	1.75	2.25	2.5	2.75	2.5	2.5	2.5	2.5
Equity-risk premium	3.5	5.5	3.5	5.5	2.5	4.5	2.5	4.5	2.5	4.5
Implied R _m	5.25	7.75	5.25	7.75	5.0	7.25	5.0	7.0	5.0	7.0
Asset beta (number)	0.68	0.73	0.80	0.96	0.8	1.0	0.42	0.52	0.46	0.58
Debt beta (number)	0.10	0.13	0.10	0.13			0.1	0.1	0.1	0.1
Equity beta (number)	1.26	1.33	1.50	1.79			0.90	1.15	1.00	1.30
Post-tax cost of equity	6.16	9.57	7.00	12.10	4.5	7.25	4.75	7.68	5.00	8.35
Corporation tax rate	28	28	28	28	30	30	28	28	28	28
Pre-tax cost of equity	8.56	13.28	9.72	16.80	6.43	10.36	6.60	10.66	6.94	11.60
Pre-tax, real WACC	5.97	8.79	6.56	10.55	5.67	8.76	4.77	6.39	4.91	6.77
Point estimate		7.38		8.55		7.75		6.2		6.5

Source: BAA/Oxera submission; CC Q4 recommendations; CC Q5 recommendations for Heathrow and Gatwick.

Note: During the course of our review, Oxera told us that recent market movements suggested to them that certain of the estimates shown in Table 1 could be too low, most notably the cost of debt, the risk-free rate and beta assumptions. To account for recent market developments, BAA told us that we should either use the high end of its estimates for the individual components or take a point estimate from the range at or above the 85th percentile.

17. The key points to note from Table 1 are as follows:

- (a) BAA/Oxera's estimates of the gearing, the cost of debt, the market return (ie the risk-free rate plus the equity-risk premium), debt beta and the tax wedge adjustment were all fairly close to the assumptions made by the CAA and us in our cost of capital analysis for Heathrow and Gatwick, although we noted that BAA/Oxera's estimates of the high end of the range for the market return and the cost of debt for Stansted were above our Heathrow and Gatwick recommendations.
- (b) This left the estimate of Stansted's asset beta as the key driver of the differences between BAA/Oxera's cost of capital assessment and the figures of 6.2 per cent and 6.5 per cent used by the CAA and us for Heathrow and Gatwick.
- (c) The question of whether to anchor the Stansted asset beta against the Heathrow and Gatwick beta estimates from the 2007 review was clearly a crucial one. The table shows that BAA/Oxera's alternative case produced a cost of capital which was more than 100 basis points higher than the BAA/Oxera base case.

18. This provided the context for the work that we conducted in this review. We now discuss each of the individual components of the calculation in turn.

Gearing (g)

19. Assumptions about gearing affect directly the weightings of the cost of debt and cost of equity components of the weighted average cost of capital calculation. They are also important inputs to the calculation of the cost of debt and cost of equity themselves as, all other things being equal, a higher level of gearing will increase the risk to both debt and equity holders, causing them to demand a higher return in exchange for making capital available.

20. Our assumption about gearing was formulated in two steps:

- (a) first, we considered what an appropriate credit rating was for a stand-alone business with Stansted's characteristics; and
- (b) second, we sought to assess what level of gearing is likely to be compatible with that rating.

Credit quality

- 21. In the Heathrow and Gatwick review we took the view that the return set by the CAA should enable the airports to obtain ratings of Baa1/BBB+. In coming to this decision we weighed a number of different considerations, including:
 - (a) the need for a buffer in the airports' financial profile to help them absorb downside shocks;
 - (b) the requirement that the airports should have ongoing access to new debt finance throughout the five-year control period; and
 - (c) the possible threat to investment that could arise from targeting a very low rating.
- 22. All these considerations applied equally to Stansted, and once again justified the targeting of a credit rating that is comfortably within investment grade.
- 23. The question that we focused on was whether a rating of Baa1/BBB+ was sufficient for Stansted in current market conditions and having regard to Stansted's business profile. There were two factors that gave us cause to target a slightly higher rating in this review:
 - (a) The first was the turbulence that has affected financial markets since mid-2007. We heard during the course of the review that companies with BBB category ratings have still, at least up until recent weeks, been able to raise new debt finance if they are prepared to meet lenders' demands on price, but must plan more carefully the timing of new issuance and will typically need to access both the bond and bank markets. By contrast, companies with A category ratings appeared to have been less affected by the credit crunch and are better placed to raise new capital at a reasonable cost. Given that there was an inevitable degree of uncertainty about the way that debt market conditions will evolve in the coming years, this suggested to us that an efficiently financed company might seek to target an A3/A- rating in the current market climate.
 - (b) The second was the riskiness of Stansted relative to Heathrow and Gatwick. In subsequent sections we show that Stansted is the riskiest of BAA's London airports, primarily because it has experienced greater volatility in traffic levels. This means that downside events, when they occur, have the potential to affect Stansted's finances much more than at Heathrow and Gatwick, and can also be expected to impact more quickly and more severely upon Stansted's rating. All other things being equal, this indicated that there would be merit in allowing for a slightly greater amount of headroom in Stansted's financial profile (notwithstanding the fact that rating agencies will also demand stronger credit metrics in exchange for any given rating).
- 24. A regulator's choice of credit rating can never be entirely scientific. We had to make a judgement about the choice that would be made by an efficient airport company looking to act in the interests of both current and future customers—a judgement that was inevitably subjective. In light of the first of the factors identified above, our view at this time and for this specific airport only was that it was more comfortable for

Stansted to have an A category rating during Q5. We therefore factored an A3/A– rating into all of our subsequent calculations.

The relationship between credit rating and gearing

25. We met with the three main rating agencies in order to understand better what level of gearing (and other financial ratios) they would consider to be consistent with our chosen rating.
26. During our Heathrow and Gatwick review, we had been told that the London airports as a group would most likely be rated one notch lower than a water company that exhibited the same financial profile and was using the same structure to raise debt. In this review, the rating agencies that were willing to express an opinion told us that Stansted could be rated up to a further two notches lower than Heathrow and Gatwick on the grounds that it was the riskiest of the three London airports.
27. We have been able to use guideline financial ratios published by the rating agencies to help us understand what this means for gearing.⁵ Importantly, these guidelines give an indication of the ratios that a rating agency would normally consider to be consistent with a particular rating but do not in themselves define a company's rating —as the rating agencies stressed to us when we spoke to them.
28. This meant that there was some judgement to be applied on our part when interpreting the rating agencies' evidence. As in the Heathrow/Gatwick review, we did not want to use a figure that was too low because this would result in higher price caps than were necessary and benefit shareholders at the expense of customers. However, we also did not want to use a figure that was so high as to make the price control package as a whole unfinanceable or which in itself signalled to the airport that it ought to gear up.
29. Our judgement was that a figure for gearing of 50 per cent was consistent with the evidence given to us by the rating agencies and struck a reasonable balance between setting a figure that was too high or too low. We show in Section 12 of the main report that other financial ratios at this level of gearing are also consistent with an A3/A– rating, giving internal consistency to our price cap calculations.

Cost of debt (K_d)

30. The risk that a company will default on its debt is the single most important consideration for lenders when determining the rate of interest. In the Heathrow and Gatwick review, this important feature of the debt market enabled us to benchmark the airports' cost of debt against the cost of debt obtained by firms with the same credit rating. We considered it appropriate to use the same approach for Stansted.
31. Our calculations contained three components:
 - (a) the interest that a stand-alone Stansted will pay on floating-rate debt and new debt to be issued during Q5;
 - (b) the interest payable on fixed-rate debt (which does not vary over time); and
 - (c) fees paid to lenders, rating agencies and arrangers of finance.

⁵Moody's (2008), *Moody's Global Corporate Finance, Rating Methodology, Operational Airports outside of the United States*, May 2008.

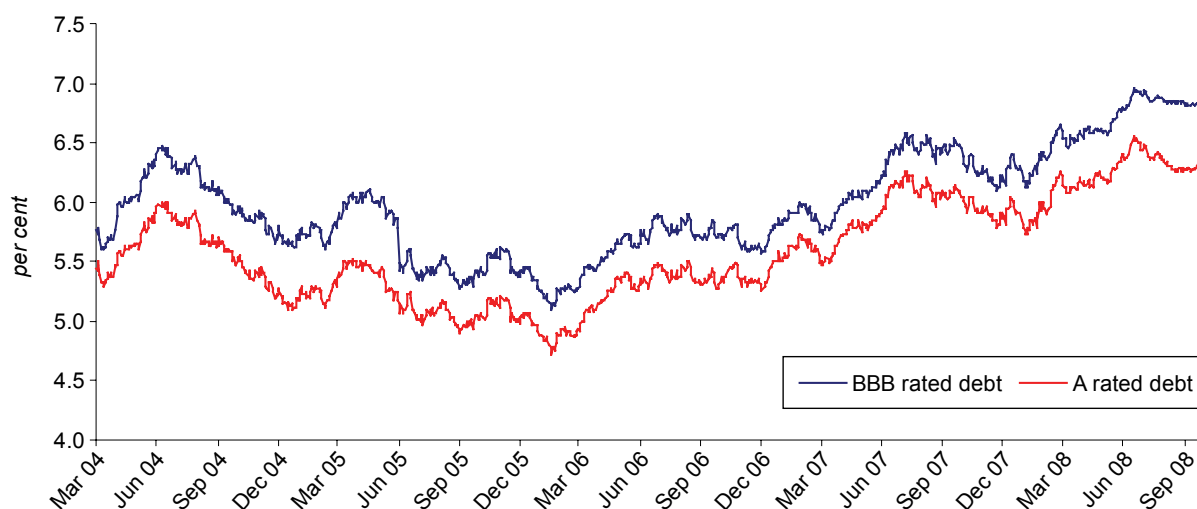
32. For the avoidance of doubt, we tried in our analysis to estimate the costs that would be incurred by an efficiently financed airport and not the costs paid by Stansted's existing owner (which, among other things, reflect lower credit quality and a range of acquisition-related costs). However, this did not mean that we ignored BAA's financing completely. As the largest issuer of UK airport-backed debt, we thought that it was important that we should take account of aspects of BAA's financing costs when it could be shown that the company had raised debt finance in a broadly efficient manner. Not all of BAA's financing passed this test, but we had no hesitation about referring to debt that did.

Cost of existing floating-rate debt and new debt to be issued in Q5

33. Benchmarks for the cost of new and floating-rate debt can be obtained from the secondary market for existing debt instruments and from the rates seen in recent issuance by comparable companies.
34. Figure 1 presents data from secondary markets for debt with A and BBB category ratings. The key feature of the chart is the increase in the cost of debt since our 2007 Heathrow and Gatwick review, with a company with an A3/A- rating currently paying around 6.5 to 6.8 per cent a year in interest, compared with around 6.2 per cent one year ago.

FIGURE 1

Secondary market yields on A and BBB rated debt



Source: Datastream.

35. The benchmark in Figure 1 is for corporate issuers in general. Table 2 contains evidence which indicates that regulated companies have been able to issue new bonds with slightly lower coupons than Figure 1 might suggest during the last six months. In part, this could be because the issuers have accessed the markets in the most advantageous ways at the most advantageous times, only going out to lenders when it was likely that they could obtain a good price. However, it may also have been because the markets have been looking more favourably on regulated companies.

TABLE 2 **Recent debt market issuance**

<i>Date</i>	<i>Issuer</i>	<i>Size m</i>	<i>Maturity</i>	<i>Rating</i>	<i>Coupon %</i>
1/7/08	Scottish and Southern Energy	€500	July 2013	A2/A	6.125
16/6/08	Anglian Water	€500	June 2016	A3/A–	6.25
7/5/08	National Grid Gas	€750	May 2013	A3/A–	5.25
6/5/08	National Grid Gas	£300	May 2038	A3/A–	6
1/5/08	Southern Gas Networks	£225	May 2020	Baa1/BBB	6.375
4/3/08	Severn Trent Water	€700	March 2016	A2/A	5.25
18/2/08	National Grid Gas	£300	March 2020	A3/A–	6.375

Source: CC analysis of FT.com.

36. A further benchmark to which we referred was the cost of new A3/A– rated debt that BAA achieved in its refinancing, which was completed in August 2008. Table 3 shows the rates obtained by BAA.

TABLE 3 **The interest cost on BAA's Class A debt**

<i>Bank facility</i>	<i>Drawing £bn</i>	<i>Pricing</i>
Backstop facility	0–1.2	LIBOR plus 100 basis points
	1.2–2.2	LIBOR plus 125 basis points
	2.2–3.2	LIBOR plus 150 basis points
	3.2–3.4	LIBOR plus 175 basis points
Capex and working capital facility	0–2.3	LIBOR plus 100 basis points

Source: BAA submission.

Note: The five-year LIBOR swap rate at 12 September 2008 was 5.23 per cent.

37. The conclusion that we drew from these three pieces of evidence combined was that a regulated company with an A3/A– rating might currently expect to pay interest of between 6.5 and 6.8 per cent a year on floating-rate debt. Assuming RPI-measured inflation for the new five-year period averages 2.8 per cent a year,⁶ this translates into a real cost of debt of 3.6 to 3.9 per cent.⁷
38. Taking all the evidence into account, our view was that a stand-alone Stansted ought to be able to match this 3.6 to 3.9 per cent range in Q5. However, we recognized that this estimate may change in the next six months as the markets settle down after their recent turbulence. Therefore, we recommend that the CAA should keep this assumption under review before its final determination and that it should be prepared to revise this figure (upwards or downwards) if there is a fundamental shift in market rates during this period.

Allowance for embedded debt

39. Given that interest rates had increased recently, it was important that our cost of debt assumption did not simply track the prevailing market rates, but instead recognized the opportunity that an airport had to protect itself against higher financing costs. In regulated industries, companies have tended for many years to issue at least a proportion of the debt that they require on a fixed-rate basis. Indeed, in the last five years, many regulated companies have made a deliberate choice to lock as much of their debt as possible into what they perceived at the time to be highly attractive

⁶This is based on an annual average of 4.0 per cent RPI-measured inflation in 2009/10, followed by RPI-measured inflation of 2.5 per cent thereafter.

⁷Calculated using the formula: nominal cost of debt = (1 + real cost of debt) x (1 + inflation rate) – 1.

rates. Against this backdrop, we thought it was reasonable to expect an efficiently financed airport to be sharing the benefits of low fixed-rate financing costs in the prices that it charges during Q5.

40. Normally, we would have wanted to factor a company's actual fixed-rate debt costs into our calculations. However, because we were setting a cost of capital for a hypothetical stand-alone Stansted this was not possible. Therefore we had two choices:
 - (a) we could have tried to construct a hypothetical debt portfolio, making judgements about how much debt would have been issued by a stand-alone Stansted on a fixed-rate basis, with what maturity, when, and at what cost; or
 - (b) we could have used the real-life experiences of BAA to guide the judgements we made about fixed-rate debt financing.
41. We had a strong preference for the latter approach. The alternative required us to make judgements with the benefit of hindsight and to second-guess what an efficient financing strategy would be. By contrast, the decisions taken by BAA show how a real airport owner has behaved. It was for this reason that our 2007 Heathrow and Gatwick report included the following statement:

At future CC reviews, provided that fixed-rate debt has been incurred prudently and efficiently, having regard to the market conditions at the time, it may be prudent for our successors to consider that it is appropriate that price caps should provide the airports with sufficient revenue to cover the costs of servicing that debt until it matures ... We would expect to apply this principle symmetrically, so that the cost of servicing historical debt which turns out to be less expensive than the prevailing market rate also passes through to users.⁸

42. The tests of prudence and efficiency demanded that we focus our attention on the financing that BAA raised prior to its acquisition by ADI Ltd in 2006. Importantly, this debt was rated Baa1 by Moody's and A by Standard & Poor's immediately prior to BAA's takeover, so it was of broadly equivalent credit quality to the stand-alone Stansted that we were considering. Table 4 shows the rates that BAA obtained.

⁸Paragraph 42, Appendix F (Cost of Capital), Heathrow and Gatwick recommendations.

TABLE 4 BAA's actual embedded fixed-rate debt costs*

<i>Issue</i>	<i>Fixed rate</i> %
£300m bonds due 2016	11.75
£250m bonds due 2021	8.50
£200m bonds due 2028	6.375
£900m bonds due 2031	5.75
€1,000m bonds due 2012	5.13
£400m bonds due 2013	5.75
€750m bonds due 2014	5.14
€750m bonds due 2018	5.36
£750m bonds due 2023	5.125
Weighted average cost of debt in years 1–3 of Q5	6.02
Weighted average cost of debt in year 4 of Q5	6.18
Weighted average cost of debt in year 5 of Q5	6.23

Source: BAA submission.

*In August 2008 BAA migrated BAA's existing bonds into a new financial structure. In order to secure bondholders' approval for this refinancing, BAA offered the incentive of an additional 10 to 70 basis points on the coupon its bonds pay. We have not included this step up in our calculations on the grounds that it is a cost related solely to ADI's acquisition of the company, and therefore one which shareholders alone should bear.

43. The table shows that BAA had secured a cost of debt of 6.0 to 6.2 per cent (nominal) or 3.1 to 3.3 per cent (real) on £4.5 billion of financing prior to its acquisition by ADI. We reviewed the fixed rates that BAA secured for each of its bond issues and satisfied ourselves that they were consistent with the prevailing market rates of the time. In our view, this confirmed that an efficient company would have significant protection against rising interest rates during Q5, even allowing for the fact that fixed-rate debt issued prior to 2003 (ie when Stansted was expanding) was more expensive than current market rates, and that we should factor the costs shown above into our cost of debt calculation.
44. The question that remained was how much weight we should give to fixed-rate debt versus new debt and floating-rate debt in our cost of debt calculation. In October 2008 BAA had in total £4.5 billion of fixed-rate debt. We allocated this pro rata to Heathrow, Gatwick, Stansted and BAA's non-regulated business in Q5, taking account of the projected increases in the value of the airports' respective RABs. This gave an average fixed-rate debt-to-RAB ratio during Q5 of just over 25 per cent. Having earlier selected a 50 per cent gearing assumption, we took from this that we should weight new debt and floating-rate debt to fixed-rate debt at a ratio of 50:50.

Fees

45. The final component in our cost of debt calculation was an allowance (amortized over the life of the borrowings) for the commitment, agency and arrangement fees that Stansted would pay respectively to lenders, rating agencies and arrangers of finance while maintaining a 50 per cent debt-to-RAB ratio. In our Heathrow and Gatwick review, we added 15 basis points a year to the cost of debt, in recognition of these fees. The further evidence that we collected in this review suggested to us that this was too high:
- (a) In a recent study on the cost of capital in the water industry NERA found that water companies pay fees of between seven and ten basis points.
- (b) BAA told us that the fees associated with the bonds in Table 4 averaged approximately five basis points.

(c) An investment bank provided us with figures which suggested that a regulated company would incur fees of no more than ten basis points a year when maintaining a constant debt-to-RAB ratio through a mixture of bank and bond financing.

46. In recognition of this evidence, we made an allowance for bond and bank fees of ten basis points in our calculations.

Overall cost of debt

47. Our overall calculation of the cost of debt is shown in Table 5.

TABLE 5 **Stansted's cost of debt**

<i>Component</i>	<i>Weight</i>	<i>Annual cost %</i>
New and floating-rate debt	0.5	3.6 to 3.9
Embedded fixed-rate debt	0.5	3.1 increasing to 3.3
Fees	-	0.1
Total		3.4 to 3.7

Source: CC calculations.

48. Table 5 shows that we calculated Stansted's cost of debt to be 3.4 to 3.7 per cent. This included an allowance for the cost of new and floating-rate debt which was well within the range put forward by Oxera. However, our overall cost of debt was lower than suggested by BAA/Oxera, due to the recognition that we were giving to embedded debt costs.

Cost of equity

Risk-free rate (R_f)

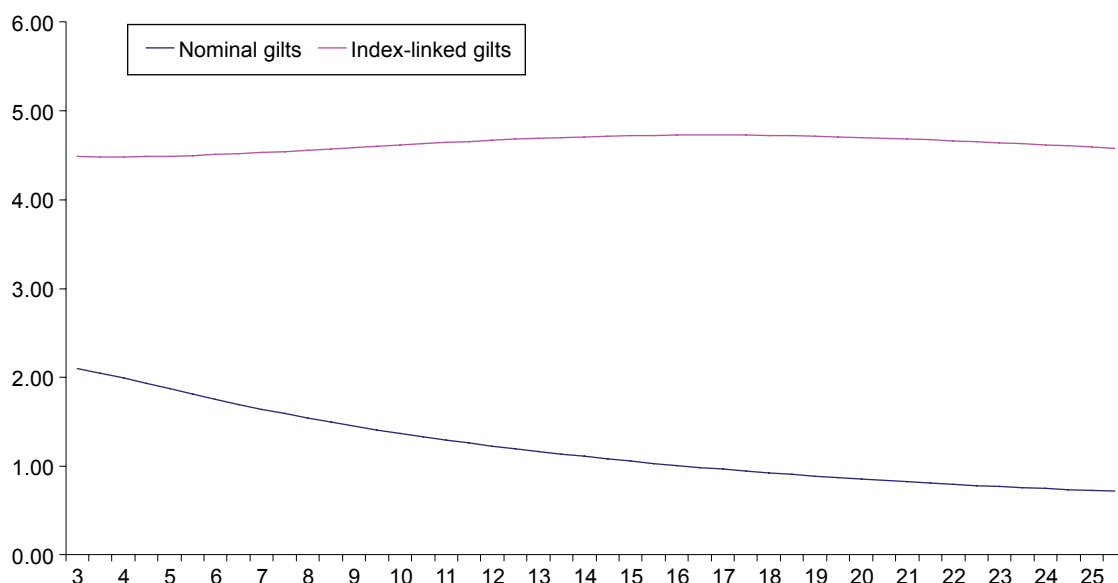
49. Having estimated the cost of debt directly, an estimate of the risk-free rate was needed solely for the purpose of estimating the cost of equity.

50. In previous reviews, the source of our risk-free rate estimates was the redemption yield on government-issued index-linked gilts (ILGs). These are assets with negligible default risk and relatively insignificant inflation risk which are generally thought to give the best available indication of the return that investors would require in exchange for holding a truly risk-free asset.

51. The main challenge that we faced when using this data was the segmentation in the gilt market caused by regulatory and accounting rules which encourage pension funds to purchase long-maturity government debt. A number of observers believe that strong demand from this one specific type of investor has pushed down the yields of long-dated ILGs (as shown in Figure 2) to the point where the returns that were on offer were attractive only to other pension funds. This is said to make the long-dated ILG yields an unreliable indicator of the risk-free rate for a typical equity investor and, in particular, for the marginal shareholder whose cost of capital we were trying to measure when estimating the rate of return that Stansted needs to earn.

FIGURE 2

Yield curves (nominal and index-linked), as at 12 September 2008



Source: CC analysis of Bank of England data.

52. Our response to this segmentation in the Heathrow and Gatwick review was to focus our attention on five- and ten-year ILGs and to place much less weight on estimates of the risk-free rate obtained from longer-dated gilts. During that review, NERA had argued that we ought to ignore evidence from the ILG market completely and look instead at indicators of the risk-free rate which can be obtained from other financial assets, in particular interest rate swaps. More recently, NERA used this approach to obtain estimates of the risk-free rate for a study it carried out for Water UK,⁹ which together with NERA met the CC's Cost of Capital Panel to present the evidence it had compiled.

NERA's approach

53. The steps in NERA's calculations were as follows:

- (a) NERA began by obtaining historical data on the five-year swap rate for the six-month LIBOR.
- (b) From the observed swap rate, NERA deducted:
 - (i) a contemporaneous measure of expected inflation, sourced to reports published by Oxford Economic Forecasting; and
 - (ii) an estimate of the default premium embedded in the swap rate, which it took to be equivalent to the five-year Credit Default Swap (CDS) rate for Senior Financials.
- (c) The residual from this calculation was then said to give a spot estimate of the risk-free rate at a particular point in time.

⁹NERA (2008), Cost of Capital for PR09.

- (d) The best indicator of the equilibrium value for the risk-free rate was said to be the average of this residual during the last ten years.
54. NERA suggested to us that estimates of the risk-free rate constructed via this approach were a like-for-like replacement for estimates derived from ILGs (ie estimates that we might previously have obtained from the ILG market were it not for the segmentation identified in paragraph 51). If this was the case, we would have been able to discard our usual approach to estimating the risk-free rate and rely instead upon NERA's estimates without any further adjustments to our methodology.
55. Having considered this proposition, our view was that NERA's contention was not correct, for the following reasons:
- (a) NERA's preferred risk-free rate was a ten-year historical average, whereas we have previously used more recent market data to make a more forward-looking estimate of the risk-free rate.
- (b) Holders of ILGs are largely protected from inflation risk, unlike the parties to interest rate swaps. NERA's risk-free rate therefore included a premium to compensate investors for risk (ie an inflation-risk premium) which was not present in the yields on ILGs.
- (c) Most importantly, there is a considerable body of research which shows that only a proportion of the differential between the return on gilts and the return on other financial assets can be attributed to credit risk. The rest of the observed gap is attributable to what is described in the literature¹⁰ as a liquidity premium or convenience yield—ie a willingness among investors to pay a premium to hold highly liquid government bonds rather than other types of financial asset.
56. We have estimated this liquidity premium in our analysis of the debt beta and found it to be worth at least 30 basis points. In practice, what this means is that the yield on other types of financial asset, including interest rate swaps, sit naturally above the yield on gilts by a non-trivial margin even before one allows for credit risk.
57. By itself, this did not invalidate NERA's risk-free rate. Professor Stephen Schaefer in a report written for BAA¹¹ argued that the risk-free rate in CAPM might be thought of as the expected return on a riskless asset with the same liquidity as equity. If there is a liquidity premium/convenience yield in the pricing of ILGs, there is at least an argument that it was better to add this premium back before running the CAPM calculations.¹²
58. However, in this review we identified other problems with NERA's approach which meant that it was not necessary for us to reach a view on Professor Schaefer's contentions. They were as follows:
- (a) *Adjustment for credit risk.* NERA's approach had a further conceptual flaw in that the credit risk embedded in an interest rate swap lies primarily in the possibility that the borrower in the underlying interbank transaction will default on their loan. It follows that this credit risk was limited by the six-month duration of the interbank loan. However, NERA, in its analysis, deducted a credit premium

¹⁰See, for example, Huang and Huang (2003), *How Much of the Corporate-Treasury Yield Spread is Due to Credit Risk?*, or Feldhutter and Lando (2007), *Decomposing Swap Spreads*.

¹¹Schaefer (2007), *BAA Quinquennial Review: The Cost of Capital for Heathrow and Gatwick*.

¹²Any adjustment would need to be applied consistently throughout the CAPM calculation. It would not be acceptable to measure the equity-risk premium as the return on equities over gilts if the return on gilts was not considered to be an appropriate proxy for the risk-free rate.

derived from a CDS which exposed the guarantor to credit risk for five years. This made NERA's adjustment for credit risk unreliable and its estimates of the risk-free rate imprecise.

- (b) *Use of LIBOR.* Even if it was possible to correct for this error, we were not convinced that it was appropriate to turn to LIBOR-based financial instruments if the ILG market was felt to be too distorted to produce reliable risk-free rate estimates. For one thing, the shape of the interest rate swap curve looks very similar to the shape of the ILG yield curve (as at 12 September 2008 the five-year swap rate was 5.28 per cent and the 30-year swap rate was 4.47 per cent). Prima facie, this implies that the ILG market and the interest rate swap market are linked to one another. More importantly, the interbank market has witnessed significant volatility in recent months and has seen government and Bank of England intervention to restore market confidence. This made the interbank market a less than obvious place to look for undistorted pricing data.
- (c) *Absence of long run data.* One way of dealing with such concerns was to attempt to obtain estimates of the risk-free rate from other financial assets where there existed a liquid CDS market. The main constraint here is that CDSs are a relatively new product and it is not possible to obtain a long enough series of data with which to analyse and test the reliability of the estimates that NERA's approach produced. We noted that NERA, in its work, had to extrapolate from post-2004 CDS data in order to be able to construct a data series for the period 1998 to 2004. This did not seem to us to be a reliable approach, particularly when we considered the turbulence affecting financial markets in 1998 and 1999.
- (d) *Imprecision in credit risk and inflation adjustments.* A final concern related to the potential for errors to be made when adjusting for credit risk and inflation. In the case of credit risk, it is not clear that a CDS is a perfect hedge for default risk. For one thing, a CDS does not compensate an investor for loss of interest at the point of default; for another, there is exposure to counterparty risk. In the case of inflation, we would be uncomfortable relying on one forecaster to extract market expectations about future inflation.

59. The cumulative effect of these points was that we did not believe we could rely upon NERA's estimate of the risk-free rate. Whilst it was possible that the underlying principles could be explored further in future reviews, our view was that it was not possible at present to populate the calculations with accurate and precise data. This introduced a considerable amount of noise and error to the estimates and meant that we needed to look elsewhere for estimates of the risk-free rate.

Estimates derived from ILGs

60. The decision above did not mean that we were dismissive of concerns that were raised about the reliability of estimates obtained from the ILG market. The earlier observations about segmentation in the market for long-dated government gilts were still relevant and we needed to be confident that short-maturity ILGs were sufficiently unaffected by these problems before we accepted ILG-based estimates of the risk-free rate.
61. One way of sense-checking yields on ILGs was to look at the forward rates¹³ built into prices. The forward curve constructed by the Bank of England showed that ILG

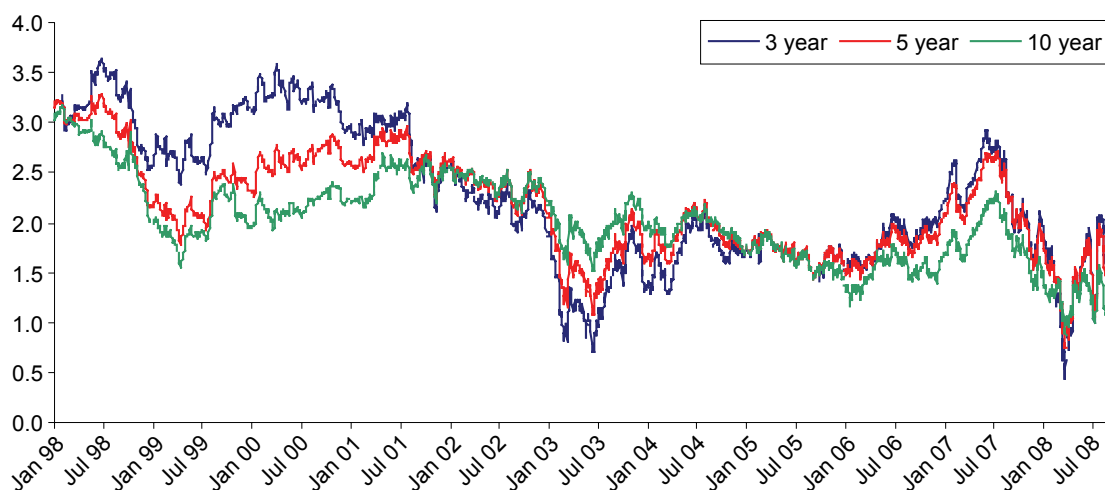
¹³Forward rates are derived from the difference in yields on actual bonds with n and $n + 1$ years in maturity, and indicate the yield that investors expect to earn at a point n years into the future.

yields in September 2008 priced in a return of less than 0.5 per cent after 15 years, justifying the view that long-maturity ILGs did not provide reliable risk-free rate estimates. However, it was also apparent that the ILGs priced in yields of less than 1.25 per cent after five years and yields of less than 0.75 per cent after eight years. Prima facie, this was evidence that the ten-year ILG benchmark was not a suitable indicator of the risk-free rate.

62. This view was confirmed to some extent by the gap between yields on nominal and index-linked gilts (shown in Figure 2).¹⁴ The data implied that the market priced in a 2.7 per cent a year inflation rate during the next five years, but a 3.3 per cent a year inflation rate over the next ten years. In an era of inflation targeting this did not feel plausible. Accordingly, we thought that it was appropriate for us to place less weight on the ten-year ILG benchmark in this review.
63. Whilst we could not say with absolute certainty that very short-maturity ILGs were completely unaffected by the pension fund dynamics affecting longer-dated ILGs, our reading of forward rates and implied inflation gave us less reason to question pricing at the short end of the market. Figure 3 shows the movement in yields on three-, five- and ten-year ILGs during the last ten years, while Table 8 provides a set of summary statistics for the data.

FIGURE 3

Benchmark ILG yields by maturity



Source: CC analysis of Bank of England data.

¹⁴The yield on a nominal bond will be higher than the yield on an index-linked bond because nominal bonds compensate the investor for inflation via the coupon payment whereas the index-linked bond offers compensation via the indexation of the principal. The expected inflation rate over a period of n years can therefore be calculated by looking at the difference between the yields on a nominal bond and an index-linked bond of n years in maturity.

TABLE 6 Yields on three-, five- and ten-year ILGs

Spot rate	per cent			
	3-year	5-year	10-year	Forward rate* for October 2011
12 September 08	2.05	1.81	1.33	1.72
Last 20 days	1.67	1.48	1.09	
Last 3 months	1.69	1.58	1.23	
Last 6 months	1.48	1.45	1.24	
Last year	1.60	1.58	1.36	
Last 3 years	1.89	1.83	1.69	
Last 5 years	1.83	1.83	1.69	
Last 10 years	2.22	2.09	1.95	

Source: CC analysis of Bank of England data.

*See footnote to paragraph 61.

64. The chart shows that the three- and five-year ILG benchmarks fell noticeably during 2001 and then remained below 2.5 per cent for all but a brief three-month period in mid-2007. As a consequence, all the recent summary statistics in Table 6 give values of less than 2 per cent.
65. In the Heathrow and Gatwick review, which concluded in September 2007, we chose a value of 2.5 per cent for the risk-free rate. The data presented above suggested to us that it would be appropriate to select a somewhat lower value in this review. This recognized the repricing of risk that has taken place since August 2007 and a well-documented increase in risk aversion within the investor community. These were changes which, all other things being equal, mean that investors are willing to accept a lower return on risk-free assets.
66. As ever, there was no mechanistic way of interpreting the data and we were required to exercise a certain amount of judgement before selecting a precise value for the risk-free rate. Our judgement was that the risk-free rate in recent years has been approximately 2.0 per cent, and that this was an appropriate assumption to use for the rest of Q5.

Market return (R_m) and equity-risk premium

Recap of the CC's previous analysis

67. The other generic parameter in the CAPM is the return on the market portfolio. In the Heathrow and Gatwick review we looked at a broad range of academic and market evidence to understand how much additional return equity investors require over the risk-free rate. This included analysis of:
- (a) the realized rate of return on stock market investments during the last 100 years;
 - (b) the rate of return that investors originally expected to earn on these stocks in this period;
 - (c) forward-looking residual income models applied to data from the last 20 years; and
 - (d) dividend growth models populated with current market data.

68. The estimates that this body of literature supplied us with, updated where appropriate for one additional year of data, are summarized in Table 7.

TABLE 7 UK market return/equity-risk premium estimates

	<i>per cent</i>		
	R_m	R_f	$R_m - R_f$
<i>Ex post estimates, long-term historical data</i>			
Dimson, Marsh, Staunton 2008, geometric averages*	5.5	1.3	4.1
Dimson, Marsh, Staunton 2008, arithmetic averages*	7.3	2.2	5.4
<i>Ex ante estimates, long-term historical data</i>			
Dimson, Marsh, Staunton 2006, geometric averages	4.0–4.5	1.0	3.0–3.5
Dimson, Marsh, Staunton 2006, arithmetic averages			4.5–5.0
Gregory 2007, geometric averages	5.4–6.8	2.2–3.0	3.3–3.8
Gregory 2007, arithmetic averages	5.9–7.8	2.3–2.9	4.4–5.3
<i>Forward-looking residual income model, recent historical data</i>			
Claus and Thomas, 2001			3.4
<i>Ex ante estimates using latest market data</i>			
Gregory 2007, geometric averages	3.8–5.6	2.3	1.7–3.3
Gregory 2007, arithmetic averages	4.3–6.2	2.3	2.0–3.9
CC 2007, dividend growth model	4.6–5.8	2.5	2.1–3.3
CC 12 September 2008, dividend growth model*	5.8–7.0	2.0	3.8–5.0

Source: CC's Heathrow and Gatwick Q5 report, and CC analysis.

*Updated evidence.

Equity-risk premium

69. In our 2007 Heathrow and Gatwick review, we took from the evidence presented above that the expected premium on the market portfolio was 2.5 to 4.5 per cent over the risk-free rate.
70. However, this conclusion had to be looked at in conjunction with our estimate of the risk-free rate in the same review of 2.5 per cent. In equation 2, we showed that the cost of equity is a function of three parameters: R_f , R_m and beta. By choosing an equity-risk premium of 2.5 to 4.5 per cent, we were, in effect, saying that the R_m term was expected to be 5 to 7 per cent.

Evidence presented by interested parties

71. This particular aspect of our calculation attracted more comment and criticism than any other part of our 2007 cost of capital analysis, especially in the detailed critiques of our work carried out by Oxera, Professor Stephen Schaefer and Professor Stewart Myers¹⁵ on behalf of BAA, and in the NERA cost of capital study. Some of these comments seemed to us to have been based on a misunderstanding of the underlying approach in that they focused on the equity-risk premium in isolation, without recognizing that the risk-free rate and equity-risk premium estimates need to be combined together in order to see the R_m estimate that goes into the CAPM calculation. We return to this point later.
72. The other main criticisms that have been made of the analysis were that:

¹⁵Myers (2008), *CAA Price Control Proposals: Heathrow and Gatwick Airports*.

- (a) the lower bound of the chosen range was too low and placed too much weight on work carried out by one of the CC's members, Professor Alan Gregory;
 - (b) the range was skewed downwards because we showed an inappropriate preference for geometric averages over arithmetic averages; and
 - (c) the range was too narrow and ought to have acknowledged that there was evidence that the equity-risk premium is as high as 7 to 8 per cent.
73. Table 7 shows that the first of these concerns is misplaced. Evidence for a market return of between 5 and 6 per cent can be found in at least four of the other entries in the table, as well as the analysis that Professor Gregory undertook. Professor Gregory's work and conclusions are also very similar to those that may be found in a contemporaneous paper by Andrew Vivian that was published in the *Journal of Business & Financial Accounting* last year.¹⁶ This work produced estimates of R_m in the range 4.9 to 5.8 per cent depending on the time frame, market index and adjustment for share repurchases used.
74. On the issue of arithmetic versus geometric averages, we merely pointed out last year that even a small amount of negative serial correlation in historical returns would cause arithmetic averages to overstate expected future returns. This was not the same as saying that it was appropriate to discard the arithmetic averages and focus exclusively on geometric averages. Arithmetic averages were still useful to us if the extent of this serial correlation was small. However, geometric averages could give better estimates if we allowed for the fact that we were trying to ensure that Stansted's shareholders earn the appropriate level of return over a longer horizon. Annex 2 explores these matters further. We recognized last year that there was no consensus in the academic community about whether arithmetic averages or geometric averages were to be preferred and we did not seek to favour one type of estimate over the other. However, we did consider it appropriate to acknowledge that arithmetic averages and geometric averages, respectively, were likely to overstate and understate the return required by investors.
75. On the third point, by taking into account a wide range of evidence, inevitably we encountered some very low and some very high estimates for R_m and the equity-risk premium. If we were simply conducting a literature review, we might have wanted to reflect the full spectrum of evidence in the form of much wider ranges for these parameters. However, our task in setting a price cap is very clear: we must come to a single point estimate of the cost of capital. This forced us to narrow down the evidence and specify what we regarded as the most likely values—something that by itself should not be a source of concern to interested parties provided that we properly explain and justify our selections.

Proposed range in this review

76. The nature of the techniques that are conventionally used to estimate the R_m term in CAPM is such that estimates are unlikely to change significantly in any 12-month period. Table 7 helps to show this in that the new entries in the table are only slightly different to the estimates that were available to us last year.
77. Consistent with the conclusions we reached in our Heathrow and Gatwick review, and notwithstanding the existence of some estimates that were above and below these values, our interpretation of the evidence in Table 7 in this review was that it

¹⁶Vivian, 2007, *The UK equity premium: 1901-2004*.

showed the expected return on the market portfolio to be broadly in the range 5 to 7 per cent. Support for the top end of the range was found in studies that looked at long-term historical data, especially when arithmetic averages were used. The bottom end of the range came from work that used more recent market data, forward-looking models and/or geometric averages. Although different individuals may prefer one type of evidence over another, we considered an R_m range of 5 to 7 per cent to be a fair summary of the R_m estimates that were used by academics and companies.

78. We have taken the view that it is better to present the judgement we were making in these terms than to specify an explicit equity-risk premium. The principal reason for this was that a considerable amount of the evidence we received during the course of our review made use of two different and inconsistent estimates of the risk-free rate in the cost of equity calculation. As examples of this:
- (a) A number of parties said that our previous equity-risk premium estimates were too low, but failed to recognize that the sum of the risk-free rate and the equity-risk premium estimates used in our Heathrow and Gatwick review corresponded almost exactly to the risk-free rate plus equity-risk premium that they used in their own calculations.
 - (b) Other interested parties in this review told us explicitly what they thought the value of R_m was, but then put forward risk-free rate and equity-risk premium estimates which summed to more than the chosen R_m .
 - (c) Often this was because the parties concerned switched between different types of risk-free rate, for example:
 - (i) estimates derived from bonds and bills;
 - (ii) the ex ante, expected return on a risk-free asset and the ex post, realized rate of return; and
 - (iii) in NERA's case, estimates derived from gilts (for the equity-risk premium) and estimates derived from interest rate swaps (for the risk-free rate).¹⁷
79. By presenting our conclusions in this review in the form of a range for R_m , we hope that we were making our interpretation of the evidence in Table 7 easier to follow and understand. We also believed, in the context of this review, that the R_m term in CAPM is unlikely to have been affected significantly by short-term changes in the risk-free rate. The last two rows of Table 7 show that the expected return on the market has, if anything, increased slightly during the last 12 months at a time when the expected return on risk-free assets has fallen. It would be illogical for us to have retained our previous range for the equity-risk premium in the absence of any reason to believe that a lower risk-free rate had translated into a lower cost of equity.

Beta

Methodology

80. Because Stansted is not a listed company, we could not estimate its beta directly from market data. Instead, we had to make comparisons with similar businesses in

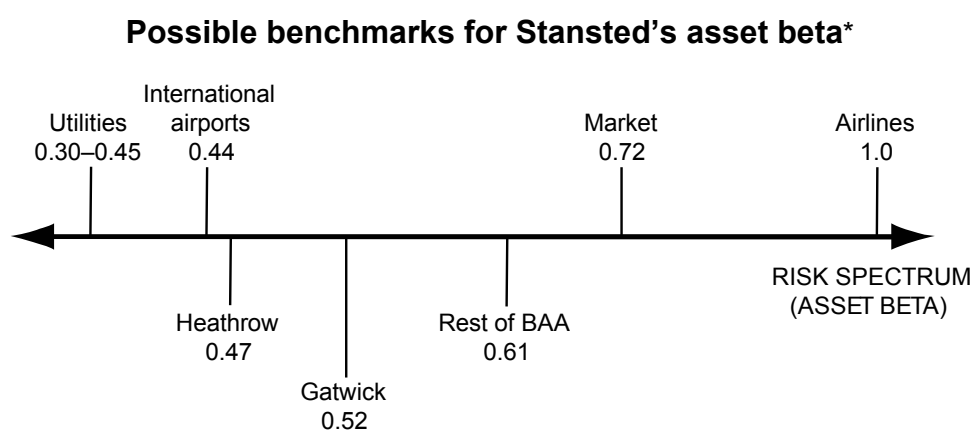
¹⁷This is potentially quite a significant error if, as argued earlier, there is a long-standing liquidity/convenience/uniqueness premium in the pricing of gilts.

order to judge how shareholders price the risk that they take on when they provide Stansted with equity capital.

81. As a starting point in such analysis, Figure 4 illustrates the sorts of benchmarks that we thought were likely to be useful to us. The data was taken from our 2007 report on Heathrow and Gatwick and comprised the basket of comparators which could be said to have most relevance to the assessment of Stansted's beta. They were of two types:

- (a) asset beta estimates for Heathrow, Gatwick and the remainder of BAA produced by us last year from a disaggregation of BAA's historical beta (Annex 4 summarizes the source of these estimates); and
- (b) direct estimates of asset betas for regulated utilities, international airports and the UK stock market as a whole.

FIGURE 4



Source: CC analysis.

*In order to compare the riskiness of different types of company it is necessary to look at the businesses' underlying asset betas rather than the equity betas. Annex 4 explains the difference between asset beta and equity beta in greater detail, and also sets out the important role that the estimate of a debt beta plays when transforming equity betas into asset betas (and vice versa).

82. The benchmarks in Figure 4 were the output of the wide-ranging and thorough review of beta evidence that we conducted during our 2007 Heathrow and Gatwick review. Given the limited time that has passed since this work was completed, we sought in this review to build on our 2007 analysis rather than carry out significant amounts of new research. Our work proceeded in three steps:

- (a) We sought to verify that the data in Figure 4 remained an up-to-date assessment of the betas for the comparator group.
- (b) We considered where Stansted's beta was likely to be positioned relative to the betas for Heathrow, Gatwick and the rest of BAA.
- (c) As a sense-check on this positioning, we considered whether Stansted was placed sensibly relative to the other types of comparator.

Changes in the perceptions of systematic risk

83. Before attempting to position Stansted in the risk spectrum shown in Figure 4, we checked that our 2007 beta estimates, and especially the estimates for Heathrow,

Gatwick and the rest of BAA, continued to give accurate insights into shareholders' perceptions of risk. For the non-BAA comparators, we updated our calculations for 12 additional months of data. Unfortunately, updating the BAA betas was not possible because BAA was delisted following its acquisition by ADI in 2006 and we had no new stock market data with which to estimate a beta directly.

84. Whilst acknowledging the difficulties that this causes, BAA/Oxera, in their evidence to us, argued that stock market investors would today view BAA's airports as riskier equity investments in comparison to the same businesses in 2006 or 2007. Their contention was that the recent increase in the oil price and evidence of a downturn in demand for air travel made airports, in general, more risky in the eyes of investors. BAA/Oxera also argued that Stansted had been hit especially hard by these developments and that it would not be appropriate for us to make use of the historical BAA beta in this review.
85. Although we recognized that there is no entirely objective way of assessing these claims, we thought that the experiences of the other companies in Figure 4 offered one way of checking the reliability of our 2007 estimates. Our logic for saying this was that BAA's airports were likely to be exposed in part to changes in shareholders' perceptions of the airports sector and in part to changes in shareholders' perceptions of regulated companies. If the comparator betas had gone up in the last 12 months, we would have considered this strong evidence that BAA/Oxera were right to downplay the historical BAA beta estimates. If, however, comparator betas had stayed broadly the same, we would have been more confident about continuing to use the data in Figure 4.
86. Table 8 contains the relevant data.

TABLE 8 **Comparator asset betas**

	<i>One-year asset beta at 14.8.07</i>	<i>One-year asset beta at 12.9.08</i>
<i>Overseas airports</i>		
Macquarie Airports, Auckland, Copenhagen, Fraport, Vienna, Zurich, Florence—unweighted average	0.47	0.46
<i>Utility companies</i>		
Severn Trent, Pennon Group, Northumbrian Water, National Grid, United Utilities—unweighted average	0.47	0.35

Source: CC calculations.

Note: To be able to make inter-company and inter-temporal comparisons, we have to convert equity beta estimates into estimates of the underlying asset beta. The formula used in this transformation is explained in more detail in Annex 3.

87. The calculations showed that the betas for international comparators had been fairly stable over the last 12 months. During this time, the betas of regulated utility companies had fallen slightly (although neither change was statistically significant). Since there was no evidence to suggest that infrastructure/airport/regulated companies as a class of asset were perceived to be more risky equity investments, we found it difficult to believe that betas for BAA's airports had increased in the last year, as BAA/Oxera had suggested.
88. One possible reason for this is that it is reasonable to expect BAA's relative sensitivity to economic shocks to have been reflected in its historical beta (put simply, it was not new news that fewer people fly when economic growth falls or the oil price increases). A company's beta will change because investors' perceptions of risk are altered by new information, eg the unforeseen credit crunch and the impact that this

has had on the wider economy. While airports were by no means immune from recent macroeconomic developments, many other types of firm—including banks, house builders and retailers—had suffered more. In comparison with these sectors, airports (and especially regulated airports) had been shown to have more stable profits and longer-lived assets which did not decrease substantially in value during periods of short-term downturn in demand.

89. In our view, what Table 8 showed above all else was how misleading it could be to look at the fortunes of one sector in isolation from what was happening in the rest of the economy. For these reasons, we were content that our 2007 beta estimates provided a reliable framework within which to analyse Stansted’s beta.

Stansted’s asset beta

90. The CAA and BAA/Oxera had each previously carried out assessments of the relative riskiness of the three London airports and separately reached the view that Stansted was riskier than both Heathrow and Gatwick. As evidence for this, they pointed, among other things, to:
- (a) the greater historical volatility of passenger numbers at Stansted;
 - (b) perceptions that Stansted was more exposed to GDP and oil price shocks; and
 - (c) the greater degree of competition that Stansted faced in comparison to Heathrow and Gatwick.
91. We agreed with the CAA and BAA/Oxera assessments and with the hierarchy identified above. The effect this had was that Stansted’s asset beta could not be any less than 0.52 (see Figure 4).
92. The question that remained was whether Stansted was more or less risky than the other activities that BAA had historically engaged in (which mainly comprised: Aberdeen, Edinburgh, Glasgow and Southampton airports, the operation of airports overseas, BAA’s property interests, and its World Duty Free business). Table 9 shows four indicative scenarios.

TABLE 9 Indicative asset beta calculations

Assumption	β_a^H	β_a^G	β_a^S	β_a^O
$\beta_a^S = \beta_a^G$	0.47	0.52	0.52	0.64
β_a^S sits halfway between β_a^G and β_a^O	0.47	0.52	0.565	0.62
$\beta_a^S = \beta_a^O$	0.47	0.52	0.61	0.61
$\beta_a^S = 0.7$	0.47	0.52	0.7	0.58

Source: CC’s Heathrow and Gatwick Q5 Report and CC calculations.

93. In its base case, BAA/Oxera argued that we should assume that Stansted contributed a beta of 0.68 to 0.73. In support of this position they reminded us of six separate pieces of analysis that Oxera had carried out during the Heathrow and Gatwick review to position Heathrow’s beta relative to Gatwick’s beta relative to Stansted’s beta, stressing in particular the analysis of historical volatility in airport profits and their analysis of the betas of each airport’s airline customers. Each different methodology came out with somewhat different results, but, on average,

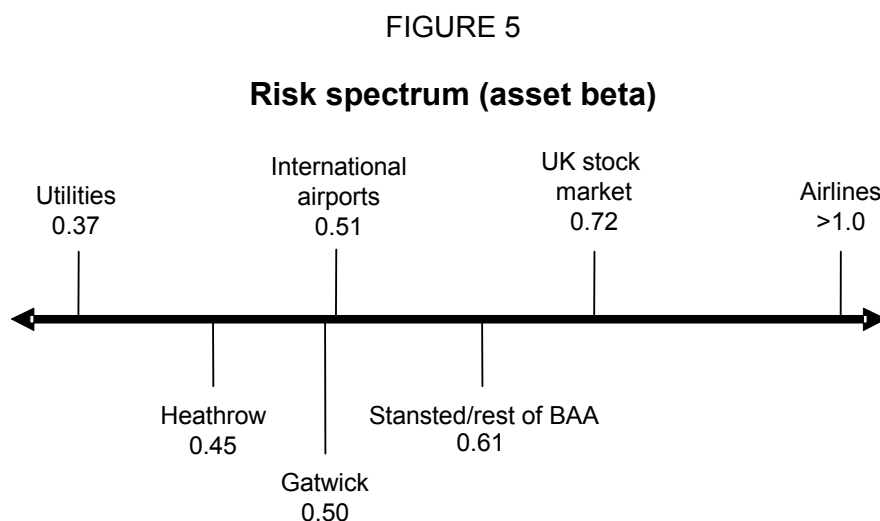
Stansted was found to have a beta which was 0.23 higher than Heathrow and 0.20 higher than Gatwick.

94. Having already considered this work at some length during the Heathrow and Gatwick review, we were unable to accept this conclusion for the following reasons:
- (a) A number of the pieces of analysis that BAA/Oxera relied upon appeared to us to suffer from conceptual and methodological flaws. In paragraphs 77 to 82 of Appendix F to the Heathrow and Gatwick review report, we set out the detailed concerns that we had about Oxera's work. Twelve months later, we were given no reason to change our stance on these matters.
 - (b) Perhaps more importantly, the Oxera work implied that Stansted was riskier than BAA's other businesses and the most risky major asset within the BAA group. This did not seem credible to us. We had found that the competitive constraints facing Stansted were currently quite limited and would continue to be quite limited throughout Q5, and as a consequence, the airport's charges should continue to be capped during Q5 (see Appendix B). Therefore, the risks that shareholders took at Stansted were determined as much by the CAA's price cap design as by the market fundamentals at the airport. We believed this limited considerably the risk borne by investors.
95. As an example of this last point, a number of UK airports have been suffering from a downturn in traffic. For most airports this meant lower profits until such time as demand picked up, but, at Stansted, shareholders would under-recover their cost of capital only until 1 April 2009 when price caps would be reset to take account of the reduction in volumes. To the extent that similar adjustment mechanisms applied in relation to other aspects of cost and performance, the nature of risk at Stansted looked fundamentally different to the sorts of risk that investors were exposed to in airports or other businesses that did not enjoy substantial market power and were not subject to price cap regulation.
96. When we put these views to the CAA and BAA, both parties disagreed. In part, this is because they have different perceptions of Stansted's market power, which we discuss in Section 3 of the main report and in Appendix B. In addition, both the CAA and BAA pointed to the relatively high historical variations in passenger numbers at Stansted and at evidence that Stansted had lost more volume than other BAA airports during the downturn affecting the industry in the last year.
97. We were not persuaded that any of these pieces of evidence showed Stansted to be a high-risk airport. The historical variations in passenger numbers appeared to us to depict the natural and entirely foreseeable development of the airport, in which rapid early growth eventually gave way to more modest annual increases in volumes. Data from the last 12 months was then affected by the very significant increases in Stansted's landing charges, making it difficult to separate a response to price from a response to the wider macroeconomic changes affecting the industry. We also thought that there was only a limited amount that one could learn from Stansted's historical experiences now that we believed it was able to price up to a binding price cap.
98. Quantifying the precise impact that all of this had on beta was far from straightforward. Our judgement that Stansted was no more risky than BAA's other businesses meant that we did not need to concern ourselves with the final row of Table 9. We also ruled out the first row as we accepted that Stansted was more risky than Gatwick.

99. Of the remaining two choices, we acknowledged that there was some evidence that Stansted had (temporarily) been hit harder than most airports by the recent slow-down in economic growth and by the high oil price. If this experience was representative of the risk that Stansted faces within Q5 (ie prior to the next reset of its price caps at the start of Q6), it was possible that the third rather than the second row in Table 9 gave the better picture of Stansted's risk profile. In the absence of any completely rigorous and unambiguous way of quantifying the component betas, we considered that we should be cautious and allowed for the possibility that Stansted was as risky as the other business historically carried on by BAA. However, we should stress that we saw this as the upper limit on the perceptions that shareholders ought to have of Stansted's riskiness.
100. This gave the following asset betas for the BAA group:
- (a) $\beta_a^H = 0.47$;
 - (b) $\beta_a^G = 0.52$;
 - (c) $\beta_a^S = 0.61$; and
 - (d) $\beta_a^O = 0.61$.

Cross-check with comparators

101. As a cross-check on these estimates, we considered what the betas in paragraph 100 implied about the riskiness of airports relative to other types of firms.
102. Figure 5 updates our earlier chart.



Source: CC analysis.

103. The first point to note about Figure 5 is the position of the three London airports relative to the market as a whole. With an equity beta of 1 (by definition) and average gearing among firms of 28 per cent,¹⁸ UK equities generally can be thought of as having an asset beta of around 0.7. We regarded it as intuitively sensible that a

¹⁸Source: Bank of England.

regulated asset such as Stansted should be a significantly less risky investment than UK equities in general.

104. A second useful comparison is the asset beta for a typical regulated utility. The average beta of the sample that we presented in Table 8 is 0.35, which is broadly in line with the water company asset beta that NERA used in the cost of capital study to which we referred in paragraph 52. Figure 5 shows that our beta estimates suggested that airports, and Stansted in particular, were more risky than conventional regulated companies. Again, we believed this made a certain amount of sense as, unlike owners of electricity, gas and water companies, investors in airports face non-trivial demand risk, which impacts on returns. However, as we noted earlier, it is important not to overstate the scale of this risk given that designated airports benefit from reset price caps every five years.
105. Overall, Figure 5 depicts what we considered to be a fairly logical spectrum of risk across different types of industry. We took this to be a high-level validation of the Stansted asset beta estimate.

Re-levering into equity beta estimates

106. The final step in the calculation involved re-levering our historical Stansted beta into an equity beta for a company with 50 per cent gearing. Table 10 sets out the final estimates.

TABLE 10 Re-levered equity beta estimate for Stansted at 50 per cent gearing

	<i>Low</i>	<i>High</i>
Asset beta	0.55	0.67
Equity beta	1.00	1.24

Source: CC calculations.

-
107. Table 10 presents a range which recognized that our original historical equity beta estimate was subject to a degree of measurement error and that it would be imprudent for us to rely solely on point estimates in our overall WACC calculation. The final section in this appendix explains how we have taken this range into account in arriving at our recommendations to the CAA.

Taxation

108. The CAPM calculates the after-tax returns required by shareholders. In order to ensure that Stansted's price caps provided the appropriate level of return, we had to make allowance for the corporation tax that Stansted will pay on the profits it makes. The way that we have done this in previous airport reviews is to gross up the cost of equity with a tax wedge adjustment equal to $1/(1-t)$, where t is the appropriate rate of corporation tax, and we continue with the same approach in this review.

Statutory versus effective rate

109. All previous airport price control reviews have grossed up the cost of equity by using the statutory rate of corporation tax as the t in the tax wedge adjustment formula in paragraph 108. However, historically, Stansted has had an effective tax rate which is significantly below the statutory rate, as shown in Table 11.

TABLE 11 Historical and forecast tax rates

		<i>per cent</i>		
		<i>Statutory tax rate</i>	<i>Effective tax rate (total P&L charge)</i>	<i>Effective tax rate (current tax)</i>
Q3	Actual, audited	30.2	N/A	5.6
Q4	Actual, audited & 1yr forecast	30.0	10.9	28.4
Q5	Forecast	28.0	31.4	26.9
Q6	Forecast	28.0	32.1	29.9

Source: CC analysis of statutory accounts and BAA submission.

110. The main reason for these low effective rates was the difference between the capital allowances used for tax purposes and the regulatory depreciation that the CAA has allowed for in price limits. These capital allowances have provided BAA with a temporary tax shield, effectively enabling it to defer tax payments to future quinquennia. In the future, this effect should start to reverse (as investments become fully written off for tax purposes and regulatory depreciation starts to exceed capital allowances). Table 11 shows that this has started to happen and that it is now likely that the effective rate will exceed the statutory rate during most of Q5, and until any substantial capital expenditure on SG2 begins, when again capital allowances would become greater than depreciation for a few years.
111. At a conceptual level, we have previously recognized that the use of the statutory rate can result in shareholders earning more or less than their cost of equity in any five-year control period. We have also said that there is a case for switching to the effective rate in future quinquennia provided that:
- (a) there is a significant difference between the effective and statutory rates (ie the continued use of the statutory rate has a material impact on price limits);
 - (b) it is possible to forecast the effective rate with a reasonable degree of accuracy; and
 - (c) the CAA allows for the historical benefit that shareholders have obtained from the use of the effective rate in years when the effective rate lay below the statutory rate (thereby ensuring that users do not pay twice for the same corporation tax payments).
112. In this review, the first of these conditions was not met. Because the forecast effective rate and the statutory rate were so similar, our choice of tax rate was largely immaterial to the returns that shareholders earn and the level at which price caps are set in Q5. As a consequence, there was little to be gained from a switch in approach (indeed, given the computational challenge that arises in calculating the adjustment referred to in paragraph 111(c), the interests of users were likely to be better served by continuing to use the statutory rate and allowing the benefit of accelerated capital allowances to unwind naturally).
113. For this reason, we chose in this review to continue with a tax wedge adjustment based on the statutory rate. The specific figure that we used in our cost of capital calculations is 28 per cent, down from 30 per cent in Q4, recognizing the reduction in the rate of corporation tax in the Finance Act 2007.

Point within the range

Range

114. Table 12 combines our individual component estimates into a range for the overall pre-tax cost of capital. For components where we estimated ranges, in the 'low' column we present the lowest estimate for all the components, and in the 'high' column we present the highest estimate for all the components. For components where we had a single estimate, we present this estimate in both the 'low' and 'high' columns. We did not interpret the 'low' and 'high' columns as two possible synchronized scenarios. Rather, the columns show simply the aggregate of the lower limits and upper limits of our estimates. The calculations give a real, pre-tax cost of capital of 5.2 per cent (using all the low estimates) and 7.5 per cent (using all the high estimates).

TABLE 12 Overall cost of capital calculation

		<i>per cent</i>	
		<i>Low</i>	<i>High</i>
A	Gearing	50	50
B	Pre-tax cost of debt	3.4	3.7
C	Risk-free rate	2.0	2.0
D	R_m	5.0	7.0
E	Equity beta (number)	1.00	1.24
$F=C+E.(D-C)$	Post tax cost of equity	5.00	8.20
G	Taxation	28	28
$H=F/(1-G)$	Pre tax cost of equity	6.94	11.39
$J=B.A+H.(1-A)$	Pre-tax, real WACC	5.20	7.54

Source: CC calculations.

Choosing a point estimate

115. In order to make recommendations to the CAA on the level of the price cap that should apply at Stansted, we needed to select a single point estimate from within our range. There were two main considerations that we believed should guide a regulator in this type of decision:
- (a) The first was that it was highly unlikely that the cost of capital lay at the very top or the very bottom of the estimated range. While there was a degree of uncertainty around several components in the calculation, it was most unlikely that the cost of debt, R_m and equity beta would all happen to lie at the very top or the very bottom of the stated ranges. The plausible range for the cost of capital was therefore likely to be narrower than that shown in Table 12.
 - (b) The second was that there were asymmetric consequences from setting returns too high and too low. Specifically, there was a significant detriment to users if Stansted was deterred by inadequate financial returns from investing in new facilities which more than outweighed the costs of setting returns too high and asking users to pay higher charges than strictly necessary.
116. The conclusion that we drew from this is that it would have been wrong for us to select a value at the mid-point of between our upper and lower limits, or lower, but also that we would have to believe that very substantial costs would result from under-investment in Q5 in order to justify choosing a point estimate at the very top end of the range.

117. Ultimately, the estimate that we made was a matter of judgement, in which we balanced the likelihood of outcomes with their cost implications. Whilst we took the risk of under-investment seriously, we were conscious in this review that our beta estimate was more likely to overstate than understate the riskiness of Stansted and, on this basis, we did not think it would be appropriate for us to go too high in the range. Furthermore, compared with Heathrow and Gatwick, the level of capex at Stansted in Q5 was forecast to be relatively modest, at approximately £125 million over the five years (see Section 8 of the main report).¹⁹ This reduced the cost of underinvestment at Stansted compared with Heathrow and Gatwick. Taking these various factors into account, our recommendation to the CAA is that it should allow for a return of 7.1 per cent a year in its price cap calculation.

Dealing with uncertainty

118. As we have noted at several points in our analysis, there has been significant recent turmoil in the financial markets, which has affected both the cost and availability of funds. We have deliberately not focused in too much detail on market data from the period after 12 September 2008, on the basis that data taken from a period in which financial markets are in a state of crisis are unlikely to be a reliable guide to the cost of capital over the longer term, when markets settle back to some form of normality. In particular, there is a danger that we would set certain parameters in the cost of capital calculation too high if we placed too much weight on data from the last six weeks.
119. As far as possible, our recommendations to the CAA do take account of the likelihood that there will be a repricing of risk in the coming months. However, we recognized that the situation has been changing quickly and that the CAA may have information that we did not when it makes its final price cap determination. Therefore, we recommend that the CAA should continue to monitor the financial markets and adjust our estimates appropriately if there appears to be a significant repricing of risk. We would expect any such changes to relate primarily to the variable element of the cost of debt because our approach to the cost of equity was one that deliberately made use of very long-term historical data on market returns.
120. In Section 8 of the main report we have proposed that under certain circumstances the CAA may wish to undertake a mid-quinquennium review in respect of SG2. Our cost of capital range was based on investors' current perception of risk facing Stansted in the long run and therefore included a current perception of the risk of SG2. However, if the CAA undertakes a mid-quinquennium review it may wish to revisit the cost of capital, if, at that time, it believes the systematic risk of SG2 has changed significantly from perceptions in October 2008.
121. We chose a point estimate from our range of possible WACCs by considering the risk and cost of setting an incorrect WACC. Part of this consideration was the cost of underinvestment in capex if the WACC was set to low. We did not believe that the inclusion or otherwise of SG2 in Q5 affected the systematic risk of Stansted, but we recognized that it may, however, affect the choice of a point estimate if it increased the cost of setting an allowable return that is too low.

¹⁹Q5 forecast capex, based on the CIP and excluding RPI and construction price inflation uplift, at Heathrow was £3.9 billion, Gatwick £874 million, and Stansted £125 million (in 2007/08 prices).

Comparison with previous CC reports

122. Table 13 compares our recommendations with the outcome of the Q4 review and our Q5 Heathrow and Gatwick recommendations.

TABLE 13 Comparison of cost of capital calculations

		<i>per cent</i>							
		<i>Stansted Q5 Range</i>		<i>Stansted Q4 range</i>		<i>Heathrow Q5 range</i>		<i>Gatwick Q5 range</i>	
		<i>Low</i>	<i>High</i>	<i>Low</i>	<i>High</i>	<i>Low</i>	<i>High</i>	<i>Low</i>	<i>High</i>
<i>A</i>	Gearing	50	50	30	30	60	60	60	60
<i>B</i>	Pre-tax cost of debt	3.4	3.7	3.4	3.95	3.55	3.55	3.55	3.55
<i>C</i>	Risk-free rate	2.0	2.0	2.5	2.75	2.5	2.5	2.5	2.5
<i>D</i>	R_m	5.0	7.0	5.0	7.25	5.0	7.0	5.0	7.0
	Asset beta (number)*	0.55	0.67	0.6	0.8	0.42	0.52	0.46	0.58
<i>E</i>	Equity beta (number)*	1.00	1.24	0.8	1.0	0.90	1.15	1.00	1.30
$F=C+E.(D-C)$	Post tax cost of equity	5.00	8.20	4.5	7.25	4.75	7.68	5.00	8.35
<i>G</i>	Taxation	28	28	30	30	28	28	28	28
$H=F/(1-G)$	Pre tax cost of equity	6.94	11.39	6.43	10.36	6.60	10.66	6.94	11.60
$J=B.A+H.(1-A)$	Pre-tax, real WACC	5.20	7.54	5.67	8.76	4.77	6.39	4.91	6.77
	Point estimate		7.1		7.74		6.2		6.5

Source: CC calculations and CC's Heathrow and Gatwick Q5 report.

*It is not possible to compare equity betas at different levels of gearing. Asset betas exclude the effects of gearing and therefore can be compared across airports.

123. The main reason for reducing returns from the 7.74 per cent a year figure built into Stansted's current price cap was a change in our calculation of beta. In our Q4 decision, we recommended deliberately and explicitly an equity beta significantly above the market evidence that was available to us at the time of the review. We expected BAA's equity beta to increase during Q4 as a consequence of the 11 September 2001 terrorist attacks and the large capital investment programme that BAA was about to undertake. This increase did not, in fact, materialize. Our choice of a lower asset beta for Q5 reflected a correction for this over-estimation, bringing down the allowed return.

124. We also noted the following differences between our recommendations for Stansted and our recommendations for Heathrow and Gatwick:

- (a) We adopted a target credit rating of A3/A- for Stansted (Heathrow and Gatwick Baa1/BBB-) in light of current debt market conditions. This in turn led us to assume a lower gearing of 50 per cent at Stansted compared with 60 per cent at Heathrow and Gatwick.
- (b) Our Stansted cost of debt assumption reflected several differences compared with Heathrow and Gatwick. The higher credit rating reduced the cost of debt and we also used a slightly lower allowance for fees. In the opposite direction, market movements led to a general increase in the cost of debt, although this was constrained by our embedded debt assumption.
- (c) Our estimate for the market return was unchanged compared with Heathrow and Gatwick. However, market conditions led us to slightly revise downwards our risk free rate assumption.
- (d) Our equity beta estimate reflected our views of the systematic risk of Stansted, which we concluded faced greater systematic risk than both Heathrow and Gatwick.

Credit ratings definitions

Long-term issue credit ratings

<i>S&P rating and Fitch rating</i>	<i>S&P definition</i>	<i>Moody's equivalent</i>
AAA	An obligation rated 'AAA' has the highest rating assigned by Standard & Poor's. The obligor's capacity to meet its financial commitment on the obligation is extremely strong.	Aaa
AA	An obligation rated 'AA' differs from the highest-rated obligations only to a small degree. The obligor's capacity to meet its financial commitment on the obligation is very strong.	Aa
A	An obligation rated 'A' is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligations in higher-rated categories. However, the obligor's capacity to meet its financial commitment on the obligation is still strong.	A
BBB	An obligation rated 'BBB' exhibits adequate protection parameters. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitment on the obligation.	Baa
BB, B, CCC, CC and C	Obligations rated 'BB', 'B', 'CCC', 'CC' and 'C' are regarded as having significant speculative characteristics. 'BB' indicates the least degree of speculation and 'C' the highest. While such obligations will likely have some quality and protective characteristics, these may be outweighed by large uncertainties or major exposures to adverse conditions.	Ba, B, Caa, Ca and C

Source: S&P

-
1. Plus (+), no suffix or minus (–), or in Moody's terminology 1, 2 or 3 show the relative standing within the major rating categories.
 2. Ratings of AAA/Aaa to BBB–/Baa3 are considered investment grade. Ratings of BB+/Ba1 and below are considered speculative.

R_m : geometric versus arithmetic averages

1. Table 7 in the appendix contains two different types of equity-risk premium and R_m estimates based on:
 - (a) an arithmetic mean: ie a simple average of the percentage returns in each year covered by the authors' samples; and
 - (b) a geometric mean: ie the compound rate of return over T years (or the T^{th} root of the value of the index at the end of T years divided by the value of the index at the beginning of the period, minus 1).
2. The arithmetic mean and the geometric mean in a sample of data will generally not be the same. As an example of this, suppose that an individual invests £100 in equities and finds that the market declines by 20 per cent in year 1 before increasing by 25 per cent in year 2. At the end of this period, the investor has £100 and has earned a zero return on the investment. The geometric mean in this case is zero. However, the arithmetic mean return is +2.5 per cent % (ie $-20 + 25$, divided by 2).
3. Except for the special case in which the annual rate of return is the same in every period, the arithmetic mean return will always be higher than the geometric mean return. Moreover, the greater the volatility in annual returns the greater tends to be the difference between the arithmetic and geometric returns.
4. In our cost of capital analysis, we were interested in obtaining estimates of the expected future values of the equity-risk premium and R_m . We looked at historical data on stock market returns because we believed that what happened in the past was likely to be a good guide to what will happen in the future. The question we faced was: should we in our CAPM analysis make use of the arithmetic mean return from previous years or the geometric mean return when selecting a value for R_m ?
5. Academic work has shown that neither of the two options gives exactly the right answer. The reason for this is that one tends to have data only from a sample of observations and does not know the underlying distribution from which these observations are drawn. If one assumes that R_m is drawn from a normal distribution with mean μ and variance σ^2 , it can be shown that the arithmetic mean return from a sample of historical annual data is an unbiased estimator of R_m after one year. However, after N years the arithmetic mean is biased upwards (ie it overstates the expected value of R_m after N years), while the geometric mean is biased downwards for so long as $N < T$.¹
6. If one further allows for the possibility that stock market returns in any given year are not independently distributed, and in particular for negative serial correlation or mean reversion over time, it can also be shown that the upward bias in the arithmetic average grows still further.
7. This means that the expected return on the market portfolio over the longer run (ie the sort of timescale in which we are interested when setting price limits for a regulated company) will lie somewhere between the arithmetic mean and the geometric mean obtained from historical data. Different experts have different views on which of

¹See Blume, 1974, *Unbiased Estimators of Long Run Expected Rates of Return*, or Fama, 1996), *Discounting Under Uncertainty*.

the two measures is the least biased or, alternatively, how the arithmetic and geometric means should be weighted. Because there is no obvious consensus on the matter, we did not seek to prefer one type of R_m estimate over another but instead took account of both arithmetic and geometric means in our cost of equity calculation.

Ex ante (expected returns) versus ex post (realized returns)

8. A further issue that requires consideration is the possibility that investors in the 20th century benefited from unusual good fortune and enjoyed more years in which the return on the market was higher than μ , than years in which R_m was lower than μ .
9. A number of researchers² have investigated this possibility and concluded that historical stock market returns overstate the returns that investors originally expected to earn and/or the returns that today's investors are likely to expect on their equity investments. In the main report we highlight work carried out by Dimson, Staunton and Marsh which suggests that the difference between ex ante and ex post ERP estimates may be as much as 1.5 percentage points. In coming to a view on the expected value of R_m we therefore need to recognize that both the arithmetic and geometric mean derived from historical data could give estimates which are too high for the purposes of setting a forward-looking cost of capital.

²See, for example, Fama and French, 2002, *The Equity Premium*.

Equity beta, asset beta and debt beta

Principles

1. In our analysis of the equity beta we had to compare the betas of firms with different levels of gearing. The usual way of controlling for changes in gearing is to obtain an estimate of a firm's underlying asset beta, using the formula shown below as Equation 1.

Equation 1: Asset beta, equity beta and debt beta at historical levels of gearing

$$\beta_a = \beta_e^h \cdot (1 - g^h) + \beta_d \cdot g^h$$

where β_a is the asset beta, β_e^h is a firm's historical equity beta, β_d is the debt beta and g^h is the historical gearing level.

2. In order to be able to calculate Stansted's cost of equity in Q5, we had to translate our asset betas into an equity beta for a company with 50 per cent gearing.
3. Equation 2 shows the formula that is used in this calculation.

Equation 2: Asset beta, equity beta and debt beta at Q5 gearing

$$\beta_e^{Q5} = \frac{\beta_a - \beta_d \cdot g^{Q5}}{1 - g^{Q5}}$$

where the Q5 superscript denotes that these values are for Q5.

4. The main evidence on which we relied comes from BAA's equity beta when it was a listed company with a gearing of 34 per cent. Substituting Equation 1 into Equation 2, and letting Δg denote the change in gearing gives:

Equation 3: Q5 equity beta

$$\beta_e^{Q5} = \frac{\beta_e^h \cdot (1 - g^h) + \beta_d \cdot \Delta g}{1 - g^{Q5}}$$

5. This final expression shows that our Q5 equity beta is a function of four variables: the historical equity beta, historical and assumed levels of gearing, and the debt beta associated with a gearing of between 34 and 50 per cent.

Estimation

6. There are two principal ways in which the debt beta parameter may be measured:
 - (a) a direct method, in which bond returns are regressed against returns on the market portfolio; and

(b) an indirect method, in which the observed cost of debt is decomposed into a number of smaller components to leave an estimate of the premium that lenders require as compensation for bearing systematic risk.

7. In our Heathrow and Gatwick review, we found that the regression-based approach was hampered by poor data quality and models with poor statistical properties. Therefore, we focused our attention on the indirect, decomposition method in which the debt beta estimate comes from the following formula:

Equation 4: Decomposition of debt premium

$$\begin{aligned} \text{Debt premium} &= \text{liquidity premium} + \text{default premium} + \text{default risk premium} \\ &= \text{liquidity premium} + \text{default premium} + \beta_d \cdot \text{MRP} \end{aligned}$$

where the debt premium is the difference between the risk-free rate and the cost of debt, the liquidity premium is the additional return that investors require if they are to hold any asset other than government bonds, the default premium is the expected cost of default (calculated as the probability of default multiplied by the loss suffered by the lender in the event of default), and the default risk premium is the compensation that investors demand in exchange for their exposure to the systematic element of this risk.

8. In order to estimate a debt beta, we must attribute values to each of the parameters in this equation. For the purposes of this review, our interest was primarily in the value of the debt beta between a gearing of 34 to 50 per cent. Over this range it was likely that Stansted would exhibit an A category credit rating, meaning that our estimate of the debt premium could come directly from the difference between our risk-free rate and cost of debt assumption, ie 140 to 170 basis points.
9. Our estimate of the liquidity premium in the Heathrow and Gatwick review was 30 to 40 basis points. This range was based on US academic studies which provided direct or indirect evidence of the proportion of the historical debt premium for investment-grade corporate debt that is attributable to illiquidity or to factors other than default risk. If anything, this was now likely to understate the current liquidity premium built into bond yields and the 140 to 170 basis points spread that we were decomposing. This was because at least a proportion of the increase in debt premiums since the start of the credit crunch was attributable to a 'flight to quality' and an increased desire among investors to hold government-issued debt rather than non-government assets.
10. In its submission, BAA/Oxera recommended that we should use a liquidity premium of 61 basis points based on the observed gap between AAA-rated corporate bonds and government gilts between 2003 and 2008. We considered this to be a more accurate and more up-to-date estimate than the liquidity premium used by us last year.
11. However, the default premium should not vary significantly over time. By design, we focused on the composition of the debt premium for debt with a given credit quality (ie A3/A-). These ratings, by definition, signify to lenders a certain expected cost of default and this allowed us to assume that the default premium in Equation 4 was a constant.
12. In this review we needed to update our 2007 estimate of the default premium to take account of the fact that we are looking at A3/A- rather than Baa1/BBB+ rated debt. Moody's Idealised Expected Loss Tables, created from expected default probabilities

and an assumption of a 45 per cent recovery rate in the event of default, indicated to us that the default premium on A3-rated debt ranges from 10 basis points for short-dated debt to 35 basis points for 30-year maturity debt.¹ We used this range in our calculations.

13. Table 1 combines these figures with our estimates of the liquidity premium, debt premium and the implied equity-risk premium in our overall WACC calculation to arrive at an estimate of the debt beta.

TABLE 1 Debt beta estimates (basis points)

		<i>Low</i>	<i>High</i>
Debt premium	R1	140	170
Liquidity premium	R2	60	60
Default premium	R3	35	10
Implied default risk premium	$R4 = R1 - R2 - R3$	45	100
Market risk premium (%)	R5	4.5	4.5
Debt beta (number)	$R6 = R4 * R5 / 100$	0.1	0.22

Source: CC calculations.

14. The range of 0.10 to 0.22 is very similar to the range of 0.09 to 0.19 that we identified in our 2007 Heathrow and Gatwick report. In this review, we started with a higher debt premium, but this did not translate into a higher debt beta because we also had a higher liquidity premium and a higher implied equity-risk premium.
15. Because the two ranges were very similar, we decided that it was appropriate to use the same point estimate of 0.1 that was used in our 2007 Heathrow and Gatwick review. However, we could not rule out choosing a value from closer to the midpoint of the range in future reviews.

¹This is the annual expected loss calculated using cumulative expected losses.

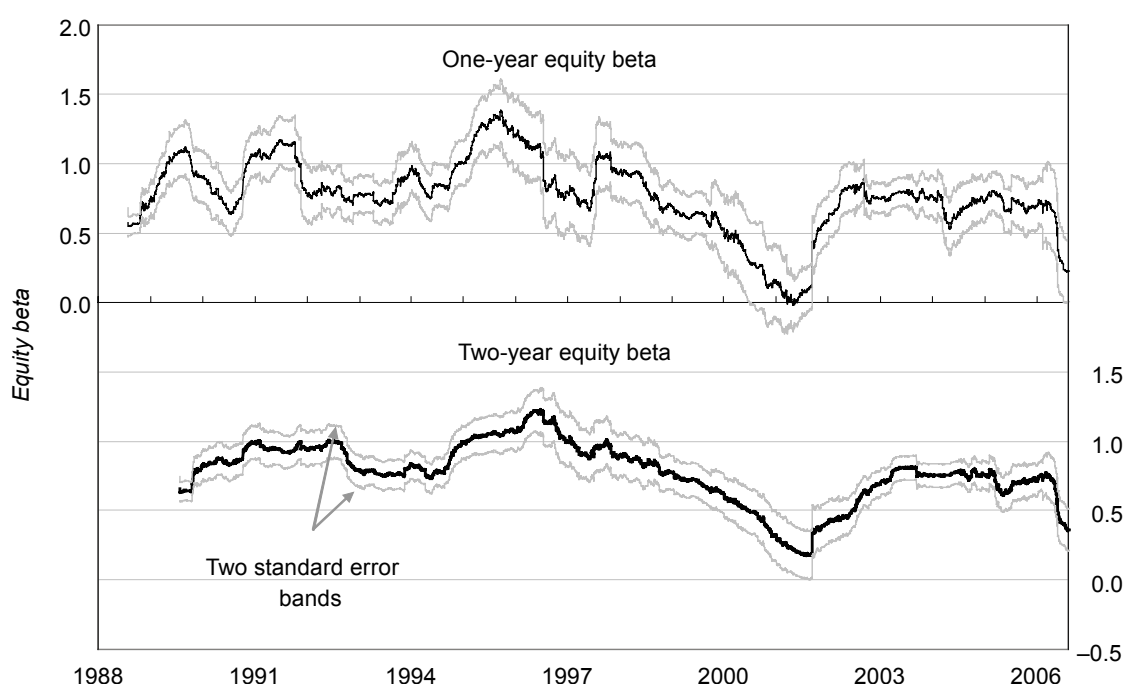
The calculation and disaggregation of BAA's beta

The BAA plc beta

1. The calculations of betas for Heathrow, Gatwick and the rest of BAA presented in paragraphs 80 to 107 of the appendix are anchored in an estimate of the BAA plc equity beta obtained prior to the group's delisting in 2006.
2. Figure 1 shows one- and two-year rolling beta estimates over the period 1988 to 2006.

FIGURE 1

Historical beta estimates



Sources: CC calculations, Thomson Financial.

3. The estimated equity beta over the two-year period prior to the announcement of ADI's interest in BAA was 0.74. Taking into account BAA plc's gearing over this same period (34 per cent gearing), this equity beta was equivalent to an asset beta of 0.52.

The BAA plc beta

4. The BAA plc beta can be disaggregated into component parts using the following formula:

Equation 1: BAA component asset betas

$$\beta_a^{BAA} = \frac{\beta_a^H \cdot K^H + \beta_a^G \cdot K^G + \beta_a^O \cdot K^O}{K^H + K^G + K^O}$$

where β_a is an asset beta, *BAA* is the BAA group, *H* is Heathrow, *G* is Gatwick, *O* is other BAA businesses (including Stansted) and *K* is the value of assets (of Heathrow, Gatwick and BAA group's other assets).

5. In our 2007 report into price controls at Heathrow and Gatwick we found the systematic risk of Gatwick to be higher but not substantially higher than Heathrow. Therefore, we used an asset beta which was 0.05 higher for Gatwick over Heathrow and assumed that the asset beta for Gatwick was no higher than the asset beta for the BAA group as a whole. These assumptions, together with the 0.52 estimate for the group asset beta as a whole, were sufficient for us to estimate asset betas for the individual component businesses, as follows:
 - (a) Heathrow: 0.47;
 - (b) Gatwick: 0.52; and
 - (c) other businesses: 0.61.