Oxera

Stand-alone costs of capital of Heathrow, Gatwick and Stansted Airports

Prepared for BAA

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Executive summary

This report estimates the real, pre-tax costs of capital for BAA's London Airports: Heathrow, Gatwick and Stansted on a separate (stand-alone) basis.[1] Using several methodologies based on a variety of analytical techniques and comparators, it aims to derive the most robust estimates of the airport-specific costs of capital where each airport is considered on a stand-alone basis.

The stand-alone costs of capital are estimated using the capital asset pricing model (CAPM) and WACC, which requires the asset beta, debt premium and gearing to be estimated separately for each individual airport, since the characteristics and riskiness of each airport might differ substantially.[2] Alternative methods of estimating costs of capital such as Fama–French are presented in a separate note.[3]

A fundamental driver of the results is the assessment of the underlying business risk at each airport. Given the absence of market information for the individual airports (ie, separate listings), a careful, in-depth analysis is necessary in order to arrive at the robust cost of capital estimates. This is particularly important in the light of the fact that historical evidence on the BAA Group cost of capital is not directly applicable to the estimates of the costs of capital of individual airports as stand-alone entities on a forward-looking basis. Moreover, there are widespread concerns identified by market practitioners, regulators, and academics (see, for example, the reports by Smithers & Co. for Ofgem[4]) regarding problems with stability and robustness of market beta estimates using historical data.

Since BAA Limited is now a private company and market data is no longer available, a robust cost of capital estimate should rely on different benchmarking methodologies taking into account different tools of financial analysis. Indeed, this is likely to be the only valid approach to the cost of capital estimation of the BAA regulated airports in the future.

In order to perform a bottom-up, comprehensive review, the analysis presented below uses the evidence from airport comparators (including the detailed, comparative assessment of multiple airport characteristics), types of airlines using particular airports, the financial drivers of risk, as well as different measures of volume, revenue and cash flow volatility for each airport, among other methods, in order to estimate betas for Heathrow, Gatwick and Stansted.

Given concerns about beta measurements as well as changes in regulation, corporate structure, and business composition, it is not surprising that a detailed bottom-up assessment may not concur with the estimates based on historical market data for the former BAA Group. Indeed, even in the absence of such changes, a standard approach used by financial analysts to identify the appropriate discount rate (cost of capital) and delineate value of the company, typically relies on the bottom-up analysis of business fundamentals, as reflected in financial flows, for each part of the business. Such an approach also aims to highlight the difference as regards observed market values at particular points in time. Still, this report takes into account historical measures of BAA Group beta where relevant, in order

[1] Heathrow and Gatwick as well as Stansted are analysed in this report and are jointly referred to as BAA's South East airports. However, CAA has recommended de-designation of Stansted in their December 2006 initial proposals.

[2] A uniform notional level of gearing for all three airports is assumed in the base case scenario.

[3] Oxera (2007), 'The cost of capital using the Fama–French model'.

[4] Wright, S., Mason, R., Satchell, S., Hori, K. and Baskaya, M. (2006), 'Report on the Cost of Capital', September 1st, Smithers & Co.

to reflect the joint ownership and financing of BAA's South East airports. A separate assessment might be necessary to quantify the impact of these factors more precisely.

Finally, it should be noted that the underlying business, financial and regulatory approaches faced by BAA airports necessarily change when moving from a group system to separately managed and regulated airports facing a fundamentally different set of incentives. Therefore, the correct estimates of individual, stand-alone costs of capital for each airport are critical in order to provide the correct investment incentives.

Results

Asset betas

In order to ensure the necessary robustness of the beta estimates as well as to avoid any potential biases that might be present in a selective use of different potential methodologies, the analysis presented below has used six different approaches for the estimation of the asset betas by airport. These methods include: peer comparison, analysis of clientele betas, derivation of risk differentials from till decomposition, estimation of betas based on financial drivers, analysis of cash flow and volume volatility by airport, and estimates of accounting betas including operational leverage. Weighted averages of the estimates using these approaches were then taken in order to arrive at the final results. The estimated ranges of overall weighted averages are presented in Table 1 below.

Table 1 Asset betas

Heathrow	Gatwick	Stansted
0.57–0.73	0.60–0.76	0.74–0.96

Source: Oxera.

It is important to note that the methodologies used for deriving asset betas incorporate an adjustment to take into account the evidence from the empirical estimates of BAA's Group beta based on historical market data. While this report argues that the use of several bottom-up methodologies is more robust than deriving beta estimates from the market evidence data, it adopts a conservative approach of taking those estimates into account in order to control for the potential effects of joint ownership and financing.

Gearing

In the base case scenario, a uniform notional level of gearing was assumed for all three airports based on regulatory precedent. Under an alternative scenario, the implied level of gearing for each airport was calculated on a stand-alone basis.

In order to avoid any potential biases, under the stand-alone scenario, the estimates of gearing were derived from the statutory allocation of equity by airport and reconciled with the regulatory asset base (RAB). All estimates were tested for consistency in terms of potential debt capacity of each airport. A summary of gearing assumptions is presented in Table 2 below.

Table 2 Notional (uniform) and implied (stand-alone) gearing assumptions by airport

Gearing assumption	Heathrow	Gatwick	Stansted
Notional (uniform) gearing	55	55	55
Standalone (implied) gearing	71	31	19

Note: Stand-alone gearing figures refer to the initial levels of gearing by airport estimated for 2006/7. Source: Oxera.

Debt premium

In order to correctly estimate debt premiums for individual airports it is necessary to consider the financial position of each airport individually through time according to established methodologies of credit default. The approach adopted in the report consists of the estimates of financial ratios, based on airports' financial performance, calculated in order to determine the implied 'shadow' credit rating for each airport as a stand-alone business. The shadow rating in each case determines credit risk of each airport and allows for the calculation of the implied debt premium by airport as the spread of an index of ten-year+ corporate bonds over the risk-free rate.

The ranges of implied debt premiums by airport are presented in Table 3 and are based on the notional, uniform level of gearing under the base case scenario and on the stand-alone gearing estimates by airport under the alternative gearing scenario.

Table 3 Implied debt premiums

Gearing assumption	Heathrow	Gatwick	Stansted
Notional (uniform) gearing	0.74-1.06	0.95-1.18	1.06-1.23
Stand-alone (implied) gearing	1.06-1.18	0.74-1.06	0.95-1.12

Source: Oxera.

Risk-free rate—based on the extensive review of market evidence and relevant regulatory precedent, a range of 1.75–2.5% was estimated for the risk-free rate. However, the latest market data as at April 24th 2007 suggest that real yields on index-linked bonds have increased over the recent months in line with interest rates. For example, the real yield on 5-year index-linked bonds has increased to about 2.2% and to even more for shorter maturities. The volatility of real interest rates does therefore suggest that a conservative estimate might lie in the upper half of this range.

Equity risk premium—based on the extensive review of market evidence and relevant regulatory precedent, a range of 3.5–5.0% was estimated for the equity risk premium.

Cost of capital estimates

Using the range of estimates for the parameters for the cost of capital presented above and the assumption of uniform gearing (55%) across airports, costs of capital were calculated for low- and high-case scenarios, with a midpoint also estimated. These results are presented in Table 4.

Table 4 Implied costs of capital under uniform gearing (excluding uplifts)

	Heathrow	Gatwick	Stansted
Range	5.34–8.78	5.61–9.06	6.36–10.52
Midpoint	7.06	7.33	8.44

Source: Oxera.

To maintain consistency from the precedent set in the Q4 price review, the measured costs of capital were uplifted by 0.5% to take into account the equity risk premium smoothing and Terminal 5 uplifts included in the CAA and Competition Commission decisions for Q4 regulatory period. These results are presented in Table 5.

Table 5 Uplifted implied costs of capital under uniform gearing

	Heathrow	Gatwick	Stansted
Range	5.84-9.28	6.11-9.56	6.86-11.02
Midpoint	7.56	7.83	8.94

Source: Oxera.

The alternative gearing assumptions, based on the implied, stand-alone levels of gearing by airport, result in similar cost of capital estimates to those under uniform gearing, as reported above. Table 6 presents cost of capital estimates under the stand-alone gearing scenario with uplifts.

Table 6 Uplifted implied costs of capital under stand-alone gearing

	Heathrow	Gatwick	Stansted
Range	6.06–9.36	6.00–9.50	6.73–10.94
Midpoint	7.71	7.75	8.83

Source: Oxera.

Finally, this report is supplemented by the evidence on the types of risk that are not captured in the traditional CAPM model. This includes the impact of additional, potentially asymmetric risks such as catastrophic risk and specific volume risk, including capacity constraints, as well as the results of the multi-factor models such as Fama–French.[5] The results from these supplementary analyses suggest that the costs of capital of BAA's regulated airports are likely to be in the upper half of the stand-alone range estimates presented in this report.

[5] Oxera (2007), 'The cost of capital using the Fama–French model'.

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1 Introduction

The CAA has consistently recognised that its statutory duties include taking an objective and balanced view on the regulated airports' costs of capital. As it recognised in its submission to the Competition Commission in 2002:

> Given a certain level of risk, the cost of capital is the level of expected return required by the financial markets to provide capital to a firm. It is often a critical issue in the regulation of capital-intensive utilities via RPI – X regulation as small changes in the cost of capital can have a major impact on the price cap and investment. This is the case for airports.[6]

Consequently, extensive consultation and efforts have been made at all preceding reviews to develop an accurate estimate of the cost of capital, principally through the capital asset pricing model (CAPM). Continuing to ensure that a firm's risk profile is accurately captured, despite potential changes over time, means that these efforts are just as important to the successful outcome of the forthcoming review (2008–13).

However, there are aspects in the forthcoming review period that bear considerable similarities to the 2003–08 period. In particular, the high levels of investment at the preceding review (particularly at Heathrow for Terminal 5) are likely to persist. BAA is planning continued investment at all three airports, with two major projects: Heathrow East and Stansted G2. Thus, motivations similar to those expressed by the CAA during the Q4 regulatory review are likely to remain important for the Q5 regulatory review:

> The cost of capital is a key parameter for this review. Given the importance of getting the best possible investment incentives for desired airport development we judge that in setting this parameter it is critically important not to set it too low in a price cap environment.[7]

The CAA has appreciated this similarity, highlighting in its December 2005 consultation paper that it:

> has in the past applied, and would expect to continue to apply, a cost of capital that provides sufficient remuneration for the long-term investments undertaken at airports. The CAA is mindful that the consequences for airport users over time of under- or over-estimating the cost of capital might be asymmetric, with the detrimental long-term impact of under-investment (resulting from a rate of return that is too low) potentially outweighing the short-term impact on prices through a rate of return that is too high.[8]

Providing a sufficient rate of return to remunerate the essential investment programme of the forthcoming period is therefore a key objective of this review. Without sufficient remuneration, the firm will be unable to attract continued finance from investors and marginal investment projects will be disincentivised.

Furthermore, going forward, BAA might adopt a new, permanent, financing structure based on a whole-business securitisation (WBS). Given the nature of WBS structures, this should result in more transparent, better incentivised, and more focused operations at each of the three airports; at the same time, it is likely to bring the corporate policy and the regulatory framework closer together, with reduced scope for error. This underscores the importance of

[6] CAA (2002), 'CAA Recommendations to the Competition Commission', p. 223.
[7] Ibid, p. 230.
[8] CAA (2005), 'Airports Review Policy Issues—Consultation Paper', December, p. 86.

correctly estimating a rate of return for the three airports, while not increasing the potential cost of financial distress as a result of a regulatory action unnecessarily triggering a credit event.

Developments in the corporate structure and the regulatory policy framework might therefore require further consideration as well as more detailed analysis to that undertaken in 2003. While independent costs of capital were applied in the Q4 regulatory review, the supporting analysis was not comprehensive, such that, in practice, the rates were the same across the airports. In its May 2006 Policy Update, the CAA proposed placing greater emphasis for Q5 on estimating a *different* cost of capital for each of the three regulated airports:

> Allowing separate costs of capital are more likely to provide appropriate incentives to invest, by removing the possibility of some airports being faced with a rate of return below the true cost of capital required by shareholders to compensate them for continued investment at the airport.[9]

Consequently, this submission is premised on the application of a 'stand-alone' approach to the cost of capital, whereby the differentiating factors between the three airports that affect their risk profile are reflected in separate estimates of the cost of capital for each. Importantly, the approach adopted in this submission treats each airport separately as though they were separate stand-alone corporate entities. This is appropriate, since the CAA's intention in setting price controls on a stand-alone basis is to remove the prospect of any cross-subsidies between airports.

This submission is structured as follows:

– section 2 introduces the methodology for estimating the cost of capital and the CAPM;
– section 3 outlines the approach to estimating stand-alone costs of capital within the CAPM;
– section 4 briefly reviews the market evidence and regulatory precedent on the *generic* parameters of the CAPM, although this is not intended to be the principal focus of the study;
– section 5 combines the preceding three sections to estimate a cost of capital for each regulated airport, and provides potential explanations for why the weighted average stand-alone estimate is higher than the group cost of capital.

[9] CAA (2006), 'Airports review—policy update', May, p. 105.

2 Methodology for estimating the cost of capital

In its December 2005 consultation paper, the CAA acknowledged the CAPM as the single most robust methodology available for estimating the cost of capital, while also recognising that other models can be informative and complementary.[10]

The model adopted for determining the allowed cost of capital (defined on a pre-tax real basis, consistent with that used by the CAA and Competition Commission) based on CAPM states that a firm's cost of capital is calculated according to the formula:[11]

$$WACC = (r_d \times g) + [r_e \times (1 - g)] / (1 - t)$$

where:

g = gearing

r_d = the cost of debt = (r_f + dp)

r_e = the cost of equity = (r_f + ERP x β)

t_c = the corporation tax rate

r_f = the risk-free rate

dp = the debt premium

ERP = equity risk premium

β = the risk of an asset relative to the market.

The key parameters (gearing, the debt premium and asset beta) in the weighted average cost of capital (WACC) are specific to the entity being assessed. However, the remaining parameters that need to be estimated (the risk-free rate and ERP) are generic to all applications of the CAPM and can therefore be treated separately. The CAA has stated its intention to concentrate on a high-level analysis of the generic parameters, while the Competition Commission would be likely to conduct a more detailed assessment.[12] For the purpose of this analysis, greater emphasis is placed on the stand-alone analysis, although an assessment of the generic parameters is also included.

Section 3 addresses the specific stand-alone airport parameters by using a variety of bottom-up methodologies, in the absence of any directly observable evidence. Section 4 considers the market evidence and regulatory precedent on the generic parameters. Section 5 complements these two CAPM-based sections by evaluating additional arguments that are relevant to the appropriate cost of capital, including arguments relating to catastrophic risk and non-CAPM models, such as the Fama–French approach.

In reaching a final range and value for the cost of capital, it must be stressed that the approach adopted throughout is a conservative and cautious one. In particular, a wide range of methodologies is used wherever possible, sensitivities are tested, and on each parameter a range, rather than a point value, is derived. This inclusive approach sometimes results in relatively wide range estimates for any given parameter or methodology adopted. However, this should not be taken to imply a thick tail distribution within a given range. Therefore, in these cases, it might be reasonable to assume a more narrow range or the midpoint as a robust estimate.

[10] CAA (2005), 'Airports Review Policy Issues—Consultation Paper', December, pp. 85–6.

[11] Assuming a debt beta of zero. See also Oxera (2007), 'Debt beta'.

[12] Ibid, p. 86.

Since a point value estimate for the final cost of capital is necessary, the midpoint of the range has been selected from the final range estimates. However, there are arguments that may influence the determination of the point value. The CAA has recognised that there is asymmetric risk from setting the cost of capital too low, as highlighted in its December 2005 consultation paper:

> The CAA has in the past applied, and would expect to continue to apply, a cost of capital that provides sufficient remuneration for the long-term investments undertaken at airports. The CAA is mindful that the consequences for airport users over time of under- or over-estimating the cost of capital might be asymmetric, with the detrimental long-term impact of under-investment (resulting from a rate of return that is too low) potentially outweighing the short-term impact on prices through a rate of return that is too high.[13]

This is consistent with the approach undertaken by other regulators. For example, Ofcom has indicated that it chooses parameter values above the midpoint in order to avoid under-investment.

> Ofcom's preferred approach to estimating a company's WACC typically involves choosing parameter values that are towards the upper end of the plausible range. An important motivation for this is uncertainty over the appropriate cost of capital and the belief that under-investment would be worse than over-investment.[14]

For the purpose of presenting the evidence derived from this study, a cautious approach is adopted in this report, based on the midpoints of the ranges. Nevertheless, there is some merit in Ofcom's arguments for using point estimates above midpoints in order to preserve investment incentives.

[13] CAA (2005), 'Airports Review Policy Issues—Consultation Paper', December, p. 86.

[14] Ofcom (2005), 'Ofcom's approach to risk in the assessment of the cost of capital', p. 100.

3 Estimating the stand-alone costs of capital

The three regulated London airports are separate companies all owned by BAA Ltd. This masks considerable variation in the operational and financial characteristics of each airport, and, in particular, in their risk profiles. Therefore, in order to assess the costs of capital on a stand-alone basis, it is necessary to consider the airports as separate entities.

To estimate the stand-alone costs of capital:

– the different risk characteristics at each airport must be identified so that the cost of capital at each can be estimated. This requires a bottom-up assessment of the risk profiles and financial characteristics of each airport;

– the costs of capital by airport should be estimated as though each airport were a separate entity. The CAA has alluded to this approach by emphasising that the assessment of any benefits of group financing is a separate analysis and decision. Indeed, only the stand-alone approach is likely to be consistent with the CAA's intention of encouraging optimal investment on the basis of an individual airport's characteristics. Thus, any impact on the cost of capital at an airport resulting from its status as part of a larger group should be extracted from group financing benefits. Again, this implies that a bottom-up assessment of the cost of capital is desirable.

This report presents a bottom-up analysis. To ensure robustness and avoid bias from data imperfections, independent but complementary methods have been used to estimate the cost of capital, the results of which can be used to establish confidence in the range for each airport.

As noted in section 3, some of the CAPM parameters (eg, the risk-free rate and ERP) are generic and can be estimated regardless of which airport is being assessed. By contrast, three parameters can be estimated at the airport level: beta, debt premium and gearing. For the tax rate, while it is plausible that separate effective rates could apply to each airport, in this analysis it is assumed that the marginal statutory rate applies to each.

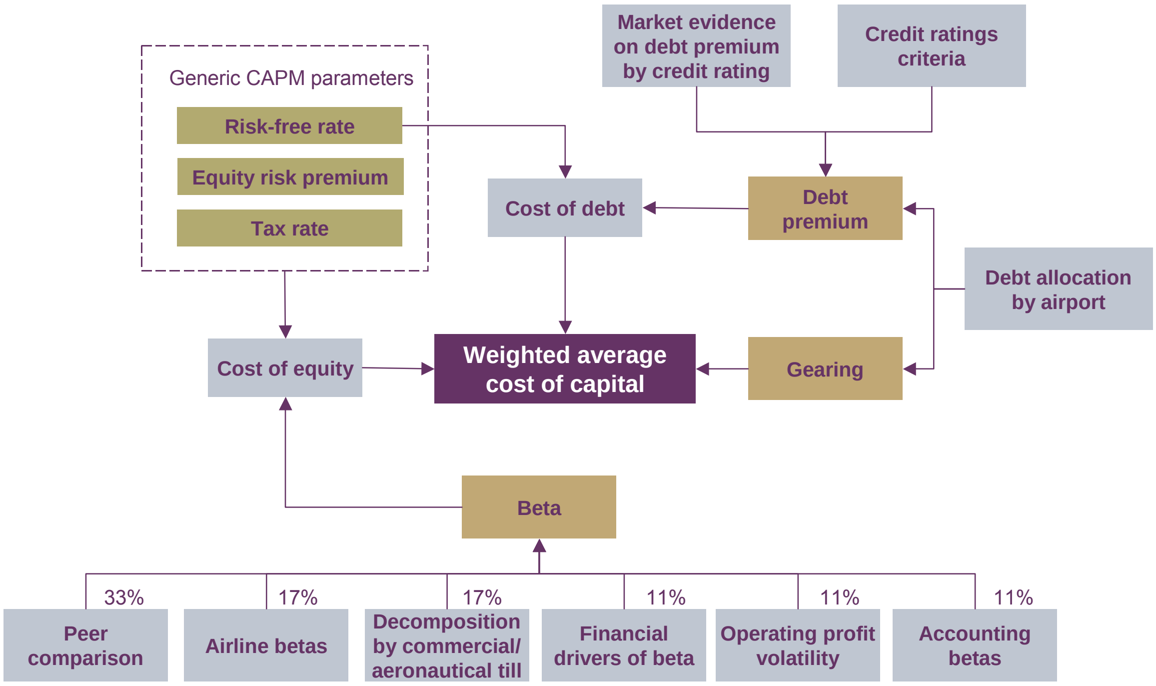
For beta, the methodologies adopted include:

– identification of comparator airports likely to have similar risk profiles;
– financial modelling of historical and forecast data on each airport to incorporate the information that equity investors would use in their financing decisions;
– use of proxies for risk factors that influence each airport, including airlines, property and real estate companies.

Certain methodologies—eg, peer comparison—are based on more comprehensive data, while, for others, only limited data is available. To reflect this, a weighting scheme is used to determine a final range for the cost of capital, as summarised in Figure 3.1. To avoid any potential bias from the adopted set of weightings, a range of sensitivities was tested (including equal weighting) to ensure that the results were robust with respect to the adopted methodology.

For the debt premium, the methodology focuses on financial modelling to obtain implied credit ratings for each airport against credit rating agency criteria, which, combined with market evidence, implies a range for the debt premium. For gearing, financial modelling is again used, based on assumptions about the implied allocation of existing debt between the airports, statutory equity, and an estimate of the market value on the basis of assets. Projected and optimal indicators of gearing are given less weight, in recognition of the desirability of not prescribing a firm's capital structure, particularly given considerable uncertainty. Moreover, an alternative approach to gearing is also adopted with a uniform, notional level of gearing assumed for all three airports. This approach has the advantage of not relying on the difficult allocation of existing debt across airports. It is important to stress that the overall results of the analysis are relatively robust to different approaches to gearing.

Figure 3.1 The methodologies and weightings used to estimate the cost of capital



Note: The application of equal weights to the methods of beta estimation has also been calculated, and does not lead to significant differences in the estimated results (see Table 3.1).
Source: Oxera.

The methodologies make repeated reference to fundamental differences in the operations of the airports, and Table 3.1 provides a high-level summary of these differences.

Table 3.1 Key characteristics of BAA regulated airports

	Size (no. of passengers)	CAPEX (provisional forecast over Q5, £m)	Financial position (FFO:debt average over Q5)	Volume volatility (standard deviation/mean)
Heathrow	67,863	3,063–3,563	14	0.162
Gatwick	33,365	301	30	0.189
Stansted	22,974	1,976	20	1.356

Note: Size represents the number of passengers in the 12 months to June 2006. CAPEX data is as reported by the CAA and includes Stansted G2 up to 2015. FFO, funds from operations.
Source: BAA website; CAA (2005), 'Airports Review Policy Issues—Consultation Paper', December; BAA Group Strategic Model; and Oxera calculations.

The substantial difference in volume volatility between Stansted and Gatwick and Heathrow can be partly explained by the high growth rate of traffic volume at Stansted. For example, over the period from January 1998 to December 2005, the monthly flow of passengers at Heathrow and Gatwick has increased by 28% and 85% respectively, while at Stansted it has more than tripled.

3.1 Stand-alone estimates of beta

3.1.1 High-level peer comparison of beta estimates

Methodology

Peer comparison is an established tool of analysis where direct data is not available. Beta estimates may therefore be obtained for airports with similar characteristics operating in a similar risk environment, and then transferred to each of BAA's London airports. Since there are inherent measurement errors in estimating beta, and since no two airports are likely to be identical, for any given airport it is desirable to identify a group of peers based on a range of financial, regulatory and operational characteristics.

In principle, companies from outside the airport sector may also be suitable candidates for the peer comparison. For example, airports are typically capital-intensive businesses, and so infrastructure funds may be informative. The telecommunications industry is also regulated, and airlines may face similar risks, particularly with respect to volumes. However, there are also considerable differences between the sectors and it is difficult to isolate the contribution of a particular characteristic to the beta. As a result, only airports were used quantitatively in the peer comparison analysis. Still, the data on related sectors, such as airlines and commercial real estate, has been used in other methods adopted in this report, as explained below.

A range of business characteristics was employed to assess the most appropriate peers. While some were explicitly included because they are expected to have a considerable impact on the beta (eg, the ratio of CAPEX to total assets or revenues), more general indicators (such as passenger numbers and number of air traffic movements, ATMs) were included to reflect the uncertainties over the drivers of beta and the value of having suitably close peers. The sample of airports included those for which a robust beta estimate could be obtained. One limitation of this approach is that it is not possible to control for variation in the regulatory regime between airports. The characteristics and airports assessed are presented in Table 3.2.

Table 3.2 Characteristics and airports

Characteristics of airports	Airport comparators
Total number of passengers	Fraport
Total ATMs	Rome Fiumicino
Commercial proportion of total revenues	Copenhagen
CAPEX:total assets	Sydney
CAPEX:revenues	Zurich
Concentration of airlines	Auckland
Percentage of low-cost airlines	Vienna
	Birmingham
	Brussels

Source: Oxera.

For certain characteristics, peers tend to be difficult to identify. Stansted, for example, has a much higher proportion of low-cost airlines than any other airport in the sample.[15]

[15] For details of how the detailed scoring was completed, see Appendix 1. Only in the manual selection method does the lack of obvious comparators become problematic. In the case of the proportion of low-cost airlines at Stansted, this is dealt with by excluding this characteristic from the assessment.

Nevertheless, three systematic mechanisms, using a variety of scoring techniques, were employed to ensure that the closest peers were objectively identified. See Appendix 1 for further details.

Results

Table 3.3 presents the comparators manually selected for each of the London airports according to a ranking of airports using a range of characteristics. First, a simple mean average of these selected comparators was taken to provide the average beta for each characteristic. Second, a simple mean average of these average betas by characteristic was taken to provide the overall beta estimate for each airport. This was one of three methods identified, and described in Appendix 1.

Table 3.3 Airport comparators using manual selection method

	Heathrow	Gatwick	Stansted
Airline concentration	Rome, Copenhagen	Zurich, Fraport	Sydney
Proportion of low-cost airlines	Fraport, Rome, Zurich	Sydney	–
Passenger numbers	Fraport	Rome, Sydney	Sydney, Copenhagen, Zurich
ATMs	Fraport, Rome	Sydney, Zurich, Vienna	Vienna, Auckland
% of commercial revenues	Auckland, Sydney	Auckland, Sydney	Auckland
CAPEX:total assets	Copenhagen	Zurich, Vienna, Auckland, Fraport	Birmingham, Brussels, Rome, Sydney
CAPEX:revenues	–	Zurich, Vienna, Auckland	Brussels, Birmingham
Simple average asset beta	**0.73**	**0.86**	**0.96**

Note: Where no peer airports are listed, none was considered a suitable comparator.
Sources: Bloomberg and Oxera calculations.

There is a reasonable degree of consistency in the reported peers, leading to differentiation in the average asset beta, most notably between Stansted, on the one hand, and Heathrow and Gatwick, on the other. Since the peers have been identified on the basis of operating and financial characteristics, they are likely to reflect similarities in the risk profile of the airports. Thus, it is reasonable to assume that Stansted will have a somewhat higher asset beta than Heathrow or Gatwick.

This result was found to hold regardless of the selection method employed, providing considerable confidence in the results. Table 3.4 presents a summary of the asset betas implied by each of the three selection and scoring methodologies, and the final overall range. The high-level conclusion is that Stansted has a substantially higher beta than Gatwick, which is itself somewhat higher than Heathrow.

Table 3.4 Asset beta range implied by airport peers

	Heathrow	Gatwick	Stansted
Manual selection method	0.73	0.86	0.96
Selecting the nearest four airports	0.75	0.81	0.97
Distance scoring method	0.83	0.86	0.89
Overall asset beta range	**0.73–0.83**	**0.81–0.86**	**0.89–0.97**

Sources: Bloomberg, Datastream, and Oxera calculations.

3.1.2 Airline betas as indicators of risk

Methodology

Since airlines and airports are so closely linked in the value chain, differences between airports in the uncertainty over cash flow from airlines would be expected to translate directly into differences in risk, and therefore beta. A major benefit of this approach is that the three BAA-regulated airports are highly differentiated by the airlines they serve.

Having identified the asset betas of the airlines operating at the individual airports (and estimated the betas for unlisted airlines on the basis of appropriate peers), an asset beta for each airport can be obtained, based on the average of asset betas weighted by their percentage contribution to aeronautical revenues at the airport.

Airlines typically have high betas due to the relatively strong correlation between GDP and passenger volumes, as demonstrated by income elasticity estimates. Given that passenger volumes also have a direct impact on airports, both directly in terms of the driver for aeronautical charges, but also indirectly for commercial revenues, the airports that rely most heavily on airlines with high betas are themselves likely to face higher betas.

However, since airline betas might be systematically higher than airport betas (inter alia, reflecting the different risks faced by different parts of the value chain), it is necessary to scale the derived airline betas by a factor that captures the relationship between airlines and airports in general. Two mechanisms were used to make this adjustment:

– the weighted average of clientele airline betas was adjusted by the ratio of the average of all airline betas with the average of all comparator airports;
– the weighted average of clientele airport betas was adjusted by the ratio of the average of the beta of airlines at BAA's three regulated airports (weighted by revenue share) to the estimate of the historic, observed market beta for the former BAA Group.

Results

Table 3.5 details the top three airlines at each airport in 2005/06 on the basis of revenue, along with their asset betas (estimated on the basis of peers where not available).

Table 3.5 Top three airlines by revenues and their associated betas

	Airline	% revenues	Asset beta
Heathrow			
1	British Airways	[Excised]	0.9
2	British Midland	[Excised]	0.95
3	Virgin Atlantic	[Excised]	0.7
Gatwick		[Excised]	
1	British Airways	[Excised]	0.9
2	easyJet	[Excised]	1.8
3	Monarch	[Excised]	0.45[16]
Stansted		[Excised]	
1	Ryanair	[Excised]	1.0
2	easyJet	[Excised]	1.8
3	Air Berlin	[Excised]	1.0

Note: Actual analysis was based on all airlines accounting for greater than 1% of revenues, not just the top three presented here. Betas for unlisted airlines were estimated from peer comparators.
Source: BAA, Bloomberg and Oxera calculations.

The evidence suggests that airlines operating at Stansted had a higher beta. This is intuitive—low-cost airlines typically target short-break holidaymakers as their core customers, rather than business travellers. Since short-break holidaymakers are likely to be more income-elastic than businesses travellers, low-cost airlines might be expected to have higher betas. This is supported by higher passenger volatility at Stansted (see Table 3.11). If this were the case, the methodology would suggest that this cash-flow volatility would be passed on to the airport—ie, that Stansted would have a higher beta.

Table 3.6 presents the implications for beta of the two transmission mechanisms discussed above. The principal conclusion is that, while Heathrow and Gatwick are likely to have quite similar betas, that of Stansted is notably higher.

Table 3.6 Implied asset betas by airport

	Unadjusted airline beta	Adjusted for airport: airline beta ratio	Adjusted for BAA:airline beta ratio
Heathrow	0.86	0.82	0.61
Gatwick	0.86	0.84	0.63
Stansted	1.07	1.02	0.76

Source: Datastream and Oxera calculations.

[16] The beta for the Monarch Airline in June 2006 was estimated as a simple average of two comparators: First Choice Holding Plc (β=0.665); and Thomsonfly, TUI AG (β=0.224). The comparators are leisure airlines operating in the UK and Spain, which fly to leading holiday resorts. However, as at March 2007, measured market betas for these comparators have changed considerably. In particular, the beta for the First Choice Holding Plc has changed to 0.766, whereas the beta for Thomsonfly, TUI AG has changed to 0.685. Therefore, the beta estimate for Monarch is 0.73 based on updated data. Although the original data is used in the calculations, it should be noted that this might bias results for Gatwick's cost of capital downwards.

3.1.3 Decomposition by commercial and aeronautical till

Methodology

Airports differ in their dependence on commercial versus aeronautical revenues. Since the drivers of these two business operations may be somewhat different, the associated risks are also likely to be different.

BAA's commercial operations are driven by rental agreements with retailers; therefore, comparators for the commercial till beta have been identified as 20 real estate companies taken from the FTSE 100 (see Table 3.7). While BAA does have some revenue-sharing agreements with tenants that may indicate that retail firms are a more robust comparator, these are negligible as a source of revenue and were therefore discounted.

Table 3.7 Comparators for BAA's commercial operations and their betas (five-year monthly beta in March 2006)

	Equity beta	Gearing (%)	Asset beta
Big Yellow Group	1.15	12%	1.01
British Land	0.88	58%	0.37
Brixton	0.72	48%	0.38
Capital & Regional	0.56	43%	0.32
CLS Holdings	0.74	63%	0.28
Derwent Valley	0.95	41%	0.57
Development Securities	0.94	14%	0.82
DTZ Holdings	1.66	n/a	1.74
Freeport	0.91	13%	0.79
Hammerson	0.94	47%	0.50
Land Securities	0.73	30%	0.51
Liberty International	0.64	48%	0.33
London & Associated Ports	0.74	51%	0.36
London Securities	1.19	26%	0.88
Maryl Warwick Balfour	1.53	75%	0.38
McKay Securities	0.77	42%	0.45
Minerva	1.08	54%	0.50
Mucklow A & J GP	0.38	23%	0.29
Primary Health Properties	0.43	58%	0.18
Quintain Estates and Developments	0.38	40%	0.23
Median	**0.83**	**43%**	**0.42**
Simple average	**0.87**	**41%**	**0.54**

Source: Datastream and Oxera calculations.

Two methods are then possible to infer an aeronautical till beta for each airport, based on:

– airport comparators where the overall beta and relative dependence on commercial and aeronautical revenues are known;

– historic beta estimate for the former BAA Group and its average dependence on commercial and aeronautical revenues across the three regulated airports.[17]

The implied aeronautical betas can then be applied at each of the three regulated airports, depending on the proportion of commercial and aeronautical revenues at each.

Results

The commercial till comparators suggested an average asset beta of 0.54. This relatively low value reflects the relatively low systematic risk exposure of property and real estate developers and investors used as comparators, even though these firms may be subject to considerable idiosyncratic shocks. It also reflects the fact that pure retailers characterised by higher betas have not been used in the analysis; however, it could be argued that the airports might be partly exposed to risks similar as those faced by pure retailers.

Table 3.8 records the commercial and aeronautical till dependence of each airport in the sample.

Table 3.8 Commercial and aeronautical tills at comparator airports

	Commercial till (%)	Aeronautical till (%)
Aeroporti di Roma	49	51
Auckland	47	53
BAA	51	49
Birmingham	39	61
Brussels	40	60
Copenhagen	42	58
Fraport	29	71
Sydney	46	54
Vienna	35	65
Zurich	41	59

Source: TRL and Oxera calculations.

The commercial till beta implies an aeronautical beta of 0.90, on the pure stand-alone basis of the average across the full sample of airports, and 0.68 on the basis of the historical BAA Group beta estimates. The assumption that aeronautical betas might be higher than commercial betas may initially appear counterintuitive. However, given the recognised vulnerability of the aviation industry to passenger downturns, and the comparative stability of the rental and real estate agreements that dominate the commercial business, this is likely to provide an accurate representation of the risks.

Furthermore, there is evidence of a 'dampening effect', such that a reduction in the number of passengers may not lead to a comparable fall in spending, since less congestion permits greater spend per passenger. Nevertheless, there may be an argument for narrowing the gap between the commercial and aeronautical till betas estimated here, on the grounds that an airport's commercial beta might be somewhat higher than that of the comparators. Specifically, there may be additional risk associated with the reliance on passenger throughput (which will be factored into rental values), and this may be more sensitive to fluctuations in GDP than general retail expenditure.

[17] Ideally, the appropriate weighting between business components would be on the basis of market value. However, in the absence of information on relative valuation, the use of revenues is the best available proxy. The historic market beta estimate for the former BAA Group was used in this context in order to avoid circularity in the analysis. Ideally, a weighted average of the forward-looking beta estimates for the three individual airports would be used. The adopted approach might bias the results downwards.

Table 3.9 shows that the airports are, to a limited extent, differentiated on the basis of dependence on aeronautical revenues, and that this translates into modest differentials in beta, with Gatwick having a marginally lower beta due to its greater dependence on commercial revenues.

Table 3.9 Beta decomposition by till

	Aeronautical revenues (%)	Commercial (and other) revenues (%)	Beta implied by calibration across full sample of airports	Beta implied by calibration with BAA's beta[1]
Heathrow	60	40	0.76	0.63
Gatwick	47	53	0.71	0.61
Stansted	58	42	0.75	0.63

Notes: [1] This method is calibrated according to BAA's group market beta.
Source: BAA, TRL, Datastream and Oxera calculations.

3.1.4 Financial drivers of beta

Methodology

Since beta is an indicator of risk, it reflects the underlying business and financial characteristics of an entity. Academic literature identifies an empirical relationship between a range of financial variables and a firm's beta.[18]

Panel data regression was undertaken to identify the relationship between observed betas and financial characteristics for a group of 74 peers from the UK utility, transport, retail and property sectors. To control for the impact of sector-specific risk characteristics, dummies were included for each sector. The financial characteristics were those that might intuitively be expected to have an impact on beta:

– ratio of CAPEX to free cash flows;
– ratio of CAPEX to fixed assets;
– EBIT margin;
– market value.

To predict forward-looking beta estimates for each regulated airport, the coefficients derived from the above analysis were applied to data obtained from BAA's Group Strategic Model for Q5 (June 2006).[19] The cash-flow measure of capital intensity (CAPEX to FCF) is preferred to the accounting measure (CAPEX to fixed assets) because of potential biases that might be introduced when using BAA's accounting data to make predictions. For that reason, and in order to avoid the potential double-counting of the CAPEX impact on betas, the CAPEX to fixed assets variable was dropped from predictions.

Results

Four models with differing econometric assumptions were derived, relating various financial variables to asset betas. The most striking result was that all four of the models revealed a positive relationship between beta and the ratio of CAPEX to fixed assets. In three out of four model specifications, this was significant at the 95% level. Other relationships included a weak positive link with CAPEX to free cash flows and a negative link with the EBIT to sales ratio. Details of the four models are provided in Appendix 3.

[18] Callahan, C.M. and Mohr, R.M. (1989), 'The Determinants of Systematic Risk: A Synthesis', *The Financial Review*, **24**, 157–181. Kulkarni, M.S., Powers, M. and Shannon, D.S. (1991), 'The Use of Segment Earnings Betas in the Formation of Divisional Hurdle Rates', **18**:2. Ismail, B.E., Kim, M.K. and Kirk, F.R. (1994), 'Accounting Data and the Prediction of Risk in the Extremes', **1**, 55–68.
[19] An estimate for the market value of each airport was obtained by disaggregating BAA's market value on the basis of assets.

The results of applying these models to Heathrow, Gatwick and Stansted are presented in Table 3.10. While there is relatively little differentiation, this masks differences in the financial drivers between airports. For example, the CAPEX to fixed assets indicator is considerably higher at Stansted than at Gatwick or Heathrow, but this is offset in the models by a lower EBIT margin. In addition, Heathrow is much higher than Gatwick on the CAPEX to free cash-flow indicator. Overall, these results should be treated with caution given the robustness of the individual parameters in the regressions. In particular, Stansted beta estimates appears to be relatively low in comparison with other methodologies.

Table 3.10 Asset betas implied by financial regression models

	Model 1	Model 2	Model 3	Model 4	Average
Heathrow	0.61	0.45	0.66	0.65	0.59
Gatwick	0.63	0.41	0.65	0.66	0.59
Stansted	0.58	0.40	0.64	0.65	0.57

Source: Datastream and Oxera calculations.

3.1.5 Operating profit volatility

Methodology

The historical regulatory regime for BAA has been a price cap specifying a maximum price that may be recovered from airlines for each passenger. This regime places all volume risk on BAA—changes in GDP that affect passenger numbers lead to higher or lower revenues. Because the underlying volatility of volumes is likely to vary between airports (due to different routes, business models and levels of excess demand), the beta will also vary between airports. For example, the revenues and profits of airports with higher volume volatility are likely to fluctuate much more sharply in response to market conditions.

In general, volatility can be estimated using a number of indicators, the most informative for beta is likely to be operating profit volatility, as this is likely to be closely related to stock market returns in the longer term.

An element of the observed volatility in volumes and profits may well be idiosyncratic and not correlated with the market, such that an airport with higher business volatility may not be exposed to higher *systematic* risk, but simply additional idiosyncratic risk. One idiosyncratic factor that is likely to have a significant impact on volatility is seasonality. Therefore, measured volatility for each of the three airports has been adjusted for seasonality in the data.

Beyond seasonality, it is difficult to delineate and classify the causal factors in business volatility of each individual airport according to their systematic component. Therefore, it has been assumed that the correlation coefficient of returns of any of the airports with the market is equal to the correlation coefficient of returns on BAA Group with the market.[20] This directly implies that the ratio of betas of one airport and BAA is equal to the ratio of standard deviations of the same airport to BAA:

$$\frac{\beta_{\text{airport}}}{\beta_{\text{BAA}}} = \frac{\text{Volatility}_{\text{airport}}}{\text{Volatility}_{\text{BAA}}}$$

[20] Former BAA Group has been used as a reference entity in this case.

where volatility is measured by the standard deviation of returns. This implies that an airport with a higher than average volatility of profits will have a higher beta.[21]

Results

Table 3.11 shows that operating profit volatility is lowest at Heathrow and highest at Stansted. Given the transmission mechanism specified above, this directly translates into a significantly higher beta at Stansted, regardless of whether the mean or median operating profit is used to standardise the volatility measures. The intuition behind the results presented below is clear—higher volatility generates greater systematic risk and a higher beta, in line with expectations and the profiles of the three airports.

Table 3.11 Asset betas implied by differences in volume and profit volatility

	Volume volatility (adjusted standard deviation)	Revenue volatility (adjusted standard deviation)	Operating profit volatility (adjusted standard deviation)	Implied asset beta
Heathrow	0.162	0.208	0.211	0.63
Gatwick	0.189	0.334	0.337	1.01
Stansted	1.356	0.503	0.467	1.40

Source: Datastream and Oxera calculations.

3.1.6 Accounting betas

Methodology

The reason that a number of methodologies are used here to estimate the regulated airports' asset betas is that there is no directly observable market evidence—only BAA as a group has been listed on the stock markets, with associated data on historical returns.[22] However, some of the information that would inform any such listing is recorded by BAA. In particular, the volatility of earnings is informative and can be used as a proxy for systematic risk.

Thus, accounting betas use accounting rather than market data to estimate beta. Furthermore, they use operating leverage (the proportion of fixed costs in total costs) rather than financial leverage.

The basic dynamic of accounting betas is that the asset beta is closely related to the beta of revenues (ie, their systematic component) and operational leverage. The argument is similar to that regarding operating profit volatility, since more volatile revenues and a greater proportion of fixed costs are likely to create more volatile operating profits and hence a higher beta.

Evidence on cost structure is relatively straightforward to obtain, although judgements must always be made about the period over which costs are rigid. Two measures obtained from BAA have been used for robustness: the first is an estimate of the present value of costs that are fixed over a period of at least 12 months, and the second over a period of at least 24 months.

However, a more subtle approach is required for the beta of revenues due to data limitations. In the following analysis, the betas of airlines are used as a proxy for the beta of *operating profits*, since their activities constitute a large proportion of an airport's earnings. This

[21] See Appendix 2 for details.

[22] BAA plc was delisted in August 2006.

estimate, obtained from the results of the methodology in section 3.1.2, can then be adjusted to derive the beta of revenues for each airport using the relationship:

$$\frac{\beta_{(revenue)}}{\beta_{(operating\ profits)}} = \frac{Volatility_{(revenue)}}{Volatility_{(operating\ profits)}}$$

The formula for calculating the asset beta is then defined as:

$$\beta_{(asset)} = \beta_{(revenue)} \times \left(1 + \left(PV_{(fixed\ costs)} / PV_{(fixed\ assets)}\right)\right)$$

where PV is the present value.

Results

There is clear differentiation between the airports, as indicated in Table 3.12, with Stansted having the highest beta and Gatwick the lowest under both scenarios. Part of the explanation lies in the airline beta differentials identified in section 3.1.2. However, there is a degree of variation in the fixity of costs which also affects the results—in particular, Gatwick's relatively high proportions of fixed costs would increase beta, while the low proportions at Heathrow are likely to reduce it, since lower fixed costs imply that prices are more closely geared to marginal costs, and hence provide greater protection from downturns in volume.

Table 3.12 Accounting beta results

	Fixed costs/EBITDA (Method 1)	Fixed costs/EBITDA (Method 2)	Asset beta (Method 1)	Asset beta (Method 2)
Heathrow	[Excised]	[Excised]	0.30–0.37	0.37–0.46
Gatwick	[Excised]	[Excised]	0.14–0.18	0.20–0.25
Stansted	[Excised]	[Excised]	0.51–0.62	0.68–0.84

Note: Method 1 assumes that costs are fixed over a period of 12 months; Method 2 assumes that costs are fixed over 24 months.
Source: BAA and Oxera calculations.

3.1.7 Summary of range of asset beta estimates

For the three regulated airports, the range of asset betas implied by the above methodologies is illustrated in Table 3.13 and Figures 3.2–3.4. A number of aggregation procedures are used to reflect the possible ways in which such data can be employed. The weighting scheme giving precedence to those methodologies with the greatest reliability is preferred and gives a range based on the average of the high estimates and the average of the low estimates across methodologies. These weightings can only be specified relatively arbitrarily, but a check is made by also reporting the results on the basis of equal weightings—these do not vary appreciably, although the estimates tend to be marginally lower.

Two of the methodologies (airline betas and decomposition by till) provide a range that includes a degree of calibration with the historic estimates of BAA's group beta. While it has been stressed that the starting point for all of the methodologies is a bottom-up analysis, such calibration might be important in reaching final estimates in the context of the regulatory review, since the CAA has stated its intention to consider the merits of including or excluding the benefits of a group financing structure. For consistency, it is therefore desirable that such calibration is extended to the other methodologies. This is achieved by adjusting one end of the range of each methodology to reflect the average degree of overestimation in a particular methodology's results across airports.[23] It should be noted that this results in a downward adjustment to the estimates in almost all cases.

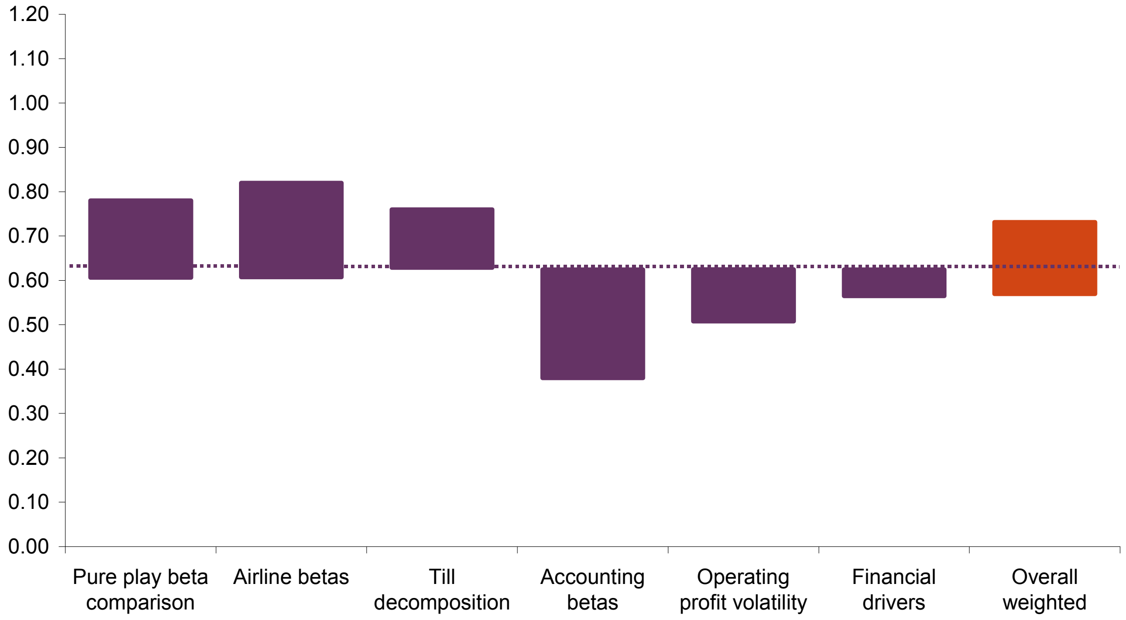
While there is considerable variation in the results, which naturally arises from the wide range of methods employed and the use of proxies for certain data sources, there are identifiable trends in the evidence. In particular, Stansted reports the highest betas on most of the indicators (with the exception of the financial drivers methodology).

Table 3.13 Beta estimates across aggregation procedures

	Equally weighted range[1]	Weighted range[2]
Bottom-up beta assessment		
Heathrow	0.56–0.69	0.61–0.73
Gatwick	0.60–0.73	0.65–0.77
Stansted	0.77–0.95	0.79–0.95
Normalised beta assessment		
Heathrow	0.55–0.71	**0.57–0.73**
Gatwick	0.58–0.73	**0.60–0.76**
Stansted	0.75–0.98	**0.74–0.96**

Note: [1] Assumes that a weight of one-sixth is applied to each of the six methods presented. The weights shown in Figure 3.1 are used. Although arbitrary, these figures are intended to reflect broadly the robustness of each method. Bold values are those used in Figures 3.3–3.5 and in calculating a cost of capital range for each airport.
Source: Oxera.

Figure 3.2 Asset beta methodologies at Heathrow



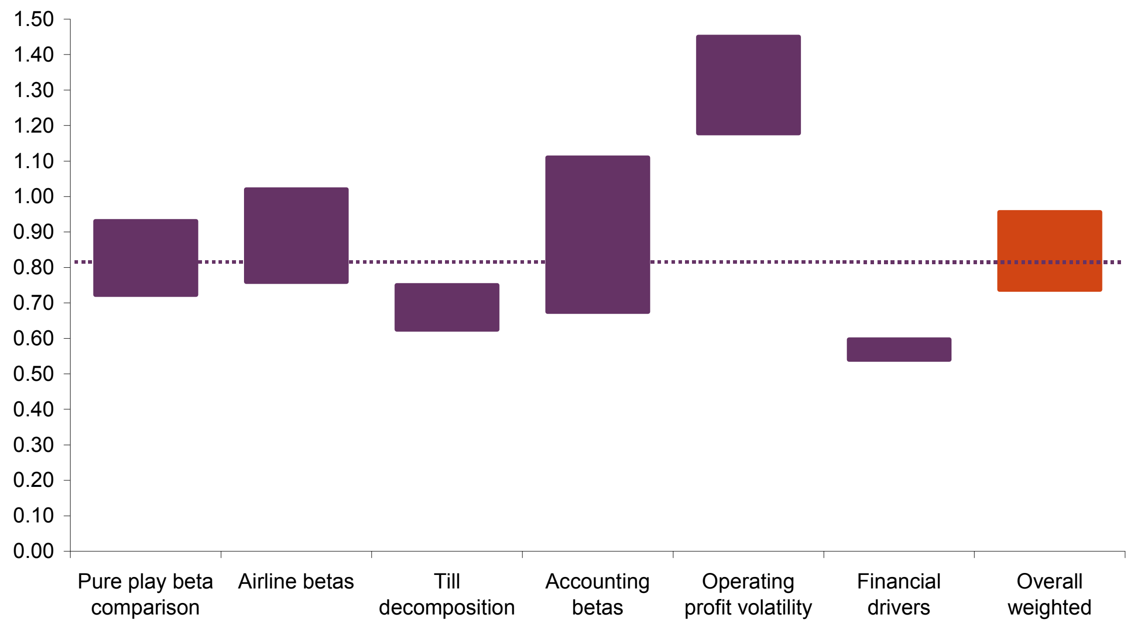
Source: Oxera calculations.

[23] A weighted average is used, where the weights reflect the RAB of each airport.

Figure 3.3 Asset beta methodologies at Gatwick

Source: Oxera calculations.

Figure 3.4 Asset beta methodologies at Stansted



Source: Oxera calculations.

3.2 Estimates of the debt premium

The debt premium is the additional return required by bondholders for investing in a firm's (inherently risky) debt as opposed to investing in a risk-free asset, such as government bonds. At the 2003 review, for example, the CAA made final recommendations of a debt premium of 90–120 basis points over the risk-free rate.

3.2.1 Methodology

Debt premiums reflect the risk of a firm's financial structure and position—for example, a firm that has small positive cash flows but needs to cover substantial interest payments is likely to have a high debt premium. Various credit rating agencies provide ratings for listed debt based on a number of key financial indicators for the issuing companies that reflect these same financial factors. Since this debt is traded, by looking across the market it is possible to associate a particular credit rating with a specific range for the debt premium. Not surprisingly, firms and debt with a poor credit rating are associated with a higher debt premium.

The value of this relationship is that financial modelling data available from BAA provides forward-looking projections of the same financial variables that are used by credit rating agencies. Using the same criteria as the credit rating agencies therefore enables an implicit or 'shadow' credit rating to be derived for each airport, which can in turn be linked to the debt premium range associated with that credit rating in the wider market.

The analysis presented in this report was undertaken on a forward-looking basis using data from BAA. Under the base case scenario uniform gearing of 55% was assumed throughout Q5. Under the alternative scenario, debt premiums were estimated on the basis of implied stand-alone gearing levels by airport.

An important assumption underlying the stand-alone scenario was the initial allocation of capital across airports. Table 3.14 records the assumed allocation, with equity allocated on the same basis as in the statutory accounts for each airport in 2006/7. Debt is then assumed to contribute the remainder of capital needed to balance the regulatory assets of each airport.

Table 3.14 Initial allocation of capital across airports (2006/07)

	Statutory equity (£m)	Equity adjustments (£m)	Debt (£m)	Gearing (%)
Heathrow	380.5	1,461.5	6,362.5	71
Gatwick	336.3	591.0	488.3	31
Stansted	503.9	532.0	264.2	19

Note: Equity adjustments include fair valuation, share premium reserve and retained earnings.
Source: BAA and Oxera calculations.

The data demonstrates that Heathrow has been assumed to be supportive of a much greater quantity of debt than the other airports. The large allocation of equity at Stansted is also noticeable, but this may well be appropriate given the airport's business profile.

The analysis under the stand-alone gearing scenario is dependent on these initial assumptions, since an alternative allocation could lead to different levels of financial indicators at one or more airports. For example, the notional gearing scenario assumed in the base case, which implicitly reallocates debt from the estimated initial gearing positions presented above to achieve uniform gearing across airports, is further discussed at the end of this sub-section.

Three key standard financial indicators were derived from BAA's projections:

- **interest coverage**—the amount of profit available relative to a firm's interest obligations on outstanding debt;
- **FFO to total debt**—the positive cash flow of a company relative to its outstanding debt;
- **debt to capital**—the outstanding debt of a company relative to its capital employed.

These indicators could then be compared with the credit rating thresholds used by Moody's Investors Service for UK utility companies, presented in Table 3.15. Because a rating is derived for each indicator, a rating is adopted for each airport based on the predominant rating, since individual instances of lower ratings are unlikely to lead to a credit downgrade by the agency.

Table 3.15 Moody's utility rating criteria

	Aa	Aa	A	A	Baa	Baa	Ba	Ba
Business risk	Medium	Low	Medium	Low	Medium	Low	Medium	Low
FFO interest coverage	>6	>5	3.5–6.0	3.0–5.7	2.7–5.0	2–4.0	<2.5	<2
FFO/debt (%)	>30	>22	22–30	12–22	13–25	5–13	<13	<5
RCF/debt (%)	>25	>20	13–25	9–20	8–20	3–10	<10	<3
Debt/capital (%)	<40	<50	40–60	50–75	50–70	60–75	>60	>70

Note: Airports are exposed to different business risks than more traditional utilities, and therefore these criteria should be seen as conservative—for a given indicator, the actual rating of an airport might be expected to be somewhat lower and entail a higher cost of debt. FFO, funds from operations; RCF, retained cash flow.
Source: Moody's rating methodology, March 2005.

One potential issue for consideration when using Moody's utility rating criteria is that BAA is likely to face greater risks than standard regulated utilities, potentially more akin to the risks characteristic of the transport sector more generally. Therefore, the actual credit rating criteria for BAA airports might be slightly higher than those presented above. In certain circumstances this might imply that BAA airports could face higher costs of debt than estimated below.

Having established a rating for each airport, the debt premium was inferred from the market evidence of yields for Merrill Lynch corporate bond indices of the relevant rating.

3.2.2 Results

Tables 3.16 and 3.17 present the credit ratings implied by the averages of financial indicators calculated over Q5 for each airport separately using financial data from the BAA Group Strategic Model (June 2006). Table 3.16 presents the implied ratings assuming uniform gearing across all three airports over Q5; Table 3.17 presents analogous results assuming differentiated, stand-alone levels of gearing over Q5 at each airport. The final column identifies the overall implied credit rating for each airport.

It is important to note that under the stand-alone gearing assumption the implied credit rating is based on the average gearing level over Q5 for each airport, which is significantly different than the initial gearing as of 2006/7 (estimated by airport—see Table 3.14 above and section 3.3) in the case of Stansted, but very similar to the initial allocation in the case of Heathrow and Gatwick.

Table 3.16 Financial indicators and implied credit ratings by airport assuming uniform gearing (average over Q5)

	FFO interest coverage (x)	FFO/debt (%)	RCF/debt (%)	Estimated gearing (%)	Implied 'shadow' credit rating
Heathrow	[Excised]	[Excised]	[Excised]	55 (A)	Aa–
Gatwick	[Excised]	[Excised]	[Excised]	55 (A)	A-
Stansted	[Excised]	[Excised]	[Excised]	55 (A)	Baa

Source: BAA Group Strategic Model June 2006, Oxera calculations and Moody's Investors Service.

Table 3.17 Financial indicators and implied credit ratings by airport assuming stand-alone gearing (average over Q5)

	FFO interest coverage (x)	FFO/debt (%)	RCF/debt (%)	Estimated gearing (%)	Implied 'shadow' credit rating
Heathrow	[Excised]	[Excised]	[Excised]	70 (A)	A–
Gatwick	[Excised]	[Excised]	[Excised]	32 (Aa)	Aa-
Stansted	[Excised]	[Excised]	[Excised]	39 (Aa)	A

Note: The estimated level of gearing is stable over Q5 for Heathrow and Gatwick, but increases over time for Stansted. That is, the average gearing of 39% over Q5 is consistent with the estimated initial gearing of 19% in 2006/7 in the case of Stansted.
Source: BAA Group Strategic Model June 2006, Moody's Investors Service, and Oxera calculations.

Table 3.18 and 3.19 use market evidence on bond indices (based on average spreads over 2002-07 to take into account embedded debt) in order to infer debt premiums by airport assuming uniform and stand-alone levels of gearing respectively.

Table 3.18 Implied debt premiums (uniform gearing)

	Premium on index of ten-year+ corporate bonds over the risk-free rate		Implied credit rating	Implied debt premium range
BBB	1.18	Heathrow	Aa–	0.74–1.06
A	1.06	Gatwick	A-	0.95-1.18
AA	0.74	Stansted	Baa	1.06-1.23

Source: BAA, Oxera calculations and Moody's Investors Service.

Consistent with the financial indicators presented above and assuming uniform gearing Heathrow displays the lowest debt premium, reflecting the strength of the Heathrow franchise and strong cash generation vis-à-vis other airports. Stansted has the lowest implied credit rating and hence the highest estimated debt premium among the three airports.

Table 3.19 Implied debt premiums (stand-alone gearing)

	Premium on index of ten-year+ corporate bonds over the risk-free rate		Implied credit rating	Implied debt premium range
BBB	1.18	Heathrow	A–	1.06–1.18
A	1.06	Gatwick	Aa-	0.74-1.06
AA	0.74	Stansted	A	0.95–1.12

Source: BAA, Oxera calculations and Moody's Investors Service.

Under stand-alone gearing assumptions, Gatwick displays the lowest debt premium, while the increased potential for financial distress at Heathrow (itself reflecting high gearing) leads to a higher debt premium, but one which is still comfortably within an 'investment grade' rating.

This stability of the investment grade credit ratings for all three airports is reinforced by the evidence presented in Table 3.20, which details the relatively high proportion of CAPEX that can be financed through retained earnings in most years.

Table 3.20 Funding of CAPEX over Q5

% of CAPEX funded by retained earnings	2008/09	2009/10	2010/11	2011/12	2012/13
Heathrow	[Excised]	[Excised]	[Excised]	[Excised]	[Excised]
Gatwick	[Excised]	[Excised]	[Excised]	[Excised]	[Excised]
Stansted	[Excised]	[Excised]	[Excised]	[Excised]	[Excised]

Notes: Dividends assumed according to BAA's disaggregation of the company's total dividend by airport.
Source: BAA and Oxera calculations.

For comparison, Table 3.21 details the spread on UK government gilts of outstanding BAA bonds based on their yield to maturity obtained from Bloomberg. While some of the spreads are low by comparison with the estimates from the stand-alone analysis presented in Table 3.19, the most recent issuances from 2003 to 2006 have spreads in the range of 0.67–0.89, which is consistent with the range estimated for all three airports. This provides confidence that the estimates adopted here are likely to be appropriate.

BAA has also provided Oxera with its effective cost of debt (for all three airports) as at January 2006. This figure is [Excised], which implies a debt premium of [Excised].[24] It is noteworthy that spreads calculated from yields to maturity of the outstanding bonds (see Table 3.21) are lower than spreads based on the effective cost of debt. This could be explained by the fact that current yields are lower than those required when the financing was arranged. Importantly, the range of [Excised] provides additional confidence that the estimates for individual airports are appropriate.

Table 3.21 BAA bonds and spreads

Issue date	Amount	Currency	Coupon	Redemption date	Yield to maturilty[1]	Spread over government benchmark[2]
Feb 14th 1991	300m	£	11.750	Mar 31st 2016	5.16	0.42
Jan 16th 1996	250m	£	8.500	Mar 29th 2021	5.06	0.45
Jan 20th 1997	200m	£	7.875	Feb 10th 2007	5.54	0.64
Jul 7th 1998	200m	£	6.375	Aug 4th 2028	4.82	0.46
Nov 8th 2001	900m	£	5.750	Dec 10th 2031	4.69	0.45
Nov 19th 2003	400m	£	5.750	Nov 27th 2013	5.64	0.78
Sep 16th 2004	750m	€	4.500	Sep 30th 2014	4.50	0.67
Feb 15th 2006	750m	£	5.125	Feb 15th 2023	5.42	0.89
Feb 15th 2006	750m	€	4.500	Feb 15th 2018	4.69	0.84
Feb 15th 2006	1,000m	€	3.875	Feb 15th 2012	4.38	0.58
Weighted average[3]			**5.76**		**4.92**	**0.64**

Note: [1] Ask yield to maturity as at October 2006. [2] Spreads are based on gilts with equivalent coupon schedule and interpolated yield for equivalent coupon and maturity to the BAA bonds taken from Bloomberg. [3] Using exchange rate of €0.67:£1 (October 2006) according to the European Central Bank.
Source: Bloomberg and European Central Bank.

A number of assumptions underlying the data and modelling are important to understanding these results.

[24] However, the average effective cost of debt over the period from January 2005 to January 2006 is 6.34%. This implies even higher spreads in the range between 1.34 and 2.11.

– CAPEX has an important influence on financial indicators. While the modelling assumptions include major investments at Heathrow and Stansted, these are unlikely to lead to a significant deterioration in the ratios. This is because the majority of associated expenditure falls at the start of Q6 and does not affect the average over Q5. Thus, while relative financial stability might be expected on the basis of this data, some deterioration could take place in later periods.

– CAPEX is assumed to enter the regulatory asset base (RAB) in the same year as it is undertaken. Therefore, assets in the course of construction (AICC) are allowed to earn a return and generate revenues rapidly. Since there might be a delay in transferring CAPEX into the asset base—which could lead to a deterioration in the airport's financial position and possible financeability concerns—the scenario presented here is likely to be a best-case scenario in this respect.

– In the absence of any known regulatory cost of capital for future periods, the data assumes that the current rate of 7.75% pre-tax continues (this is broadly consistent with the derived uplifted, stand-alone cost of capital estimates except for Stansted where the latter is somewhat higher). Since this is subject to a degree of regulatory discretion, the actual cash flows could be substantially affected if this assumption were to prove inaccurate.

– All free cash flows from operations (after dividend and tax payments) are assumed to be available for the funding of CAPEX. In practice, to the extent that cash balances are required for liquidity or to manage cost overruns, each airport's financial position is likely to be tighter.

In summary, these assumptions are likely to be supportive of a robust and stable financial position, including during periods of considerable capital investment. Therefore, the financial indicators and credit ratings obtained in Tables 3.16–3.19 need to be interpreted with the understanding that outturn financial indicators could be weaker. Oxera has based its analysis on financial data from BAA and has not undertaken any sensitivities to the data because these could be so numerous and interdependent.

The analysis also indicates that the difference between the uniform gearing assumption and stand-alone levels of gearing does, to some extent, affect the calculated financial ratios. The overall impact of the analysis is that the implied debt premium for Heathrow is higher under the stand-alone gearing assumption while the implied debt premiums for Gatwick and Stansted are lower than under the base case scenario.

3.2.3 Financeability

While the CAA has no explicit duty to maintain a specific credit rating at any of the London airports, it has an important role in ensuring that investment can be financed and delivered in a timely and efficient manner. To this end, it is important that the CAA assesses the financial impact of the overall regulatory determination. The above evidence suggests that, on the given assumptions regarding the allocation of existing debt (prior to acquisition) and capital investment, each of the airports is likely to maintain sustainable credit ratings at the investment-grade level, at least for the duration of Q5.

3.3 Gearing estimates

In its December 2005 consultation paper, the CAA recognised three approaches to the treatment of capital structure: actual, projected and optimal gearing. Actual gearing was used by both the CAA and Competition Commission at the preceding review. The use of projected gearing would require the CAA to make assumptions about the financial strategy of each airport. This is an approach that the CAA has rejected in light of recent ownership developments at BAA:

> The CAA will set caps on airport charges in accordance with its statutory duties and not in order to accommodate any particular financing arrangements adopted.[25]

Since there is a range of costs and benefits associated with different financing structures, it is plausible that there is some 'optimal gearing' level for any particular airport. However, the CAA recognised at the preceding review that it was not feasible to calculate this optimal gearing level.

> Both theoretical and empirical evidence seem to suggest that the firm's capital structure does matter. However as far as the CAA is aware, there is no adequate theory and neither a normative model that would enable a regulator to establish this 'optimal' gearing level.[26]

Furthermore, the CAA also recognised that it is not desirable to prescribe to a firm its optimal gearing:

> In the view of the CAA capital structure decisions are best left to the firm and its financiers as they should and will be carrying the full risk associated with a change in financial strategy/policy and hence capital structure.[27]

The use of notional gearing could avoid the difficulties of these approaches because it makes no assumptions about future capital structure. Table 3.22 indicates that there is some variation in the regulatory treatment of gearing. However, most of the recent regulatory precedent falls within the 50–60% range for assumed gearing.

Therefore, this analysis has assumed 55% notional gearing across all three airports as the base case scenario. This corresponds with the assumption made by CEPA in its analysis for BA and is slightly higher than the ratio of the total net debt for the BAA Group to RAB of the regulated airports as at March 2006 (pre-acquisition), which is estimated at 48%.[28]

Table 3.22 Selected regulatory precedent on treatment of gearing

Regulatory review	(%)	Optimal or actual
Ofreg (NIE, 2002)	50	Actual
Ofgem (DNOs, November 2004)	57.5	Optimal
Ofwat (WASCs, December 2004)	55	Optimal
Ofgem (TPCR, December 2006)	60	Actual
Ofgem (GDPCR, December 2006)	62.5	Actual

Note: NIE, Northern Ireland Electricity; DNO, distribution network operator; WASC, water and sewerage company, TPCR, electricity transmission price control review.
Source: Regulatory determinations.

Given the uncertainty about the details of the permanent financing structure that might be adopted in future in light of the potential securitisation of regulated airports, the approach used in this submission under the base case scenario is based on notional gearing. This

[25] CAA (2006), 'Airports Review—Policy Update', May, p. 133.

[26] CAA (2002), 'CAA Recommendations to the Competition Commission—Annex: Cost of Capital for Heathrow, Gatwick and Stansted', February, p. 45.

[27] CAA (2003), 'CAA Decision', February, p. 41.

[28] The ratio of net debt to RAB itself is likely to overestimate the level of gearing since the part of the total BAA Group debt associated with the unregulated businesses would need to be estimated and subtracted from the total debt figure. An alternative measure of the pre-acquisition level of gearing for the BAA Group based on net debt to enterprise value (where equity is measured at market values) implies 37% gearing estimate as at March 2006.

corresponds to the CAA's stated approach of abstracting from any potential changes to the financial structure in determining price caps, as stated above. An alternative scenario could be based on stand-alone gearing estimates by airport.

Methodology

This analysis has assumed 55% notional gearing across all three airports as the base case scenario, which is consistent with the recent regulatory precedent.

The alternative approach is to assess gearing on a stand-alone basis rather than assume a uniform, notional level of gearing for all three airports. Assessing gearing on a stand-alone basis requires assumptions about the allocation of group-level debt between the three regulated airports, since the level of debt is not directly observed at the individual airport level.

The stand-alone analysis is based on the calculation of the levels of gearing by airport using statutory equity and the RAB by airport, as presented in Table 3.23 below. For comparison, Table 3.23 also reports the bottom-up allocation of existing debt among the three airports in accordance with the 2001/02 Deloitte & Touche analysis of debt at individual BAA airports.

The stand-alone gearing estimates based on statutory equity are consistent with the debt premiums assumed for the stand-alone scenario, as discussed in the previous section.

Results

Table 3.23 presents the range of gearing estimates by airport. The modelled values of RAB minus statutory equity as a proportion of RAB are used in the calculation of the alternative cost of capital estimates under stand-alone gearing assumptions.

Table 3.23 Alternative gearing estimates by airport (%)

	Deloitte & Touche (2001/02)	RAB minus statutory equity % of RAB (2006)	Notional gearing
Heathrow	31	71	55
Gatwick	16	31	55
Stansted	21	19	55

Source: BAA, Deloitte & Touche, and Oxera calculations.

3.4 Taxation

This analysis of the stand-alone cost of capital for each regulated airport employs an approach to corporate taxation in line with the regulatory approach adopted by the CAA at the last review. A pre-tax approach is used to calculate the WACC, and the tax rate is the standard statutory corporation tax rate of 30%. This approach is selected here in order to ensure comparability with the group allowance of 7.75% at the last review.

In the 2003 review, the CAA applied the standard marginal statutory corporation tax rate of 30%, noting:

> this approach probably creates some headroom for BAA but this should be seen as part of an overall package of regulatory policies.[29]

Also, the Competition Commission adopted the same assumption, confirming that:

[29] CAA (2003), 'CAA Decision', February, p. 43.

the difference between actual and standard rates of tax is thought unlikely to be significant over the long term.[30]

[30] Competition Commission (2002), 'BAA plc: A Report on the Economic Regulation of the London Airports Companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd)', pp. 172–76.

4 Generic CAPM parameters

An overview of evidence from the markets, academic studies and regulatory precedent is presented below in order to derive a high-level view of the generic components of the cost of capital. The CAA has stated its intention to rely primarily on regulatory precedent, and given the importance of the transition to stand-alone costs of capital, less emphasis is placed in this report on the CAPM parameters. The following sections briefly describe the evidence that informs estimates of the risk-free rate in the range of 1.75–2.5%, and of the ERP in the 3.5–5.0% range.

4.1 Risk-free rate

4.1.1 The risk-free rate at the last review

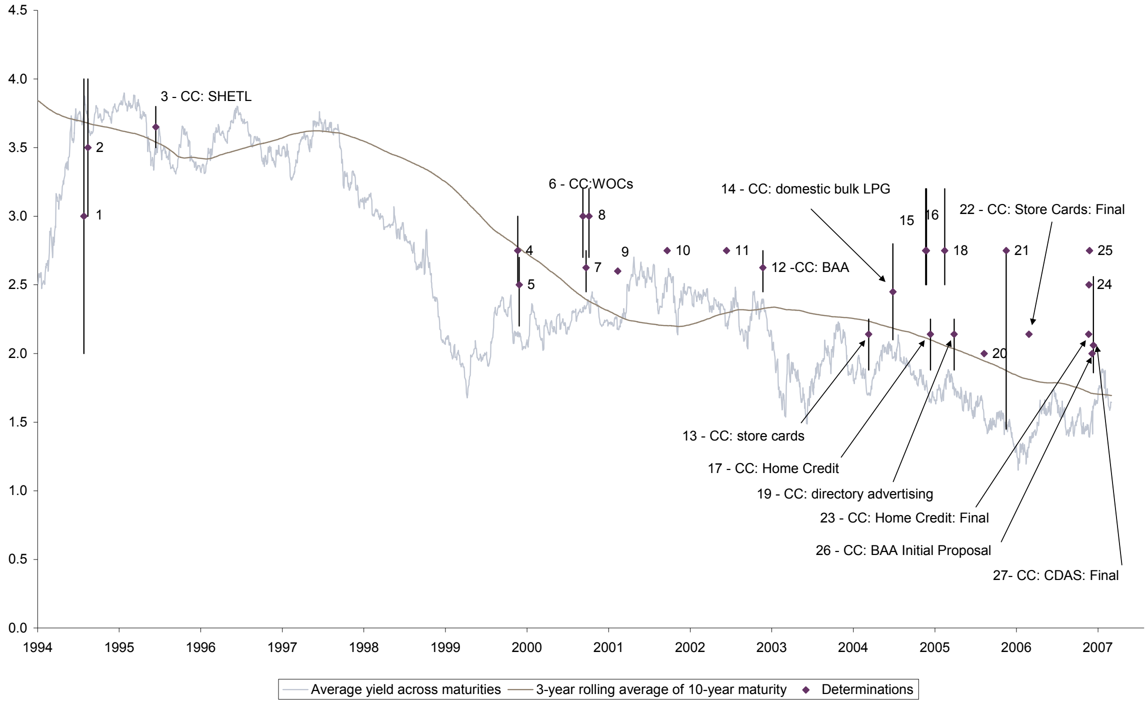
In its Q4 decision paper, the CAA did not address the level of the risk-free rate. However, in its recommendations to the Competition Commission in February 2002, the CAA indicated a range of 2.75–3.25%, with a midpoint of 3%. The Commission proposed a range for the risk-free rate of 2.5–2.75%, which was somewhat above the prevailing spot rate of around 2.2%, in recognition of the importance of incorporating historical data, the low supply of government bonds at the time, and the expected abolition of the minimum funding requirement for pension funds.[31]

4.1.2 Market evidence on the risk-free rate

Evidence on the risk-free rate continues to suggest that real yields have been low relative to historical averages and the range assumed by the Competition Commission for Q4, as shown in Figure 4.1 below.

[31] Competition Commission (2002), ‘BAA plc: A Report on the Economic Regulation of the London Airports Companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd)’, pp. 172–76.

Figure 4.1 Real zero coupon yields on gilts



Note: [1] Ofwat, water and sewerage companies (WASCs)/water-only companies (WOCs), July 1994. [2] Ofgem, public electricity suppliers, August 1994. [3] CC, SHETL, June 1995. [4] Ofwat, WASCs, November 1999. [5] Ofgem, distribution network operators, December 1999. [6] CC, WOCs, September 2000. [7] Ofgem, NGC, September 2000. [8] ORR, Railtrack, October 2000. [9] Oftel, BT Retail, February 2001. [10] Ofgem, Transco, September 2001. [11] Ofreg, NIE, June 2002. [12] CC, London Airports, November 2002. [15] Ofgem, electricity distribution network operators, November 2004. [16] Ofwat, WASCs, November 2004. [18] Ofgem, Scottish transmission operators, February 2005. [20] Ofcom, BT Local Loop, August 2005. [21] Ofgem, NGET, November 2005. [22] CC, Store Cards Credit Services, March 2006. [24] Ofgem, Transmission price determination, December 2006. [25] Ofgem, Gas distribution price determination: one year extension, December 2006. [26] CAA, Airports price control review - Initial proposals for Heathrow, Gatwick and Stansted, December 2006. [27] CC, Classified Directory Advertising Services, December 2006.

Source: Bank of England, Regulatory Determinations

However, since it is necessary to set a forward-looking risk-free rate, this evidence of low yields should be balanced against academic evidence of mean reversion in real interest rates—the suggestion that future rates are more likely to rise than fall. For example, Coakley and Fuertes (2002) find evidence of mean reversion in UK real interest rates.[32] The upwards trend registered over recent months seems to support empirically the mean reversion argument. This proves that using the low values registered in the second half of 2006 would have been imprudent from a regulatory point of view.

These considerations suggest that historical evidence can provide supplementary information to spot rates as to the likely path of future rates. The CAA has been cautious, however, about the point at which historical data becomes insufficiently relevant to current and future market conditions. Table 4.1 summarises a range of relevant evidence.

[32] Coakley, J. and Fuertes, A.-M. (2002), 'Asymmetric Dynamics in UK Real Interest Rates', *Applied Financial Economics*, **12**, 379–87.

Table 4.1 Summary of market evidence on the risk-free rate

Type of evidence	Value: five- and ten-year maturities (%)
Spot real yields: March 2007	1.7–2.1
Spot real yields: annual averages over the last 1–3 years	1.7–1.8
Spot real yields: annual averages over the last 1–10 years	2.3–2.4
Mean reversion evidence	Suggests that current low rates are not necessarily a good guide to future rates

Notes: Forward rates cover five-year lending, three years hence, ten-year lending, three years hence, five-year lending, five years hence, and ten-year lending, five years hence.
Sources: Bank of England, regulatory determinations and Oxera calculations.

4.1.3 Regulatory precedent on the risk-free rate

During assessments of the cost of capital, regulators have typically allowed a margin above the current risk-free rates. Such an approach has generally been adopted as a prudent measure to allow potential fluctuations in the risk-free rate over the control period. Table 4.2 shows that this has consistently been the case since the start of Q4. Indeed, the premium appears to have been rising in recent decisions. This suggests that concerns over mean reversion and institutional influences on the risk-free rate are still relevant. Since the CAA has emphasised its intention to place considerable emphasis on regulatory precedent, and has provided a premium against current market evidence in the case of National Air Traffic Services (NATS), continuation of this approach would appear to be justified.

Table 4.2 The risk-free rate at recent regulatory determinations

Regulator	Year	Subject	Risk-free rate used in determination (midpoint, %)	Premium to then prevailing market risk-free rate (%)
CC	2002	Airports	2.6	0.2
CAA	2002	Airports (submission to the Competition Commission)	3.0	0.6
Ofgem	2003	Gas DNOs	2.8	1.1
Ofwat	2004	WASCs	2.8	1.0
Ofgem	2004	Electricity DNOs	2.6	0.9
Ofgem	2005	NGET	2.8	1.3
CAA	2005	NATS	2.5	0.9
Ofcom	2005	BT copper access	2.0	0.5
Postcomm	2006	Royal Mail	2.5	1.0
CC	2006	Storecards (backward-looking)	2.15	0.8
CC	2006	Bulk liquefied natural gas (LPG)	2.45[1]	0.8
Ofgem	2006	Transmission	2.5	0.8
Ofgem	2006	Gas distribution	2.75	1.1
CAA	2006	Airports (initial proposal)	2.0	–0.1[2]

Note: [1] Presented as 4.2–4.9% nominal, with an inflation assumption of 2.1%. [2] Based on 2.1% real spot yield as at March 2007.
Sources: Regulatory documents.

For the recent TPCR, Ofgem commissioned Smithers & Co to undertake a study on the cost of capital of the UK utilities.[33] The central estimate of the risk-free rate reported in this study is 2.5%. In particular, the authors note that this figure is widely used as the benchmark by central banks. Moreover, according to Smithers & Co, a very similar figure is also implicit in the current term structure of nominal yields. The authors also suggest that current market yields are likely to be low due to high equity market volatility and the pension fund minimum funding requirement. In addition, the report quotes the statement by the Competition Commission that 'historical yields may be more important than current yields as a predictor of future yields, since yields may revert towards the mean'.

4.1.4 Identifying a range for the risk-free rate

– **A low value of 1.75%**. This value places particular weight on the current market evidence of a relatively low risk-free rate, and the observation that it has remained low for a significant length of time, suggesting that the mean reversion hypothesis may not be correct, or that there has been a structural shift towards lower equilibrium rates. Nevertheless, since the price control review is forward-looking, while less weight might be placed on the mean reversion view, it should arguably not be discounted entirely. Also, in the light of regulatory precedents and accompanying evidence, the lower estimate of the risk-free rate may not be appropriate. Moreover, recent evidence points at an upward trend in the risk-free rate.

– **A high value of 2.5%**. This value places particular weight on regulatory precedent, including the 2005 CAA decision for NATS (which adopted a value of 2.5%), Ofgem's final proposals for the extension of National Grid's price control by one year (2.75%) and the Competition Commission's decision on the bulk LPG case. This value also places particular weight on the evidence in the academic literature of the presence of mean reversion as well as on the recent upward trends in the risk-free rate.

4.2 Equity risk premium

4.2.1 The ERP at the last review

The CAA did not refer explicitly to the ERP in its final decisions for the airports review, while in its initial proposals it used a figure of 4%.

The Competition Commission identified a range of 2.50–4.50%. The midpoint, at 3.5%, was below previous Commission decisions (4% for the water companies, 4.25% for Cellnet/Vodafone). It recognised that the decrease in the ERP may have been transitory; however, rather than increasing the ERP range, it preferred to apply an increase of 0.25 in the overall level of the WACC for BAA in order to achieve smoothing.[34]

4.2.2 Measuring the ERP

The ERP cannot be directly observed, but may be estimated on the basis of either ex ante or ex post evidence. The most comprehensive ex post assessment is that of Dimson, Marsh and Staunton (2002), who conclude that the UK ERP lies in the range 4.0–6.0%. Ex ante assessments are based on forward-looking surveys, and consideration of studies such as Welch (2001) and Dimson, Marsh and Staunton (2002) suggests a range of 3.5–5.5%. Table 4.3 provides estimates of the ERP presented by Dimson, Marsh and Staunton (2002) on a number of measures and in a number of regions.

[33] Smithers & Co (2006), 'Report on the Cost of Capital', September.

[34] Competition Commission (2002), 'BAA plc: A Report on the Economic Regulation of the London Airports Companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd)', pp. 178.

Table 4.3 ERP around the world, 1900–2000 (%)

	Relative to bills			Relative to bonds		
	Geometric mean	Arithmetic mean	Standard deviation	Geometric mean	Arithmetic mean	Standard deviation
UK	4.3	6.0	19.9	4.0	5.2	16.9
USA	5.5	7.4	19.7	4.6	6.6	20.2
World	4.7	6.1	16.8	4.0	5.1	15.1

Source: Dimson, E., Marsh, P. and Staunton, M. (2002), 'Triumph of the Optimists: 101 years of global investment returns', January.

4.2.3 Regulatory precedent on the ERP

A recent precedent is that of Ofcom, which systematically reviewed a range of evidence including ex post (both historical averages and historical averages adjusted for contemporaneous investor expectations) and ex ante estimates.[35] Ofcom determined that the appropriate value of the ERP was in the range of 4–5%, and that the appropriate ERP estimate was the midpoint value of 4.5%.

> Having reviewed its approach in this area and on review of the available evidence and responses on this issue Ofcom believes that values in the range 4.0% to 5.0% are reasonable. Within this range Ofcom takes the view that 4.5% is the appropriate value for it to use in estimating a company's cost of capital.[36]

In May 2005, the CAA adopted a range of 3.5–5.0% for NATS, and the final cost of capital decision implies the choice of 4.4%, a value above the midpoint. Most recently, Ofgem's initial proposals for the 2007 transmission price control review advocated a range of 6.5–7.5% for the cost of equity, and its central estimate implied an ERP of 5.2%, somewhat higher than in other recent cases.

Table 4.4 The ERP at recent regulatory determinations (%)

Regulator	Year	Subject	ERP range	ERP used in determination or implied by final decision
CAA	2005	NATS	3.5–5.0	4.4
Ofcom	2005	BT copper access	4.0–5.0	4.5
Postcomm	2006	Royal Mail	3.5–5.0	4.4
CC	2006	Storecards	3.0–5.0	4.0
CC	2006	Bulk LPG	3.0–5.0	4.0
Ofgem	2006	TPCR	4.4–5.1	5.2

Sources: Regulatory documents.

The Smithers & Co report to Ofgem also provides estimates of the ERP, ranging between 4% and 5%.

4.2.4 Identifying a range for the ERP

– **A low value of 3.5%**. This value focuses on the ex ante estimates of the ERP. It is consistent with the lower end of the CAA's range for NATS, and lower than Ofcom's

[35] Ofcom (2005), 'Ofcom's Approach to Risk in the Assessment of the Cost of Capital', August.

[36] Ofcom (2005), 'Ofcom's Approach to Risk in the Assessment of the Cost of Capital', August, pp. 2–3.

recently discussed 4.0–5.0% range. It is, however, higher than the Competition Commission’s recent lower-bound value of 3.0% used in its investigation into LPG, although this represented a backward-looking estimate. The appropriate value for BAA is arguably higher due to the continued investment focus of the company.

– **A higher value of 5.0**. This value represents the ex post estimates for the ERP, and is again consistent with regulatory precedent—the Competition Commission, the CAA, and Ofcom have all recently employed 5.0% as the upper end of their range.

5 Towards stand-alone costs of capital

The above methodologies complete the picture on the cost of capital by estimating separate assumptions for beta, the debt premium and gearing. Using the equation in section 2, the WACC for each airport can be obtained. Table 5.1 records the parameters adopted and the final cost of capital ranges under the base case scenario of uniform gearing.

Table 5.1 CAPM parameters and the cost of capital range by airport (base case)

	Heathrow		Gatwick		Stansted	
	Low	High	Low	High	Low	High
Real risk-free rate (%)	1.75	2.50	1.75	2.50	1.75	2.50
ERP (%)	3.50	5.00	3.50	5.00	3.50	5.00
Asset beta	0.57	0.73	0.60	0.76	0.74	0.96
Debt premium (%)	0.74	1.06	0.95	1.18	1.06	1.23
Cost of debt (pre-tax) (%)	2.49	3.56	2.70	3.68	2.81	3.73
Tax rate (%)	30	30	30	30	30	30
Notional gearing (%)	55	55	55	55	55	55
Equity beta	1.26	1.62	1.33	1.69	1.64	2.13
Cost of equity (post-tax) (%)	6.17	10.61	6.42	10.94	7.49	13.17
Cost of equity (pre-tax) (%)	8.82	15.16	9.17	15.63	10.69	18.81
WACC (pre-tax, real) (%)	5.34	8.78	5.61	9.06	6.36	10.52
WACC midpoint (%)	**7.06**		**7.33**		**8.44**	

Source: Oxera analysis.

The equity betas are derived from the estimated asset betas and notional gearing by airport using the Modigliani–Miller (MM) adjustment.[37] A comparison of the final costs of capital demonstrates that Stansted has a notably higher cost of capital than the other regulated airports, which reflects the higher asset beta applicable to this airport.

An alternative approach to gearing based on stand-alone gearing estimates by airport (rather than uniform notional gearing for all three airports) and hence different dept premium results in broadly similar cost of capital estimates as in the base case. These results are presented in Table 5.2 below.

[37] Modigliani, F. and Miller, M.H. (1958), 'The Cost of Capital, Corporation Finance and The Theory of Investment', *The American Economic Review*, **3**, June, 261–97.

Table 5.2 CAPM parameters and the cost of capital range by airport

	Heathrow		Gatwick		Stansted	
	Low	High	Low	High	Low	High
Real risk-free rate (%)	1.75	2.50	1.75	2.50	1.75	2.50
ERP (%)	3.50	5.00	3.50	5.00	3.50	5.00
Asset beta	0.57	0.73	0.60	0.76	0.74	0.96
Debt premium (%)	1.06	1.18	0.74	1.06	0.95	1.12
Cost of debt (pre-tax) (%)	2.81	3.68	2.49	3.56	2.70	3.62
Tax rate (%)	30	30	30	30	30	30
Stand-alone gearing (%)	71	71	31	31	19	19
Equity beta	1.97	2.52	0.87	1.10	0.91	1.19
Cost of equity (post-tax) (%)	8.61	15.09	4.79	8.01	4.94	8.43
Cost of equity (pre-tax) (%)	12.30	21.55	6.85	11.44	7.05	12.04
WACC (pre-tax, real) (%)	5.56	8.86	5.50	9.00	6.23	10.44
WACC midpoint (%)	**7.21**		**7.25**		**8.33**	

Note: The stand-alone gearing estimates presented in the table are for 2006/7, whereas debt premiums are based on the average levels of gearing over Q5 derived from the same 2006/7 initial estimates, as explained in section 3.2. If the average gearing levels over Q5 were used in WACC calculation instead of the 2006/7 gearing estimates, the midpoint cost of capital for Stansted would change from 8.33 to 8.36%; the difference is not material in the case of Heathrow and Gatwick. Source: Oxera analysis.

As above, the stand-alone equity betas are derived from the estimated asset betas and stand-alone gearing by airport using the Modigliani–Miller (MM) adjustment.[38] As a result of high gearing, the equity beta for Heathrow Airport is high relative to other airports despite the fact that the asset beta is lower. Empirical evidence suggests that as gearing increases the equity beta increases in line with the MM theory. This means that equity risk is highly sensitive to gearing.

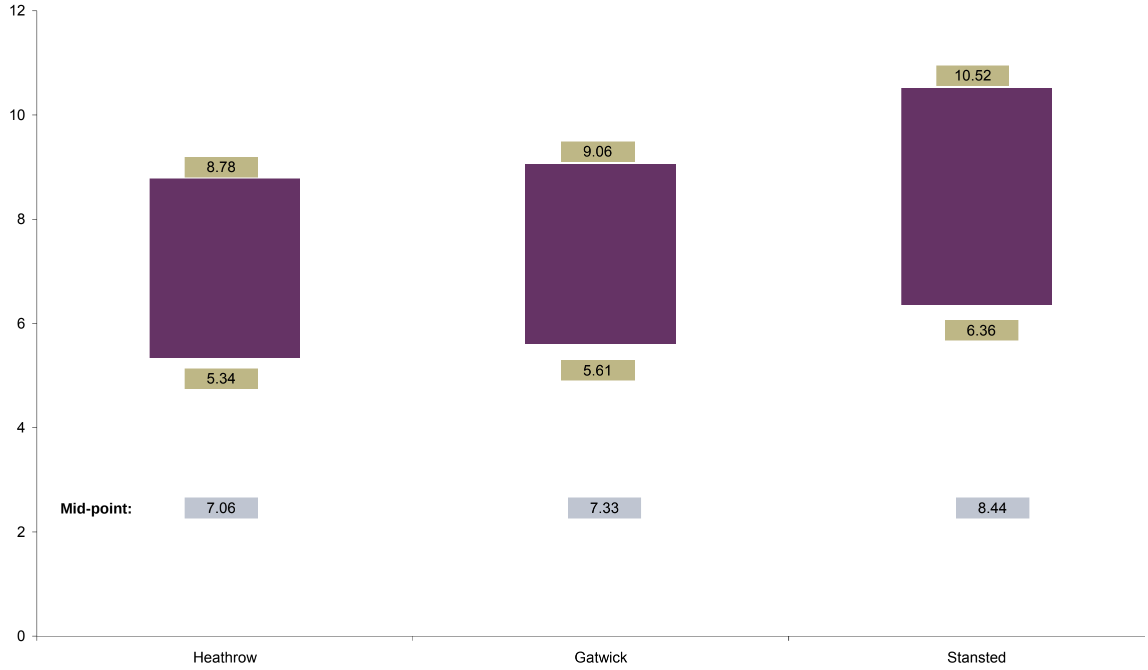
– As in the base case, Heathrow and Gatwick exhibit a similar overall cost of capital, reflecting similar levels of business risk. Heathrow, however, has a much higher allocation of debt, and this drives up the cost of equity and debt that it faces.

– Gatwick faces a much lower cost of equity, reflecting a lower implied level of gearing. An alternative view to gearing, based on the sustainable amount of debt, which could be allocated to each airport given the need for future capital investment, might lead to different results. However, the impact on the post-tax cost of capital would be likely to be limited.

Figures 5.1 and 5.2 illustrate the range at each airport and the WACC, assuming the breakdown of uniform level of gearing and stand-alone level of gearing derived by Oxera.

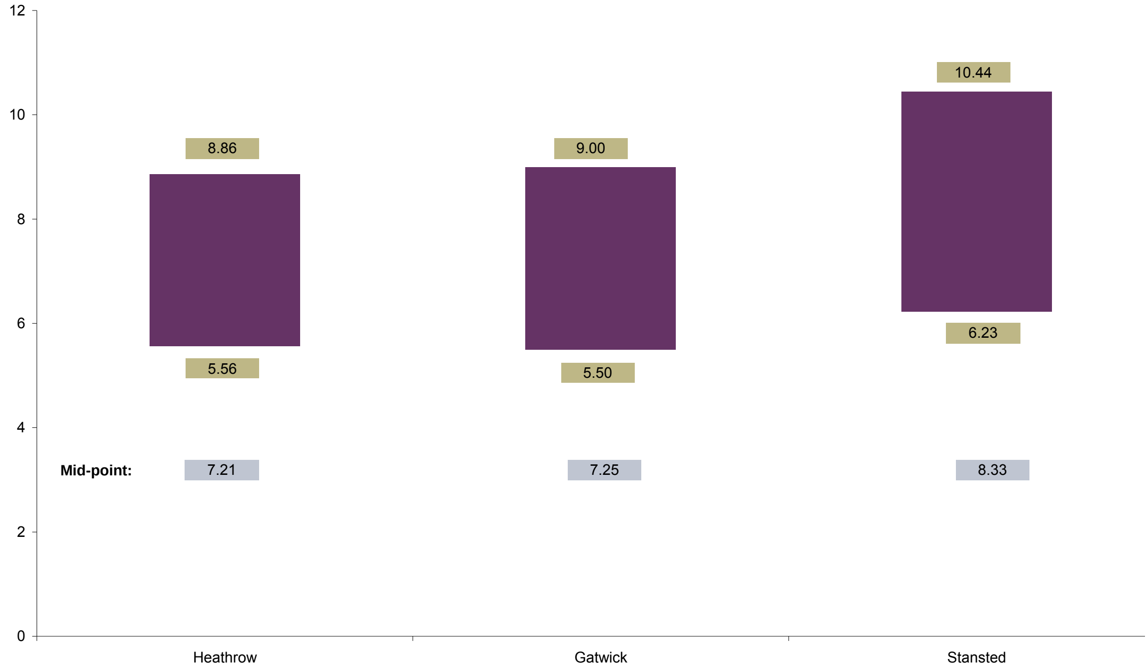
[38] Modigliani, F. and Miller, M.H. (1958), 'The Cost of Capital, Corporation Finance and The Theory of Investment', *The American Economic Review*, **3**, June, 261–97.

Figure 5.1 Stand-alone cost of capital estimates with uniform gearing (%)



Source: Oxera analysis.

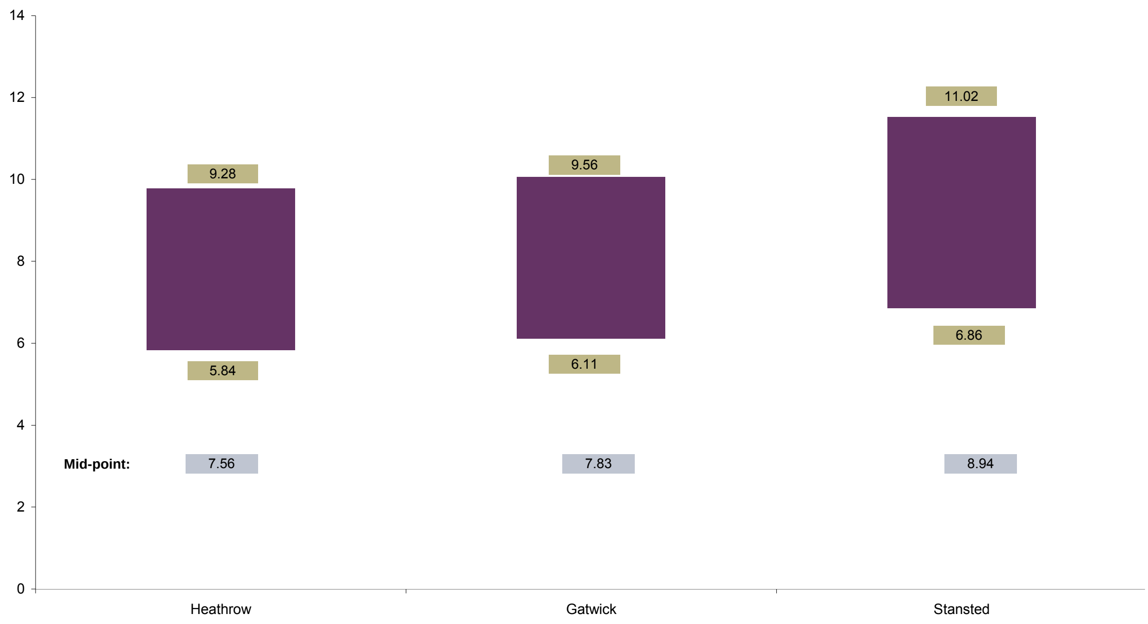
Figure 5.2 Stand-alone cost of capital estimates with stand-alone gearing (%)



Source: Oxera analysis.

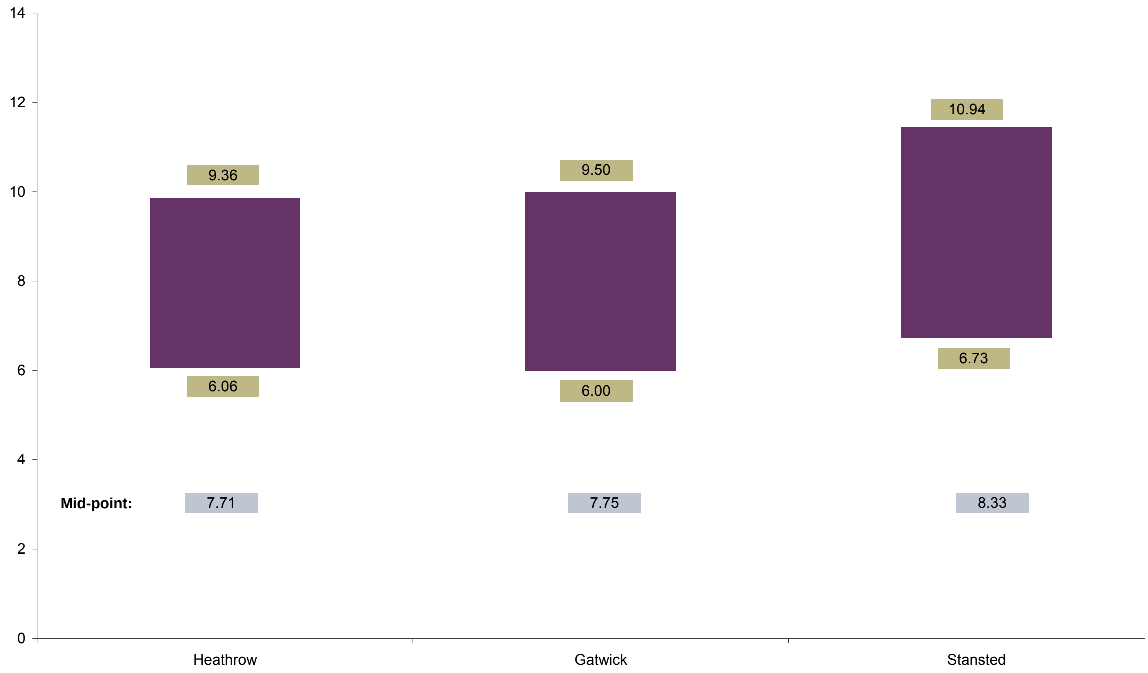
It should be recognised that, in order to maintain the bottom-up nature of the analysis, these estimates exclude the ERP smoothing and Terminal 5 uplifts that the CC and CAA included in their 2003 decision. However, since these were incorporated as part of the last price review, it would be inappropriate to exclude them from the allowance for Q5. Thus, they are legacies of a previous regulatory decision and are assumed to continue to be applied to ensure regulatory consistency and investment incentives. Accordingly, the values presented in Figure 5.1 and 5.2 are adjusted upwards by 0.5% in each case to include the two uplifts, as shown in Figure 5.3 and 5.4.

Figure 5.3 Stand-alone cost of capital estimates with uniform gearing and T5 and ERP smoothing uplifts (%)



Source: Oxera analysis.

Figure 5.4 Stand-alone cost of capital estimates with stand-alone gearing and T5 and ERP smoothing uplifts (%)



Source: Oxera analysis.

These represent the final cost of capital ranges estimated for each airport. While Heathrow and Gatwick are broadly comparable, with midpoints close to that set by the CAA at the previous review, Stansted displays a higher cost of capital, primarily reflecting its higher beta. This conclusion is intuitive, since it reflects, among potential other aspects, the substantially higher volume risk at Stansted in the absence of excess demand.

5.1 Alternative generic parameters

A useful reference point for the some of the assumptions made in the course of the analysis presented above is the study undertaken by CEPA for British Airways.

Although CEPA did not undertake a stand-alone analysis of the cost of capital by airport and therefore direct comparison of the conclusions reached is inappropriate, the approach to estimating the generic parameters—the risk-free rate and the ERP—is broadly consistent with that presented above. Differences in the range selected are likely to represent differences in the weight attached to various sources of evidence. As a sensitivity, therefore, Table 5.3 replaces the generic parameters applied above with those estimated by CEPA. A higher risk-free rate of 2–2.5, rather than 1.75–2.5, is applied, while a somewhat lower ERP of 3–5.0, rather than 3.5–5.0, is assumed.

Furthermore, the last part of Table 5.3 presents the results of the stand-alone cost of capital analysis with the adoption of CEPA's approach to generic parameters. This sensitivity analysis adopts the uniform level of gearing of 55% applied to all three airports as in the base case. As discussed in section 3.3, regulatory precedents on the treatment of gearing indicate that a range of 50–60% is consistent with the assumptions of optimal or assumed gearing in other regulated industries. Similarly, CEPA paper assumes the level of gearing of 55%.

Table 5.3 CAPM parameters and the cost of capital range by airport alternative estimates of the risk-free rate, ERP and gearing

	Heathrow		Gatwick		Stansted	
	Low	High	Low	High	Low	High
Real risk-free rate (%)	2.0	2.5	2.0	2.5	2.0	2.5
ERP (%)	3.0	5.0	3.0	5.0	3.0	5.0
Asset beta	0.6	0.7	0.6	0.8	0.7	1.0
Tax rate (%)	30.0	30.0	30.0	30.0	30.0	30.0
Implied, stand-alone gearing by airport (%)	71.0	71.0	31.0	31.0	19.0	19.0
Equity beta	2.0	2.5	0.9	1.1	0.9	1.2
Cost of equity (post-tax) (%)	7.9	15.1	4.6	8.0	4.7	8.4
Cost of equity (pre-tax) (%)	11.3	21.6	6.6	11.4	6.8	12.0
Debt premium (%)	1.1	1.2	0.7	1.1	1.0	1.1
Cost of debt (pre-tax) (%)	3.1	3.7	2.7	3.6	3.0	3.6
WACC (pre-tax, real) (%)	5.4	8.9	5.4	9.0	6.0	10.4
WACC midpoint (%)	**7.2**		**7.2**		**8.2**	
Notional gearing	55.0	55.0	55.0	55.0	55.0	55.0
Equity beta	1.3	1.6	1.3	1.7	1.6	2.1
Cost of equity (post-tax) (%)	5.8	10.6	6.0	10.9	6.9	13.2
Cost of equity (pre-tax) (%)	8.3	15.2	8.6	15.6	9.9	18.8
Debt premium (%)	0.7	1.1	1.0	1.2	1.1	1.2
Cost of debt (pre-tax) (%)	2.7	3.6	3.0	3.7	3.1	3.7
WACC (pre-tax, real) (%)	5.2	8.8	5.5	9.1	6.1	10.5
WACC midpoint (%)	**7.0**		**7.3**		**8.3**	

Source: Oxera analysis.

Table 5.3 demonstrates that the overall stand-alone cost of capital estimates for the airports using the CEPA ranges for the risk-free rate and the ERP are broadly similar to those presented above. The alternative assumptions for the generic parameters lower the cost of equity but increase the cost of debt for the low end of the range. The high end of the range remains largely unaffected. Similarly, the sensitivity analysis indicates that the assumption of the uniform gearing of the BAA Group, combined with alternative assumptions for the generic parameters, has a limited impact on the estimated stand-alone costs of capital.

5.2 Reconciling stand-alone and group cost of capital estimates

While the beta estimates derived in the course of the analysis presented above incorporate a degree of normalisation to ensure that the ranges for each airport include historical beta market estimates for the former BAA Group, the ranges are principally derived from the bottom-up methodologies that take no account of group status. The CAA has recognised that the two estimates might differ:

> in undertaking a stand-alone assessment of the cost of capital, the CAA will consider whether—and how far—to treat financing costs as it does other costs incurred by the designated airports.[39]

Understanding the sources of the potential difference between the historical weighted average group beta estimates and forward-looking, stand-alone estimates might be important in assessing the choice of any particular value within the range.

Potential explanations for why the required rate of return on capital of stand-alone airports might be different to those at the group level are discussed below.

5.2.1 Stand-alone airports are a different business operation

Considering individual components of a group directly generates a number of changes that have implications for the operations of the airport. As smaller entities, market evidence and models such as Fama–French[40] directly indicate that the costs of debt and equity are higher. Investors may take into account factors such as size and inclusion in leading market indices. Recognising these effects at the 2004 review, Ofwat provided for a small-company risk premium on both the cost of debt and equity.

Without the diversification offered by a group, the volatility of cash flows is likely to be greater. While this may not represent systematic risk, investors may nevertheless price such factors as the costs of financial distress. With respect to the cost of debt, since non-systematic volatility still affects financial ratios, credit ratings and the cost of debt could be higher.

5.2.2 Financing costs

If any airport were to experience a degree of financial distress, additional financing costs would be incurred. Reliance on external funds would increase to reflect lower effective debt capacity at individual airports and the impossibility of retained earnings at one airport supporting finance at another. Economies of scale in equity issuance may also be lost, increasing the transaction costs associated with new equity issuance.

With respect to the cost of debt, eliminating the group status removes the ‘coinsurance’ effect that debt held at one airport can support debt held at another, reducing debt capacity. Consequently, financial ratios are likely to be less robust and the cost of debt will be higher.

[39] CAA (2006), ‘Airports Review—Policy Update’, May, p. 105.

[40] For further details of the Fama–French approach to estimating the cost of capital, see section 6.2.

A number of these mechanisms may in practice have a greater impact on expected cash flows than risk and the cost of capital. Nevertheless, since any change affecting expected cash flows would lead to investors requiring compensation to continue to supply capital, providing remuneration through the cost of capital may be vital to ensuring the continued ability to raise finance in the context of significant future investments.

The methodologies used to derive the stand-alone estimates are likely to capture some of these effects. For example, the peer comparison of airports, by identifying peers on the basis of similarly sized—and in many cases stand-alone operated—airports, would have captured any higher risk associated with these differences and transferred them to the beta estimates for each BAA airport. Similarly, the cost of debt analysis would reflect any effect of increased revenue volatility in weaker financial ratios and therefore a higher debt premium.

To the extent that there is a direct impact on the cost of capital of moving to complete stand-alone, it is then arguable that this is more likely to increase rather than decrease the cost of capital. Thus, if, as the CAA has suggested, it is desirable to start from a full stand-alone position, the cost of capital is likely to be located nearer the upper end of the range presented in this report.

5.3 Additional factors affecting cost of capital

The CAA notes in its May 2006 policy update that:

> the CAPM is a tool adopted by regulators to assist in a judgement on the appropriate cost of capital. Whilst the output of the model can therefore be expected to provide important evidence in making this judgement, it should not be viewed as a mechanical tool which will automatically determine the cost of capital allowance at each airport.[41]

Indeed, there is a wide range of factors that can affect an airport's cost of capital, and it is unlikely that these are fully captured by the CAPM. It is therefore important to consider additional arguments that are likely to affect the appropriate level for the cost of capital. These arguments are explored in the supporting papers on catastrophic risk, airport-specific volume risk and the Fama–French cost of capital estimates.[42] The results of the supporting analyses point at the upper half of the cost of capital estimates presented in this report.

[41] CAA (2006), 'Airports review—policy update consultation paper', May, p. 104.

[42] Oxera (2007), 'Cost of capital using the Fama–French model'

Appendix 1 Selection criteria for comparators

This appendix discusses the use of criteria to select comparators for BAA's three London airports and should be read in conjunction with the spreadsheet used to derive comparative beta estimates.

The overarching objective of this exercise is to characterise the BAA airports as well as the comparator airports according to several key business dimensions that are likely to impact their overall risk profiles. The assumption underlying this methodology is that the selected criteria jointly characterise business risk to the extent that the process of matching comparators can be undertaken in a meaningful way and provide sufficient insight into key risk differentials among airports. Each criterion is therefore assumed either to have a direct impact on the airport beta, or to act as a proxy for other factors that affect the beta.

While informed to a large extent by the nature of the airport business, the choice of the seven characteristics was also driven by consistent data availability. Data was taken primarily from TRL,[43] with some additional supplementary data derived from *Airline Business*.[44] In this context it was critical that the selected criteria provide consistent data input that could be used for all potential comparators. Although other airport characteristics may also be valid for comparison, the seven variables selected fulfil the data availability criterion and were deemed jointly sufficient to capture the key risk drivers.

A1.1 The seven criteria

The make-up of an airport's customer base can affect its beta. Two measures of the customer base were used.

1) **Airline concentration: top three carrier proportion**—calculated as the sum of the percentage of flights/frequencies by each of the largest three carriers.

   This measure identifies whether the airport's customer base is focused on a few key airline customers (eg, acting as a hub), or around a broader base of carriers. A higher concentration with a small number of carriers may imply a different risk profile. For example, if a network carrier operating a hub-and-spoke network is operating from that airport, to the extent that the network carrier has market power derived from network externalities, this may reduce demand risk, in turn reducing the appropriate airport beta. On the other hand, being focused on a small number of carriers may expose the airport to concentration risk in the event that one of its main customers suffers financial difficulties. To the extent that concentration risk affects systematic risk, this will also affect the airport beta.

2) **Proportion of low-cost airlines**—calculated as the sum of the percentage of flights/frequencies by all low-cost carriers that are also one of largest three carriers. It is important to note that, although the data on all low-cost carriers associated with airports may have been a more relevant benchmark, it was unavailable. The choice of whether an airline is low-cost was made manually in accordance with general business characteristics.

[43] Transport Research Laboratory (2005), 'Airport Performance Indicators 2005', September.

[44] *Airline Business* (2005), June issue.

Demand for low-cost airlines, and hence for airport services, differs significantly from that for traditional carriers. For example, low-cost carriers are generally more focused on leisure than full-fare carriers, suggesting different demand drivers. Capturing this differentiator is particularly important given the high proportion of low-cost airlines that make up Stansted's customer base and that potentially affect Stansted's business risk.

Empirical tests of financial markets have established beyond reasonable doubt the importance of size for determining required returns to investors across sectors. In fact, corporate size is now widely recognised as the key driver of required returns in multi-factor asset pricing models and is typically unaffected by other factors (ie, it is robust to changes in model specifications). Size has been linked to both fundamental business risk characteristics and behavioural features of investors' perceptions of risk drivers. In the case of airports, as in other industries, size can be seen as one of the most fundamental risk drivers.

Two measures of airport size were used.

3) **Number of passengers per annum**.

4) **Number of air traffic movements (ATMs) per annum**.

Both of these measures have been used to avoid a bias that might be caused by using a single measure. This approach avoids determining which measure is the better representation of the size of an airport, although clearly the use of two size-based variables increases the effective weight attributed to this factor. In fact, these measures produce markedly different airport comparators, due to variations in aircraft size. For example, Gatwick ranks third highest in terms of passenger numbers, while ranking only eighth in terms of ATMs.

5) **Proportion of revenue from the commercial till**. Calculated as commercial revenue as a proportion of total revenue. Note that the total revenue in TRL data is calculated as aeronautical revenue plus commercial revenue plus other revenue. Other revenue generally accounts for less than 10% of the total revenue.

Airports usually have two main income streams: those from commercial sources (eg, shops and car parks), and those from aeronautical sources. It could be argued that, while related, these two business components are characterised by significantly different systematic risks. Therefore, differences in the proportions at different airports will affect the airport betas. This issue is explored further in the section on the decomposition by commercial and aeronautical till in the stand-alone costs of capital paper.

The size of a CAPEX programme can have important implications for the beta and the level of underlying business risk. Undertaking large CAPEX programmes may be characteristic of the airport facing higher risks associated with additional exposure to construction and development risks. For example, as CAPEX tends to be lumpy, large CAPEX may reduce excess demand faced by the airport, potentially exposing it to increased risks.

Regulators also regularly recognise the importance of CAPEX for the cost of capital determinations. In Q4, for example, the scale of T5 investment prompted the Competition Commission and the CAA to support an uplift to the cost of capital of 0.25%. More generally, regulators have often recognised in determinations the impact of investment on the embedded business risks and the consequent need to provide for an adequate rate of return through the cost of capital.

Two measures of CAPEX intensity were used for the selection criteria:

6) **CAPEX:total assets**—calculated as CAPEX divided by total assets.

This measures the importance of CAPEX with respect to the existing asset base. However, since the data available relates to accounting measures of asset size, this measure may overestimate the importance of CAPEX programmes in locations where a short depreciation profile has been used, or (because the comparisons are international and the asset values are generally not indexed) where inflation has been relatively high.

7) **CAPEX:revenue**—calculated as CAPEX divided by total revenue.

Using this measure helps to overcome some of the difficulties of the CAPEX to total asset measure, as both the CAPEX value and revenue values are flow rather than stock variables. However, this measure also has some potential weaknesses. Since the cost base, and hence the revenue, incorporates an element of OPEX, this measure is itself somewhat imperfect. For example, airports with significantly different OPEX as a proportion of revenue would return significantly different CAPEX to revenue values, despite the CAPEX being of equal size.

Appendix 2 Relationship between betas and volatilities

Statement:

$$if \quad \frac{corr(r_{airport}, r_{market})}{corr(r_{BAA}, r_{market})} = 1 \quad \Rightarrow \quad \frac{\beta_{airport}}{\beta_{BAA}} = \frac{Volatility_{airport}}{Volatilty_{BAA}}.$$

Proof:

$$\frac{corr(r_{airport}.r_{market})}{corr(r_{BAAt}, r_{market})} = \frac{\text{cov}(r_{airport}, r_{market})}{\text{cov}(r_{BAA}, r_{market})} \bullet \frac{\sqrt{Var(r_{BAA}) \cdot Var(r_{market})}}{\sqrt{Var(r_{airport}) \cdot Var(r_{market})}}$$

$$= \frac{\text{cov}(r_{airport}, r_{market\,M})}{Var(r_{market})} / \frac{\text{cov}(r_{BAA}, r_{market})}{Var(r_{market})} \bullet \frac{\sqrt{Var(r_{BAA})}}{\sqrt{Var(r_{airport})}}$$

$$= \frac{\beta_{airport}}{\beta_{BAA}} \bullet \frac{\sqrt{Var(r_{BAA})}}{\sqrt{Var(r_{airport})}}$$

$$if \quad \frac{corr(r_{airport}, r_{market})}{corr(r_{BAA}, r_{market})} = 1 \quad \Rightarrow \frac{\beta_{airport}}{\beta_{BAA}} \bullet \frac{\sqrt{Var(r_{BAA})}}{\sqrt{Var(r_{airport})}} = 1 \quad \Rightarrow$$

$$\Rightarrow \quad \frac{\beta_{airport}}{\beta_{BAA}} = \frac{\sqrt{Var(r_{airport})}}{\sqrt{Var(r_{BAA})}} = \frac{Volatility_{airport}}{Volatilty_{BAA}}.$$

Q.E.D.

Appendix 3 Financial determinants of beta

This appendix discusses the use of an econometric model to derive estimates of beta at BAA airports based on financial characteristics as measures of business risk. These estimates constitute inputs into the analysis combining six methodologies used to derive the overall beta estimates for BAA airports.

This analysis must be viewed in the context of the overall approach to the estimation of the costs of capital for BAA airports. In general, the absence of market data constitutes a challenge for the estimation of individual costs of capital. As in other cases, where costs of capital need to be estimated for businesses that are not listed (ie, where no market data exists), employment of a selection of methodologies constitutes a critical requirement for ensuring robustness of the overall analysis.

A range of methods employed in this context are aimed at avoiding potential biases that might be associated with any particular method. Therefore, while the derivation of betas based on financial ratios constitutes only one approach used by Oxera and should be viewed as such (rather than on a stand-alone basis), it provides a useful additional benchmark for the overall analysis.

While this method constitutes an indirect approach to beta estimation and might not be regarded as the preferred method in an environment unconstrained by data limitations, in the context of unlisted companies it might be viewed as providing a useful reference point in conjunction with other methodologies.

The approach of linking betas with financial ratios is not new: Ismail, Kirk and Kim (1994), Kulkarni, Powers and Shannon (1991), and Mohr (1985) have employed this methodology to improve beta estimates and estimate betas of business segments.[45] These studies have used this methodology to explore the relationship of beta with a variety of factors, such as intensity of capital expenditure, leverage profitability, and size. The underlying assumption is that a set of financial ratios might be a good proxy for the systematic risk component, for which investors need to be compensated.

A3.1 Econometric models

A3.1.1 Model selection

The scope of the analysis was to determine the relationship between a set of financial variables and beta estimates for a large sample of comparators, and then to use the model to predict the betas of BAA airports based on equivalent financial variables, as specified for Heathrow, Gatwick and Stansted Airports.

The analysis examined a number of possible models linking beta estimates to specific corporate financial indicators by utilising different econometric techniques. The models explored were as follows:

– panel data models using fixed and random effects;
– pooled cross-sectional regression models;

[45] Ismail, B., Kim, M. and Kirk, F. (1994), ‘Accounting Data and the Prediction of Risk in the Extremes’, *Review of Financial Economics*, **4**:1, 55–68; Kulkarni, M., Powers, M. and Shannon, D. (1991), ‘The Use of Segment Earnings Betas in the Formation of Divisional Hurdle Rates’, *Journal of Business Finance & Accounting*, June, and Mohr, R. (1985), ‘The Operating Beta of a U.S. Multi-Activity Firm: An Empirical Investigation’, *Journal of Business Finance and Accounting*, 575–94.

– panel data models (with fixed and random effects), using lagged betas as dependent variables (three-quarter and eight-quarter cases were examined);
– pooled cross-sectional regression models using lagged betas as the dependent variable (three-quarter lag was used);
– cross-sectional regression models using the time series averages for the explanatory variables.

The models selected for the analysis had the following specifications:

– Model 1: pooled cross-sectional regression;
– Model 2: cross-sectional regression with time-series average of explanatory variables;
– Model 3: pooled cross-sectional regression, beta with two-year lag;
– Model 4: pooled cross-sectional regression, beta with three-year lag.

A3.2 Sample for model derivation

The sample used for model estimation is composed of 1,825 observations, with 73 companies, and spans the period from Q1 of 2000 to Q1 of 2006 (25 instances across time, 73 cross-sectional observations).

The following sectors are represented in the sample: real estate, utilities, retail, telecoms and industrials. These sectors are often selected as comparators for infrastructure assets due to the underlying mix of business activities.

Table A1.1 Number of companies per sector

Sectors	Industrial	Real estate	Retail	Telecoms	Utilities
Number of companies	13	19	20	9	12

Source: Datastream.

The actual data used for dependent and independent variables is detailed in the following table. All data used in the analysis, with the exception of the sector dummy variables, is both time- and company-variant.

Table A1.2 Data used

	Measure	explanation
beta	Beta	Market estimates
mval	Market value	Proxy for size
ebitsales	EBIT/total sales	Gross margin
opsales	Operating profit/total sales	Operating margin
capexfcf	Capital expenditure/free CFO	CAPEX funding
capexfa	Capital expenditure as a percentage of fixed assets	Fixed assets formation
capexta	Capital expenditure as a percentage of total assets	Growth

Source: Oxera calculations and Datastream.

In addition to the above, the analysis made use of sector dummies to capture any sector-specific effects.

The choice of different financial measures to be included in the model as independent variables was based on the examination of potential relationships between financial indicators and general business risk characteristics corresponding to the systematic risk component of required returns (in line with finance theory, corporate finance practice and the principles of financial analysis). The selection used in the models was also based on a review of the results from earlier research employing similar techniques—only measures that proved significant in other studies were explored in line with the implicit approach of moving from general to specific.

The data for 'opsales' and 'ebitsales' posed some additional challenges. For these two explanatory variables the data is available on an annual rather than quarterly basis (ie, the same figure is used for all quarters within a year for each individual company). This also constitutes the basis for the time series data used throughout the analysis. This issue does not preclude the use of any advanced econometric techniques, although, in principle, it could increase the standard errors of estimated parameters, leading to larger confidence intervals.

The results of different models' estimations are reported in the tables below for each model. The models estimated were subsequently used to derive beta estimates for BAA airports (as reported in Table 3.10 of the main report), using corresponding financial characteristics of these airports based on data from BAA for the last financial year.

Model A1.1 Cross-sectional regression

				Number of observations		798
				R-squared		0.5278
	Coefficient	Standard error	t	P>t	95% confidence interval	
mval	–1.81E–06	3.09E–06	–0.59	0.558	–7.87E–06	4.25E–06
capexfcf	–0.00	0.00	–0.34	0.734	–0.00	0.00
capexfa	0.00	0.00	5.84	0	0.00	0.01
ebitsales	–0.25	0.02	–9.76	0	–0.30	–0.20
transport	0.39	0.03	12.78	0	0.33	0.45
telecoms	0.56	0.05	10.71	0	0.46	0.67
retail	0.44	0.03	14.58	0	0.38	0.50
restate	0.73	0.04	18.21	0	0.65	0.81
_cons	0.31	0.02	11.63	0	0.26	0.36

Source: Oxera calculations.

Model A1.2 Cross-sectional modelling with time-series average of explanatory variables

				Number of observations		48
				R-squared		0.6224
	Coefficient	Standard error	t	P>t	95% confidence interval	
mval	–2.94E–06	1.44E–05	–0.2	0.839	–0.00	2.62E–05
capexfcf	0.00	0.00	0.06	0.954	–0.00	0.00
capexfa	0.00	0.01	0.69	0.496	–0.01	0.02
ebitsales	–1.82	0.39	–4.68	0	–2.61	–1.03
transport	0.09	0.17	0.53	0.599	–0.25	0.43
telecoms	–0.13	0.34	–0.38	0.706	–0.82	0.56
retail	0.05	0.17	0.32	0.751	–0.30	0.41
restate	0.31	0.28	1.12	0.27	–0.25	0.88
_cons	0.83	0.18	4.56	0	0.46	1.21

Source: Oxera calculations.

Model A1.3 Pooled cross-sectional regression, beta with two-year lag.

				Number of observations		702
				R-squared		0.5134
	Coefficient	Standard error	t	P>t	95% confidence interval	
mval	–1.47E–06	3.55E–06	–0.42	0.678	–8.43E–06	5.49E–06
capexfcf	–0.00	0.00	–0.57	0.568	–0.00	0.00
capexfa	0.00	0.00	5.51	0	0.00	0.01
ebitsales	–0.16	0.02	–6.35	0	–0.21	–0.11
transport	0.40	0.03	12.47	0	0.33	0.46
telecoms	0.60	0.05	11.12	0	0.50	0.71
retail	0.46	0.03	14.19	0	0.39	0.52
restate	0.74	0.04	17.93	0	0.66	0.83
_cons	0.28	0.02	10.1	0	0.23	0.34

Source: Oxera calculations.

Model A1.4 Pooled cross-sectional regression, beta with three-year lag

			Number of observations			656
			R-squared			0.5146
	Coefficient	Standard error	t	P>t	95% confidence interval	
mval	–3.45E–07	3.95E–06	–0.09	0.93	–8.10E–06	7.41E–06
capexfcf	–0.00	0.00	–0.5	0.614	–0.00	0.00
capexfa	0.00	0.00	5.46	0	0.00	0.01
ebitsales	–0.13	0.02	–4.75	0	–0.18	–0.07
transport	0.39	0.03	12.18	0	0.33	0.46
telecoms	0.62	0.05	11.27	0	0.51	0.72
Retail	0.46	0.03	14.08	0	0.40	0.53
Restate	0.76	0.04	18.13	0	0.67	0.84
_cons	0.27	0.02	9.33	0	0.21	0.33

Source: Oxera calculations.

As can be seen from the modelling outputs, all of the above models provide reasonable goodness-of-fit (R^2 ranging from 0.51 to 0.62) and display a number of intuitive properties. In short:

– CAPEX to fixed assets percentage coefficient is positive in all models and significant in three of them;
– the sector dummy variables are significant in three of the four models and also suggest an intuitive risk premium for each sector examined;
– market value coefficients all bear a negative sign (although they are determined to be statistically insignificant).

The analysis did not make use of the results of more advanced panel data techniques for two main reasons. Due to the method used by Datastream to estimate betas (using a 60-month rolling-forward period with overlapping observations across the time series), the appropriate panel data estimation technique would be fixed effects. This way, the fixed group-specific effect created due to the use of the Datastream estimated betas could be controlled for. However, the fixed effects estimation cannot make use of the sector-specific dummy variables, which are expected to be significant from a theoretical and a statistical perspective, as these are time-invariant. The sector dummies could only be included in a random effects specification, which would be inappropriate due to the beta estimation method used, as mentioned above. Therefore, the use of panel data techniques was discarded in favour of the simpler pooled OLS regression.

The use of the above models does not preclude the existence of models that are better suited for the purpose of assessing the determinants of risk. This analysis only examined a small number of factors and made use of relatively simple techniques. Additional research could provide a clearer picture of this complex issue.

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