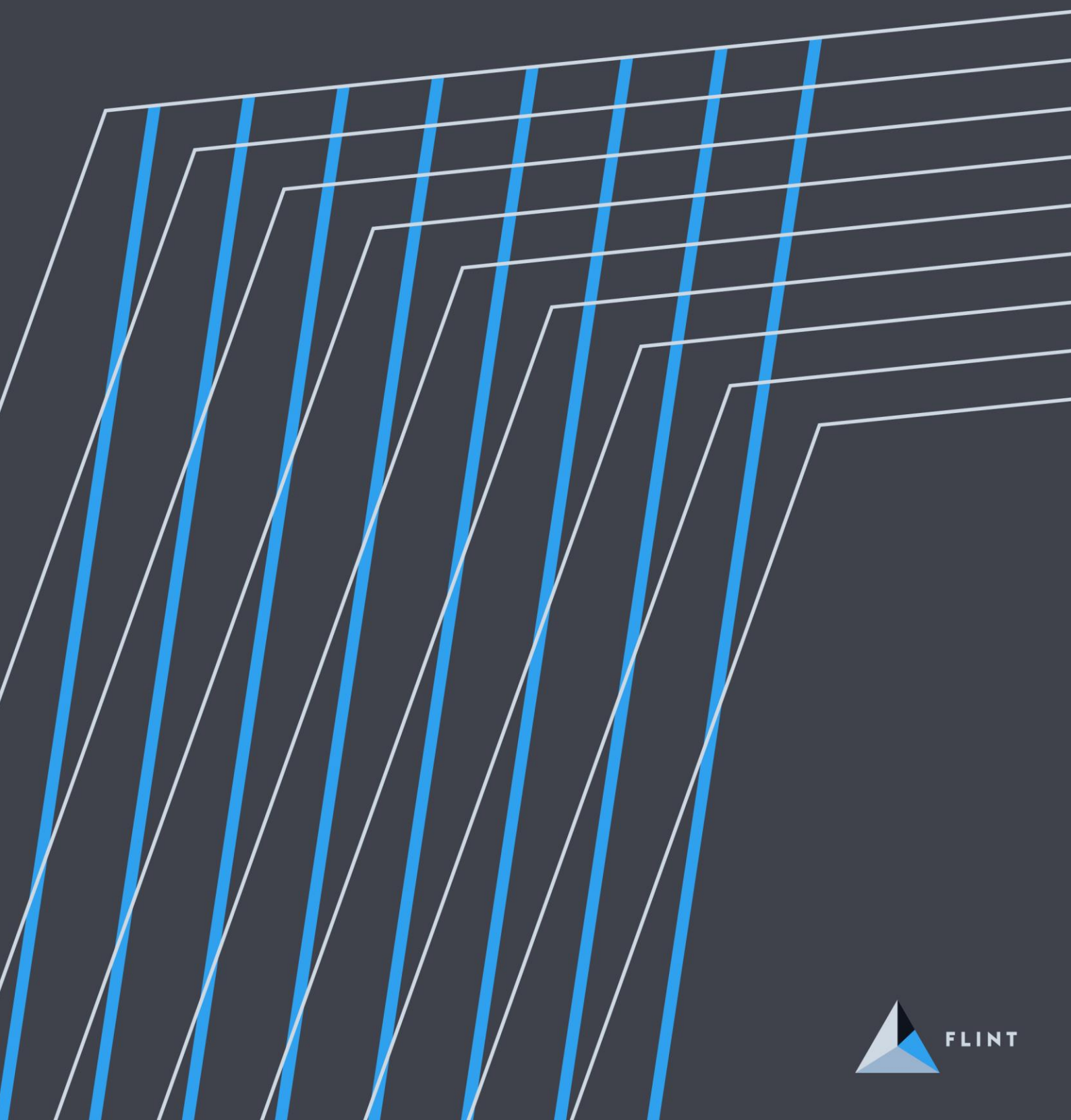
Support to the Civil Aviation Authority:
Estimating Heathrow's beta post-COVID-19



FLINT

Table of contents

FLINT

Executive summary

Flint was commissioned by the Civil Aviation Authority (CAA) to evaluate the implications of COVID-19 for the future assessment of beta for Heathrow Airport, and at H7.

In this report, we propose that the CAA estimates the asset beta in two parts:

- A baseline beta – which ignores the impact of COVID-19 (effectively a 'pre-COVID' beta)
- A 'COVID adjustment' – to be added to the baseline beta, reflecting the risk of events similar to COVID-19 that may occur in the future.

Background

Alongside its effects on the economy more generally, COVID-19 has prompted significant traffic downturn across the aviation sector globally. In 2021 traffic volumes were 70% down across all major international airports. The effects are significant and need to be recognised in future regulatory controls. One aspect of this is risk, for which an allowance has historically been made in the cost of capital, through the beta parameter.

Our approach

In our analysis we review the directly observed impact of COVID-19 on beta by considering comparator airport groups over the past five years. The impact has been significant.

This analysis of 'backward-looking' betas contains important information about what has happened in the past. However, it does not faithfully portray forward-looking risks, that should form the basis of the cost of capital allowance at H7.

To reach a view on what would be appropriate for H7, we have made full use of the recent data – both pre- and post-COVID-19 to develop forward-looking beta estimates that combine the data according to assumptions about the potential mix of future risks that companies will face. We reflect a range of scenarios for the future occurrence of similar events – and weight the post-COVID-19 / pre-COVID-19 evidence accordingly.

Using our approach, we estimate the value of beta that would prevail for each comparator if an event like COVID-19 never happened again (the baseline beta). We then consider the effect of an event like COVID-19 occurring again in the future – for example once every 50 years. We then calculate a 'COVID adjustment' that represents the difference between this value and the baseline beta.

Resulting beta estimates

As a baseline beta, we retain our April 2020 (pre-COVID) beta range of 0.50 to 0.60, based on observed pre-COVID betas for AENA (Madrid), ADP (Paris) and Fraport (Frankfurt), the set of comparators which we consider are most similar to Heathrow prior to COVID-19.

For the COVID adjustment, we also estimate a range. Our range reflects a similar event to COVID-19 occurring between once every 50 years, and once every 20 years. This range suggests an increase in the baseline beta of between 0.04 and 0.14.

TABLE 1: FLINT ESTIMATES OF PRE-COVID-19 ASSET BETA AND COVID ADJUSTMENT

	Lower Bound	Upper Bound
Baseline beta	0.50	0.60
Beta adjustment for COVID	0.04	0.14

Implications for H7

Our beta calculations offer a view of the long-term systematic risks faced by airport investors. We consider that these estimates are appropriate for setting charges during H7 (and in future price controls). Importantly, they are not an attempt to forecast the 2- or 5-year beta that may prevail over a given period. Instead, our estimates reflect the full combination of risks faced by airport investors, including low frequency but high impact events, exemplified by COVID-19. Such risks have prominent systematic features and should be properly recognised and weighted, despite their likely infrequency – and the distinct possibility that they may not crystallise at all within any given price control period.

Our estimates do not address the CAA's proposal to introduce a new mechanism for traffic risk-sharing at H7. We have consciously developed them as being representative of Heathrow's systematic risk without any such sharing arrangements. The beta eventually adopted by the CAA for H7 will need to be moderated in line with the form of risk sharing that is implemented.

1 Introduction

The Civil Aviation Authority (CAA) is setting the Weighted Average Cost of Capital (WACC) allowance for Heathrow Airport at the H7 price control. It has commissioned Flint to consider recent equity market evidence in light of the COVID-19 pandemic and evaluate potential implications for the assessment of Heathrow's forward-looking beta, which it will use to support its decision. This analysis follows the WACC assessment we previously undertook for the CAA in April 2020[1] which did not take account of any effect of COVID-19 on the beta, and analysis by the CAA on potential comparators for Heathrow since the pandemic.[2]

In summary, we propose that the CAA estimates Heathrow's beta at H7 by combining two elements:

- A baseline beta which ignores the impact of COVID-19 (effectively a 'pre-COVID' beta); and
- A 'COVID adjustment', to be added to this baseline beta, reflecting the additional risk of similar events that may occur in the future.

Our report is structured as follows:

- Chapter 2 explains the background to this work;
- Chapter 3 sets out our proposed approach, including our discussion of methods proposed by other stakeholders;
- Chapter 4 summarises our selection of comparator airport stocks from which we estimate the effect of COVID on betas;
- Chapter 5 presents the results of our assessment of the effect of COVID-like events on the beta, and our resulting estimate of the 'COVID adjustment';
- Chapter 6 explains the implications of our analysis for the underlying baseline beta estimate;
- Chapter 7 discusses the effect of proposed changes to Heathrow's regulation on its beta; and
- Chapter 8 sets out or overall conclusions and recommendations.

Further detail of some aspects of our analysis is set out in appendices.

[1] Flint (Apr 2020), Support to the Civil Aviation Authority: Business as Usual WACC for H7.
[2] CAA (Apr 2021), Appendices to Economic regulation of Heathrow Airport Limited: Consultation on the Way Forwards.

2 Background

Developing estimates of beta and systematic risk for the purposes of setting regulated charges is challenging at the best of times. In benign periods practitioners might often adopt 'unedited' backward-looking beta calculations and take these to be a faithful proxy for systematic risks of the future.

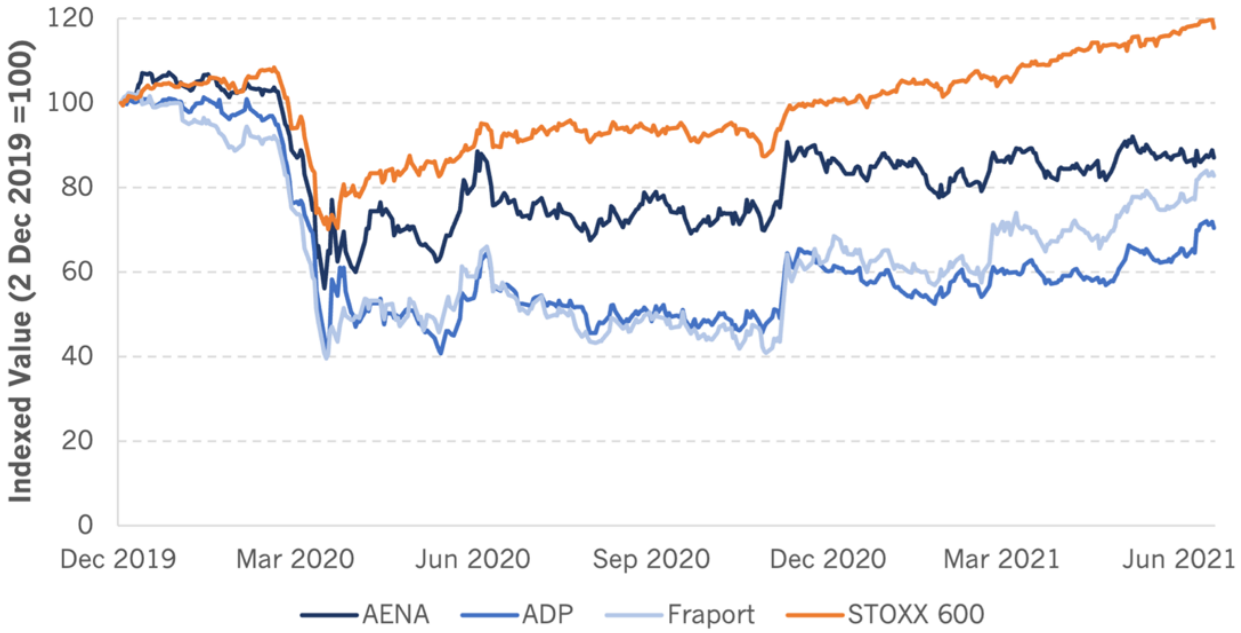
This approach has previously been adopted by the CAA and the CMA, along with other regulators. In the CAA's instance, because Heathrow is privately owned, there is an absence of directly observable share price and beta information. Hence the backward-looking beta assessment was made by reference to comparator airports that were considered to exhibit similarities to Heathrow.

2.1 Effects of COVID-19

Since early 2020, following the onset of the COVID-19 pandemic, market valuations of listed airports (and airlines) have exhibited significant volatility linked to the pandemic, and have fallen materially overall. The aviation sector has been one of the most prominently affected, with widespread global restrictions on travel driving significant reductions in passenger numbers and revenues.

There has also been significant volatility across equity markets in general, with day-by-day movements in recent periods often prominently driven by COVID-19 related news and events. Unlike the aviation sector, however, equity markets as a whole now appear to have recovered much of the value lost during the pandemic.

FIGURE 1: AIRPORT EQUITY PERFORMANCE SINCE DECEMBER 2019

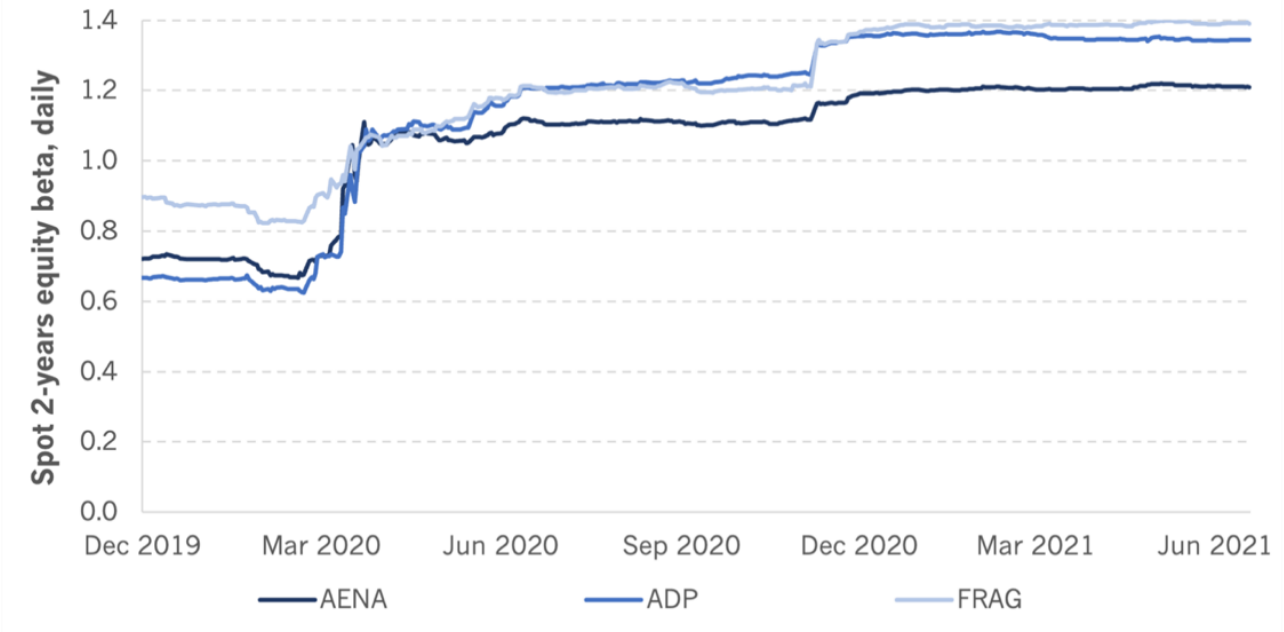


Source: Flint analysis of Thomson Reuters data as of 18th June 2021.

These movements have combined to drive a substantial increase in the levels of observed (backward-looking) beta statistics for airports as shown in Figure 2 below. The increase is

particularly significant when short assessment windows are used which include the period(s) most affected by COVID related events.

FIGURE 2: SPOT 2-YEARS EQUITY BETA, DAILY



Source: Flint analysis of Thomson Reuters data as of 18th June 2021.

Daily airport share price movements since COVID-19 exhibit a stronger relationship with the index, leading to the changes in short-term beta observed above. Figure 10 in Appendix 1 demonstrate this.

2.2 Challenges of beta estimation

Assessing the effect of COVID-19 on future beta estimates is challenging. However, it is important that the risks faced by Heathrow are fairly assessed and reflected in regulated prices in future to provide Heathrow's investors with a 'fair bet', meaning that:

- First, the forecasts used by the CAA in establishing the price controls at H7 should reflect expected values (of traffic, revenues, costs etc.) allowing for a range of outcomes, including low probability, high impact events (such as a 'COVID-like' event). Put simply, projected cashflows should *fairly reflect* the range of possible outcomes.

- Second (and the main focus of this report), the systematic risks of likely returns around this set of expected values is also faithfully captured, reflecting the extent to which these risks are borne by Heathrow's investors, after adjusting for any regulatory mechanisms that provide for risk sharing. Put simply, the allowed rate of return should *fairly reflect* the risks faced.

Although we cannot be certain, the likelihood of a repeat of events with effects similar to the recent pandemic in the very near future is low. This means that a backward-looking approach of this type is likely to be inappropriate. Beta statistics derived from recent data would be likely to overstate systematic risks faced in the future, should airport share price behaviour revert to a 'pre-COVID' pattern during more normal periods.

For example, consider a two-year daily beta, estimated at June 2021. The dataset from which such a beta is calculated would be 70% made up of daily share price and index movements that were from the post February 2020 period and hence heavily influenced by COVID-19. Moreover, extreme daily market or share price movements (or both) exhibit an unusually strong influence on the beta calculation, due to the basis of its mathematical formulation. So, the COVID-19 events of early 2020 (and the vaccine news later that year) would essentially dominate the beta calculation.

The challenge for the CAA is not necessarily about whether or not to reflect the recent evidence, but about how and to what extent. To set future charges efficiently, it needs to allow for a beta and cost of capital that fairly capture the future risks faced by Heathrow's investors, taking account of the evidence from the past 17 months and what it implies about future risks. As we discuss in the chapter below, stakeholders have presented different views about the appropriate interpretation of recent data.

There are also other challenges involved in analysis of this type:

- The COVID-19 pandemic has not yet fully run its course – we may face further market and aviation sector volatility.
- Share prices will have reflected investor perceptions and expectations at the time they were observed. We are not able reliably to infer what these may have been, though they will have reflected the potential for government or regulatory intervention for each comparator. The data tells us the market's view of the 'net' risks borne by the comparator airports after the level of such prospective interventions.
- The frequency of global healthcare crises such as COVID-19, or other events of similar potential impact, cannot readily be predicted. Moreover, future extreme events will inevitably differ in nature, scale, impact and response.
- The risks represented by COVID-19 cannot be classified with certainty as systematic rather than idiosyncratic.

On this last point in particular, the type of risk that should be represented by beta is systematic, or market risk – risk that cannot be eliminated by diversification. It stems from market-wide events that have an impact on all businesses.

It could be argued that the COVID-19 pandemic and its consequences for the aviation sector are not entirely systematic. That is to say that there may be elements of risk reflected in the share price movements of the airports that influence the observed beta calculations but can be argued as idiosyncratic in nature, and/or exhibit some circularity.[3]

That being said, we note that in the 2020 water redeterminations, the CMA explicitly refers to COVID as a "predominantly" systematic risk.[4]

[3] Situations such as this may have been observed previously – for example, in the banking sector during and following the 2008 crash and in the telecoms sector during the boom/bust period of the late 1990's / early 2000's. In these cases an underlying event triggered a decline in the stock market as a whole, while certain sectors exhibited extreme exposure and prominently drove movements in index values.
[4] CMA (Mar 2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, p. 863, para 9.493.

So, while aware of the challenge, we note that risk analysis of this type is complex, involves judgement and is beyond the scope of our work. For the purposes or this analysis, we treat the COVID-19 events, and the market and individual equity price responses, as systematic. In our view, the data supports the view that the pandemic can predominantly be seen as a (series of) market wide event(s) that had a profound effect on the market as a whole and affected all businesses. We consider the observed statistical relationships and resulting beta calculations to be faithfully representative of historic systematic (i.e. undiversifiable) risk.

3 Our approach

The CAA has received a range of representations on the way in which it should take account of COVID. In this chapter we briefly summarise those representations and set out our view of how best to estimate a forward-looking beta for Heathrow.

3.1 Stakeholder proposals

Heathrow and the London (Heathrow) Airline Consultative Committee (LACC), advised by CEPA, have between them produced several reports which refer to beta. They propose different approaches to dealing with COVID in the context of beta estimation.

Heathrow has suggested that "*the impact of COVID-19 in March 2020 represented a discontinuity in investors' views on the riskiness of airports.*"[5] It argues that this warrants the use of spot 2-year beta estimates, and other shorter estimates based on data only from March 2020. This approach essentially suggests that most of the historical evidence prior to the pandemic outbreak should be disregarded.

CEPA proposed two exploratory approaches to understand the effects of a single disruptive event as part of a longer time series:[6]

- Shorter beta estimation: for example 90-working-day asset betas for ADP showed recent betas (after the onset of the COVID pandemic) are below pre-COVID betas.
- Winsorisation: CEPA proposed an approach based on a statistical technique for removing outlier data within a regression analysis – as set out in a paper by Welch[7]. This approach caps the daily rates of return of individual companies used in the beta regression to an artificial maximum deviation from the market rate of return that day. The 'overwritten' share price data is then used instead of the true share price data as a basis for estimation of the beta.

3.2 Our proposed approach

Our proposed approach differs from both the Heathrow and the LACC approaches, sitting in between these very different positions, and offering what we believe is a more balanced appraisal of the evidence. We reflect the recently observed COVID data in long-term estimates of beta. We also neither ignore pre-COVID data nor artificially bound or restate the actual COVID data.

We recognise Heathrow's suggestion that perceptions of risk may have changed. We agree that there may be heightened perceptions of risks faced in future, associated with events such as those recently experienced being more frequent in future than they have been in the past. We also agree that the beta appropriate for defining the future cost of capital allowance may now be higher than it was.

However, we do not believe that this is consistent with Heathrow's suggestion that the CAA should rely entirely on very recent beta statistics, which are dominated by COVID-19 data. There will be

[5] Heathrow, H7 WACC updates, p.3.
[6] CEPA (Jun 2021), Way Forward – Technical Appendix, p.4.
[7] Welch I. (Jun 2021), Simply Better Market Betas.

periods in future where we might reasonably expect observed systematic risk experienced at airports to be more benign, since, as Heathrow recognises, COVID-like events are not likely to happen frequently. This might plausibly be reflected in prolonged periods during which index behaviour and associated airport share price movements more closely resemble a pre-pandemic pattern.

Through similar reasoning, we do not believe that extremely recent short window daily beta estimates referred to by CEPA are a reliable indicator of future systematic risk perceived by investors – these, wrongly in our view, fully ignore the most significant periods during which COVID-19 drove marked share price and index movements and affected the observed betas. They are also of questionable statistical significance.

It would be wrong to disregard the COVID period entirely. COVID-19 has been an important driver of risk in the recent past, and this risk has exhibited systematic properties affecting all businesses. COVID-19 has increased the relative systematic risks experienced by airport investors. If similar events are likely to occur in the future, their likelihood and heightened systematic risk features should be duly reflected alongside the lower systematic risks observed during more benign periods, in establishing a balanced view of the prospects faced by airport investors. Such a view – while involving speculation about the future – would form an appropriate basis for forward-looking beta estimates and allowed returns.

Therefore, rather than simply relying on recently observed 'raw' betas from our comparator airports, we have considered different ways of reflecting the effect of the ongoing COVID-19 pandemic on airports' asset betas. These methods reflect a reweighting of the post-COVID-19 evidence and evaluation of the effect this would have on the comparator airports' betas.

In its PR19 redeterminations in the water sector, the CMA considered the question of whether and to what extent changes in observed betas due to the pandemic represented changes in systematic risk (that should be reflected in the allowed rate of return via the assumed beta parameter):[8]

> *"While we consider that the pandemic represents a systematic event which should not be excluded from our estimates, we also recognise that this type of economic crisis is relatively rare and that it is likely to be over-weighted in our range of beta estimates, which cover the last 2-, 5- and 10-year periods."*

The CMA's decision concerned a different sector and did not adopt the same quantitative techniques that we set out in this report. However, the CMA's decision supports the principle behind our approach – that recent evidence on the effect of COVID-19 should be reflected in estimates of a forward-looking beta. Moreover, the CMA's suggestion – that relying directly on betas calculated from recent data would likely overstate the influence of recent events that are likely to be prove rare in future – would also support our approach, which directly reflects their prospective future infrequency.

As we discuss in Chapter 2 above, it is not possible to predict the nature (or timing) of events that might cause similar scale of disruption to the airport industry as COVID-19. As we discuss further below, future events which cause disruption to airports may not be similar to COVID. For example,

[8] CMA (Mar 2021), Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations, p. 870, para 9.493.

in a post-COVID world, if events of similar nature are expected to occur more frequently, the sector may be better adapted to respond, e.g. to an unexpected international health crisis.

Hence, rather than making a speculative assessment of how future airport valuations and betas are likely to respond to adverse events of a different nature to COVID, we instead ground our quantitative analysis on observed stock market data before and since the COVID-19 pandemic began, while recognising that future events will obviously differ from COVID-19. So, whilst a useful reference framework for potential impact, our results need to be interpreted in this light.

We also carry out a cross check, comparing our results with an alternative reference point for estimation of beta over a long time period, and explain why (despite differing results) we consider our approach more appropriately reflects a greater impact of the COVID evidence.

In practice, we present our analysis of the beta in two parts:

- First, we assess an underlying 'baseline beta' which reflects the value of beta that would prevail for each comparator if an event like COVID-19 never happened again.
- We then consider the effect of an event like COVID-19 occurring again in the future – for example once every 50 years on the long-run beta. We can then calculate a 'COVID adjustment' that represents the difference between this value and the baseline beta.

In our April 2020 report for the CAA, we estimated a 'pre-COVID' beta, i.e. one which reflected the risk faced by airports prior to the pandemic. Here we rely on that analysis to inform our underlying baseline beta, accounting for non-COVID conditions. While we consider the implications of new evidence and recent market events on our underlying 'baseline beta' in Chapter 6 below, the bulk of our analysis in this report concerns estimation of the COVID adjustment.

3.3 Our detailed methodology

To estimate the COVID adjustment, we have developed a methodology which creates a 'reweighted' beta estimate based on daily share price and index data over recent years. Some of this data is directly affected by COVID-19. Some of the data pre-dates COVID-19 entirely.

We change the weight on the COVID-affected observations in our dataset relative to the non-COVID observations. This allows us to simulate betas for longer time horizons but reflecting different frequencies with which the COVID-19 data occurs (correspondingly reflected in the reweighted dataset). This provides an estimate of the effect on long-run beta estimates of different assumed frequencies of a sequence of simultaneous share price and market movements of the type that have been observed since the COVID-19 outbreak.

As a simplified illustration of the approach, imagine we had five years of actual observed data. One year of the data can be identified and attributed to the full cycle of a specific event, and four years of the data was unaffected (i.e. pre-dated the event). A simple 5-year beta calculated from this raw data would be suitable for use as a forward-looking beta estimate only if it was considered likely that future similar events would occur once every five years.

But what if the expected frequency of future events was lower, say one in 10 years? Using the same data, we can simulate a beta for an event frequency of one in 10 years by increasing the weight on the 'non-event' data such that it accounts for nine years of a new 10 year dataset, while holding

the weight of data affected by the event constant. A beta calculated from this constructed dataset would reflect the prospective systematic risk if events were expected to occur once every 10 years.

So, we can reformulate recent, historical data, which we know to represent an observed combination of events and time periods, to form a forward-looking beta that reflects different possible combinations of such events in the future, over the long term. We do exactly this with recent stock market data, which pre-dates, and then captures the effects of the COVID-19 'event'.

We implement our approach as follows.

A stock's equity beta (β) is calculated as the covariance between the return of the stock index (r_i) and the return of the market index (r_m), divided by the variance of the market index:

$$\beta = \frac{Cov(r_i, r_m)}{Var(r_m)}$$

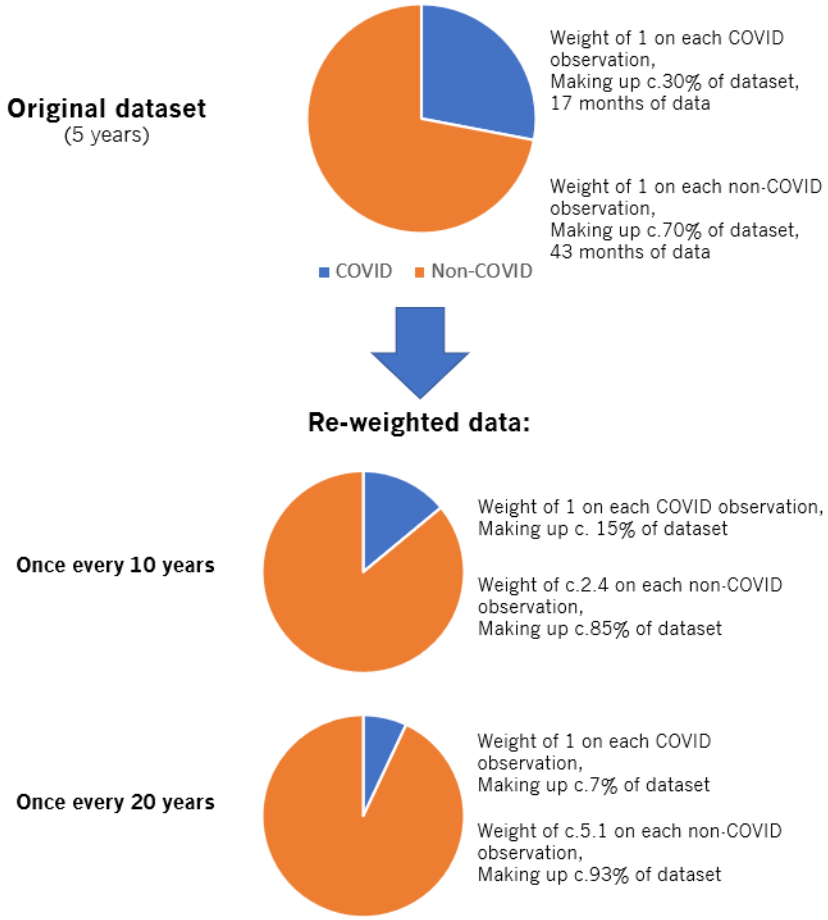
However, we can also calculate this relationship from the coefficient on the slope in a simple linear regression between the return on the stock and the return on the market index.

Across our comparator set, we classify daily data as COVID-affected data and non-COVID affected data. We then calculate an equity beta for each comparator using a linear regression, with different weights assigned to COVID and non-COVID observations. The weights can be translated – in effect – into an equivalent 'frequency' at which a 'COVID-like' event occurs.

We then repeat this regression for a series of different weightings of 'COVID-like' events to represent different frequencies. Finally, we convert the equity betas into asset betas using the observed gearing over the period. We use a weighted average gearing, consistent with the weights we assign for COVID and non-COVID data and assume a debt beta of 0.05 for all comparators (consistent with our April 2020 report).

Figure 3 below illustrates this approach, for two frequencies of COVID-like event, based on the modelling assumptions and scenarios which we discuss in the subsection below.

FIGURE 3: ILLUSTRATION OF OUR REWEIGHTING APPROACH



3.4 Modelling assumptions

In order to implement this approach described above, we must make a series of choices about key parameters in our model:

- First, how we classify data as 'COVID-affected' and non-COVID affected. As we describe below, we assume a single 'COVID window'. Hence we focus our analysis on the start date and end date of the period over which we assume COVID has affected betas and the assumed duration of future COVID-like events.
- Second, the frequency at which we assume COVID-like events occur in future. We chose to present results for a range of frequencies of event, from one in five years to one in 100 years, and suggest the CAA focusses on results within the range once in 20 and once in 50 years.
- Third, the size of the historical dataset upon which we rely. We use a 5-year dataset, giving us sufficient pre-COVID data while avoiding problems associated with relying on a longer dataset.

We discuss each of these assumptions in turn below.

I. COVID window

Start date

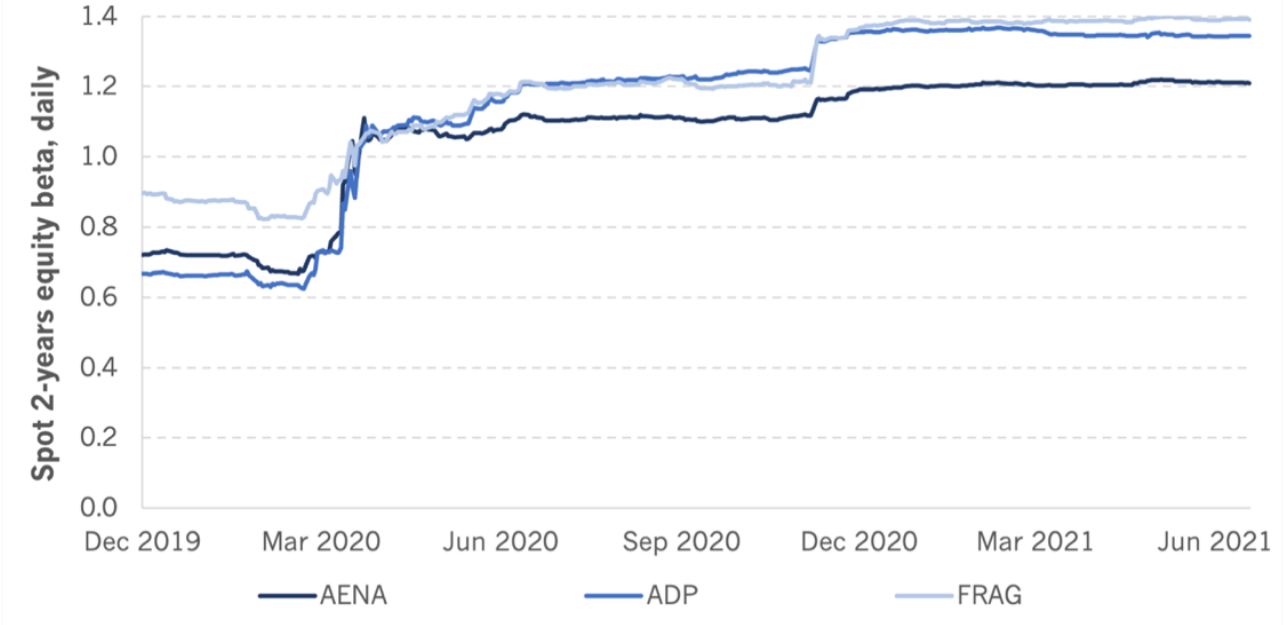
To identify the time-period over which COVID-19 materially affects estimates of beta, we analysed share price movements (for airport stocks and for market indices) and 2-year rolling betas. As Figure 4 below shows, there is a pronounced decline in airport and market indices in early 2020 (around February and March).[9] As Figure 5 shows, this leads to a pronounced increase in the 2-year beta. Figure 5 also shows significant beta movements in late 2020, apparently associated with positive news related to COVID vaccines.

FIGURE 4: AIRPORT EQUITY PERFORMANCE SINCE DECEMBER 2019

Source: Flint analysis of Thomson Reuters data as of 18th June 2021.

[9] We also examined shorter rolling betas (6-weeks) to explore at a more granular level the effect of COVID (see for example Figure 11 in Appendix 3) to substantiate our interpretation of the COVID effect and its timing. However, we do not place any emphasis on these estimates as a basis of actual beta estimation, due to their limited statistical reliability.

FIGURE 5: SPOT 2-YEARS EQUITY BETA, DAILY



Source: Flint analysis of Thomson Reuters data as of 18th June 2021.

Based on this analysis, we consider a start date between January 2020 and March 2020 can be justified. While stock market movements are most pronounced in March 2020, there is some evidence of material stock market movements slightly earlier. Therefore, we have chosen to rely upon a start date of 1st February 2020, to ensure that all data affected by emerging COVID-related news is included in our COVID window.

For completeness, we also considered alternative assumptions up to a month either side of 1 February but find these have very limited effect on our results. We discuss these sensitivities in Appendix 4 below.

Since COVID-related news is likely to have been significant in driving price movements since the beginning of the period at which markets became aware of its impact, we treat all data from the start of our COVID window as COVID-affected. We do this rather than modelling multiple, shorter 'COVID windows' during the peaks (e.g. in February-March 2020 and November 2020), which would require subjective assessment of precise periods where COVID-related news was more dominant. For the same reasons, we do not use statistical methods to identify and remove specific data points e.g. when stock/market movements exceed a particular threshold.

End date and duration of COVID-like events

We assume that COVID continues to affect share prices and betas until the end of our 5-year dataset, that runs to 18th June 2021. Like our decision to avoid using multiple windows, this approach avoids us from making subjective judgements about if and/or when we assume betas have returned to a 'normal' level. By implication, we assume that airport share prices and index values remain significantly influenced by COVID related news and events through to June 2021.

There is some emerging evidence that market movements and share prices responses may be returning towards their pre-COVID pattern and are no longer dominated by COVID news and events in the way observed through 2021. However, COVID continues to affect the markets, and the

aviation sector in particular, at the time of writing. This suggests that future COVID-like events (and indeed the COVID-19 pandemic itself) may have a longer effect on betas than the 17-month period observed to date.

Therefore, when we present our results below, we present an estimate for a 'lower-bound' duration and an estimate for an 'upper-bound' duration. In the lower-bound estimate, we assume future COVID-like events affect betas for 17 months, and in the 'upper bound' we assume a COVID-like event may continue to affect betas for up to two and a half years in total, and with a similar impact through this entire period as has been observed in the 17-month 'actual' window observed to June 2021. We discuss our reasoning for the duration of our 'upper bound' in subsection 5.2 below.

II. Frequency of COVID-like events

To avoid falsely precise assumptions about the probability of COVID-like events occurring in the next regulatory period, we consider and illustrate a wide range of COVID-like event frequencies, from once every five years (i.e. as observed in the five years to June 2021) to once every 100 years.

When presenting our results below, we focus our discussion on the range of results for frequencies between once every 20 years and once every 50 years, noting that Heathrow suggested a "return period" for a pandemic within this range, of once every 30 years.

We also reiterate that our analysis is based on speculated future 'COVID-like' events exhibiting identical properties to COVID-19. Should events of lesser or greater consequence occur, or should the impact on the aviation sector be different in scale, this would also influence our illustrative beta impact.

III. Dataset

Given we identify a COVID window lasting around 17 months from within our historic dataset, we choose to estimate our reweighted betas using 5 years of daily data, i.e. with around 3.5 years of non-COVID data. A two year dataset, would have unduly restricted the amount of non-COVID affected data in our sample. We also chose not to use a longer dataset (such as 10 years) for two main reasons; first, data for AENA (the airport we consider to be Heathrow's closest comparator- see Chapter 4 below) was not available, and second, due to the risks either that our selected comparators exhibited different risks in the past than they do today or that perceived systematic risks in the aviation sector have generally changed over the period.

In our view, a 5-year combined dataset provides a suitable foundation for our analysis, fully encapsulating the available data to reflect the COVID-19 impact, and offering a 'pre-COVID-19' dataset that spans approximately four years, which sits helpfully within the beta estimation windows (of 2, 5, 10-years) emphasised by the CMA and CAA in previous decisions.

4 Selection of comparators

As we describe in above, our objective is to help the CAA form a view of the appropriate beta that might be adopted in H7 to reflect the forward-looking risks faced by Heathrow. Specifically, we want to set out how the recent market response to COVID-19 should be interpreted, and considered as a driver of future risk, recognising that events of such nature may occur in the future.

To do this, we follow a different approach to that generally adopted when estimating the beta for use in regulatory price setting. However, our analysis still requires us to identify appropriate comparator stocks from which we can observe the response of airport share prices and betas to the COVID-19 pandemic.

In our April 2020 report, we considered AENA, ADP and Fraport the most relevant comparator airport groups. During the COVID-19 outbreak, the CAA has indicated that "*reliance on an overly narrow comparator set could lead to excessive weight being placed on results that are driven by specific circumstances that may not be applicable to HAL.*"[10] At CAP 2139, the CAA concluded on a set of eight comparators: AENA, ADP, Fraport, Zurich, Vienna, Copenhagen, Sydney and Auckland. The CAA filtered these comparators from a list of 16 quoted airport businesses based on the following criteria:[11]

- Availability of stock return data over a period of at least five years;
- Absence of substantial non-airport revenue streams;
- Existence of market power at the main airport(s) within the group;
- Application of a revenue or price cap by an economic regulator;
- Size in terms of air traffic movements ("ATMs") and passenger numbers ("pax"); and
- Whether the main airport within the group is a "hub".

We agree with the CAA's view that in understanding the impact of COVID-19 it may be appropriate to consider a wider set of comparators. We have therefore reviewed the wider comparator set for specific suitability for our own analysis, while trying to retain a broad set of benchmarks where possible. Our framework for establishing the most relevant comparators includes an assessment of:

- The reliability of daily share price data, which underpins our later analysis;
- The regulatory regime and regulators' responses to the pandemic; and
- Group and main airport features that may have influenced the impact felt through the pandemic.

[10] CAA (Apr 2021), Appendices to Economic regulation of Heathrow Airport Limited: Consultation on the Way Forwards, p.68.
[11] CAA (Apr 2021), Appendices to Economic regulation of Heathrow Airport Limited: Consultation on the Way Forwards, p.69.

Appendix 2 provides more detail of our assessment of the underlying share price and beta data, and Appendix 3 outlines the framework we used to assess the wider suitability of the comparators describing operational features and regulatory considerations. We summarise our main conclusions below.

4.1 Reliability of comparator beta estimates

First, we have analysed the share price data for the comparators and the appropriateness of the relevant market index, and the resulting reliability of beta calculations. We consider that we do not have sufficiently reliable share price and daily beta analysis for two of the CAA's eight comparators:

- Only 1% of shares in Copenhagen airport are traded on the stock market. With such a low level of free trade, and the associated potential for infrequent trading, daily share price data may be unreliable. Weekly or monthly data may suffer less from these problems, but the short COVID-19 period effectively rules out weekly or monthly analysis. Furthermore (and potentially as a result of its infrequency of trading), there is relatively low statistical certainty about the precision of our estimate of Copenhagen's beta.[12]

- Auckland airport is traded on the NZX exchange, a market which is not highly diversified. For example, Auckland airport alone makes up 6% of the NZX. Hence, movements in the market index may be driven by movements specific to Auckland airport, creating some circularity in the beta estimates for Auckland. (We also note that Auckland airport's business activities include significant non-aviation exposure which may undermine the relevance of its beta estimates.)

- We note that under these same criteria we might also place less weight on the beta data for Sydney and Vienna. Sydney's market index – All Ordinaries – is less diversified than the STOXX 600 (even though Sydney is not a dominant constituent). Vienna airport only has 10% free float, and its beta estimate is notably less statistically robust than the remaining candidate betas.

4.2 Comparability of airport groups

For the remaining six comparator stocks, we assessed the comparability of the airport/group to Heathrow, based on their regulatory and operational features, up to and during the COVID-19 period:

- Our analysis of regulation is focused on the main airport(s) within the respective group.

- Our analysis of operational features considers geographic exposure, traffic types and financial position – in light of COVID-19.

Effect of and comparability of regulatory regimes

Prior to the COVID-19 outbreak, the regulatory framework might be argued to have less influence on the overall risks faced by an airport. During benign periods, the need for significant pricing or operational changes may be limited and/or predictable, and therefore less constrained by

[12] Specifically, we find relatively wide confidence intervals around our spot estimate of its beta when estimating it using an OLS regression.

regulation. However, during periods of extreme disruption, regulatory frameworks may more significantly constrain airport behaviour and take greater prominence in driving risk.

The CAA has carried out a review of the regulatory regimes in place in each of the proposed comparator airports. Comparing other airports' regulatory frameworks to that of Heathrow's at H7 (absent new risk mitigations, see Chapter 6 below), we observe the following points which are pertinent to our analysis:[13]

- Overall Madrid (AENA) appears to operate under regulatory arrangements similar to those that previously applied to Heathrow. The regime has not undergone fundamental change through the COVID-19 outbreak. Madrid now seems most comparable with Heathrow in this regard.

- Paris (ADP)'s regulatory framework was previously considered comparable to Heathrow's. However, its regulator, ART, has adapted the regulatory regime in light of the pandemic, effectively shortening the formal controls, and increasing Paris Airport's charging flexibility. That being said, we understand that there remain potential broader legal constraints that limit the scale of increases in Paris' tariffs. Paris may therefore remain hampered in its response to COVID, by a more complex set of regulatory constraints, albeit a different set of constraints than applied previously. Notwithstanding the complexity, the comparability of Paris with Heathrow may now be reduced, due to these changes.

- Zurich Airport's regulatory framework remains comparable to that adopted for Heathrow. As yet, the FOCA's framework has not been subject to major change following the COVID-19 outbreak.

- Vienna Airport retains a short control period with a more flexible regulatory framework.

- Sydney Airport is not subject to a formal regulatory price control. We place little weight on Sydney as a comparator for this and other reasons.

Effect of and comparability of operational features

Capacity utilisation was perceived as a key driver of risk for Heathrow prior to the pandemic but may now be less relevant. Passenger numbers (and flights) have significantly fallen and may not recover quickly, potentially leaving spare capacity at airports across the comparator set in the near term.

Therefore, airports with less pressing capacity constraints before the pandemic may now be more comparable with Heathrow, despite having previously been given less weight in the comparator analysis than airports which were similarly capacity constrained (AENA, ADP and Fraport). We therefore place less weight on capacity utilisation when considering comparator airports on their similarities to Heathrow – supporting the adoption of the broader comparator set.

With regards to traffic profile:

- AENA, ADP and Fraport remain the closest comparators to Heathrow in terms of aggregate passenger numbers, with each of their main airports registering over 60 million passengers in

[13] This information has come from the CAA's review of available sources and discussions with the regulators of AENA, ADP and Zurich.

2019. All three airports have a lower proportion of transit traffic than Heathrow, though international traffic dominates all of these comparators.

- We also note that all of the main airports experienced a similar decline in aggregate traffic due to COVID-19 – suggesting that the immediate effect was not restricted to international traffic only. International traffic may plausibly take longer to recover than domestic traffic as domestic restrictions are relaxed ahead of international. This may affect Heathrow's recovery.

- Sydney's traffic mix was previously dominated by domestic traffic. The evolution and impact of COVID-19 (for example in terms of early case numbers) has been very different in Australia.

With regards to group activities:

- ADP and Fraport have significant holdings in other geographies, including outside of Europe, and exhibiting potentially different responses to COVID-19. As we note above, the main airports have similarities to Heathrow that justify continued inclusion in our sample – but they exhibit important differences in range of activities and group holdings. This leads us to put less emphasis on these two comparators.

- Despite the similarities between traffic mix at Vienna and Heathrow, for example in the proportion of transfer passengers, Vienna's is significantly (circa 6x) smaller than Heathrow.

- We also note the CMA decided to exclude Vienna and Zurich from its beta comparator group in the provisional findings for the NERL/CAA appeal, primarily on the grounds of size, potential for company specific issues to distort comparisons and possible liquidity concerns.[14]

4.3 Summary

Overall, we recommend placing greatest weight on AENA, as the closest comparator to Heathrow when considering both the pre-COVID-19 and post-COVID-19 period. However, we also consider ADP, Fraport and Zurich to be useful benchmarks. In the face of the uncertainties of this exercise and in the interest of maintaining a comparator set as broad as possible we retain Vienna and Sydney for analysis – but place limited weight on the results for these comparators.

Reflecting our assessment, we use three broad sets for representation of the results of our beta analysis in the forthcoming chapter:

- AENA only, the group with the most comparable main airport, Madrid-Barajas, and overall group operational features that appear most similar to Heathrow.

- The average of the four airports that we consider most comparable to Heathrow: AENA, ADP, Fraport and Zurich.

- An average of all six retained comparators: AENA, ADP, Fraport, Zurich, Vienna and Sydney.

[14] CMA (Mar 2020), NATS (En Route) Plc / CAA Regulatory Appeal, final report, p.186, para 13.74.

5 The impact of COVID on beta

In Chapter 3 above, we describe our approach to estimating the 'COVID adjustment' from 'reweighted' beta estimate based on daily share price and index data over the last five years.

In this chapter we present the results of our analysis. We present our primary results in two stages:

- First, we set out results for a lower-bound, based on an assumed COVID-like event of 17-month duration. This lower bound reflects the possibility that, based on the assumption that future COVID-like events.
- Then, as a second stage, we set out an upper-bound result based on a longer, 30-months (or 2.5 year) assumed duration of a future COVID-like event.

The upper and lower bound reflect uncertainty about both the duration of the effect of COVID-19 on betas (which may or may not be fully realised as of June 2021) and uncertainty about the duration of possible future events.[15]

For both sets of results we rely upon observed data on stock and market movements between February 2020 and June 2021. We take these to represent the impact of COVID-like events but adjust our analysis to simulate different durations of event. We implicitly assume that the magnitude of its effect remains similar throughout its extended duration. For both our lower-bound and our upper-bound we consider estimates based on a range of *frequencies* of COVID-like event, as we set out below.

We then consider the results of an alternative cross-check in which, rather than constructing a single beta based on reweighted data, we take a weighted average of a COVID-affected and non-COVID affected beta over time.

5.1 Lower-bound results

In the table below, we set out the results of our analysis for a set of scenarios. Each scenario corresponds to an assumed frequency of future COVID-like events.

By way of reference, the first two rows of the table also set out raw, observed historical spot 2-year and 5-year daily beta calculations as at June 2021.

The subsequent rows show our constructed betas, placing progressively lower weight on the COVID window data (from February 2020 to June 2021) relative to non-COVID daily data, simulating COVID-like events happening less frequently. For example, the "one in 10 years" row shows results for a reweighted beta equivalent to a 10-year beta with a single COVID-like event, or a five year beta with a 50% chance of a COVID-like event.[16] The final, "N/A" row, shows a beta which places zero weight on COVID data, i.e. it relies only on pre-COVID data.

[15] See Chapter 3, subsection 3.4. above.
[16] For example, for a one in 10-year COVID-frequency, we assign a weight of 0.42 to COVID-affected observations, and hold the weight on non-COVID affected observations at 1.

As the table shows, the reweighted beta falls as we reduce the frequency of COVID-like events. These results are particularly low compared to a raw 2-year beta which, if used to set a long-run beta for Heathrow, would effectively imply the expectation of a COVID-like event every two years.

TABLE 2: REWEIGHTED ASSET BETA ESTIMATES FOR DIFFERENT FREQUENCIES OF COVID-LIKE EVENT OF 17-MONTH DURATION

	AENA *Madrid*	ADP *Paris*	Fraport *Frankfurt*	Zurich	Vienna	Sydney	AENA	4 company	6 company
2-year raw beta	0.93	0.89	0.69	0.78	0.83	0.60	**0.93**	**0.81**	**0.79**
5-year raw beta	0.82	0.84	0.70	0.80	0.64	0.57	**0.82**	**0.79**	**0.73**
Frequency of COVID-like event (1 in X years)									
7.5	0.78	0.78	0.68	0.78	0.56	0.57	**0.78**	**0.75**	**0.69**
10	0.75	0.74	0.65	0.76	0.50	0.57	**0.75**	**0.73**	**0.66**
15	0.71	0.69	0.62	0.74	0.44	0.57	**0.71**	**0.69**	**0.63**
20	0.69	0.66	0.60	0.72	0.40	0.56	**0.69**	**0.67**	**0.61**
50	0.64	0.59	0.55	0.69	0.32	0.56	**0.64**	**0.62**	**0.56**
100	0.62	0.57	0.54	0.68	0.28	0.56	**0.62**	**0.60**	**0.54**
N/A	0.60	0.54	0.51	0.67	0.25	0.56	**0.60**	**0.58**	**0.52**

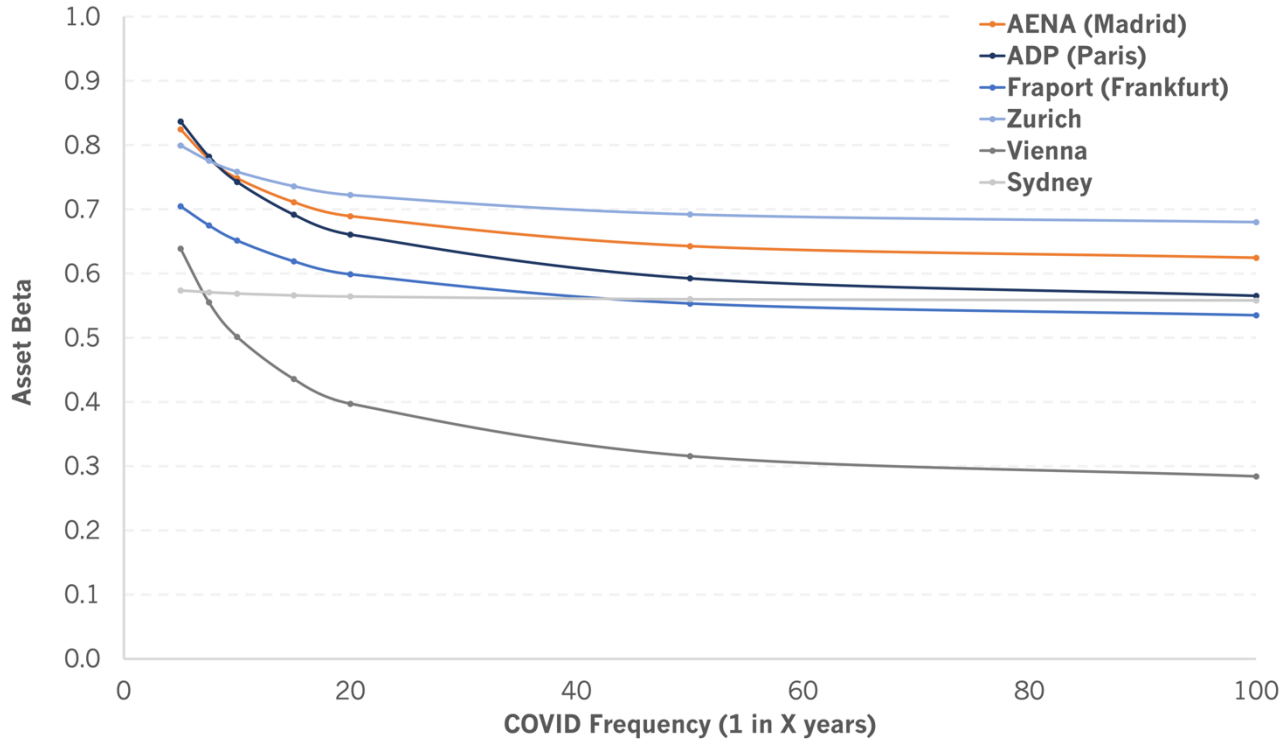
Note: Assumes debt beta of 0.05. '4 company' column takes a simple average of AENA, ADP, Fraport and Zurich. '6 company' column takes an average of all six comparators.
Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

Figure 6 below shows these same results as a graph. For all seven comparator airports, the reweighted beta estimates decline as we reduce the weighting of the COVID-19 data and implied frequency of COVID-like events, although the effect differs across the comparator set.

Each airport in our preferred comparator set (AENA, ADP, Fraport, Zurich) exhibits a broadly similar pattern, albeit anchored to different 'pre-COVID' betas.

Two of the comparators diverge from the set in different ways. Vienna appears to exhibit the most notable 'COVID impact' in the recent spot beta calculations and therefore experiences the steepest decline in beta as the weighting of the COVID data is reduced. The beta of Sydney, on the other hand, appears to have been less significantly affected by the pandemic, based on the spot beta calculations. This may be a function of their handling a greater proportion of domestic traffic compared to the European airports. Nonetheless, because of this, the reweighted beta for Sydney declines only moderately as the COVID-19 data is given less weight.

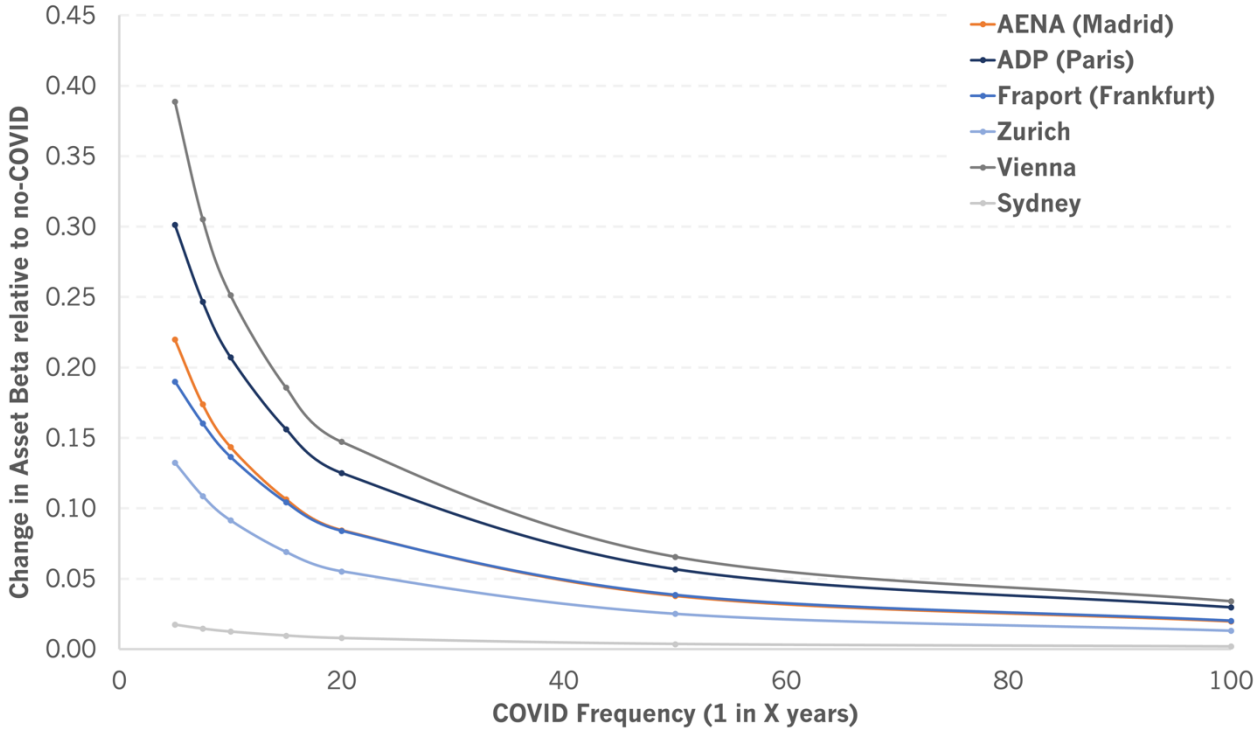
FIGURE 6: REWEIGHTED ASSET BETA ESTIMATES AT DIFFERENT FREQUENCIES OF COVID-LIKE EVENT



Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

We present these same results below, in terms of the implied change in beta relative to a world in which there are no COVID-like events, the beta for which is given by the "N/A" row in the table above (i.e. the 'pre-COVID' beta).

FIGURE 7: CHANGE IN ASSET BETA RELATIVE TO NO-COVID-LIKE EVENTS AT DIFFERENT FREQUENCIES OF EVENT

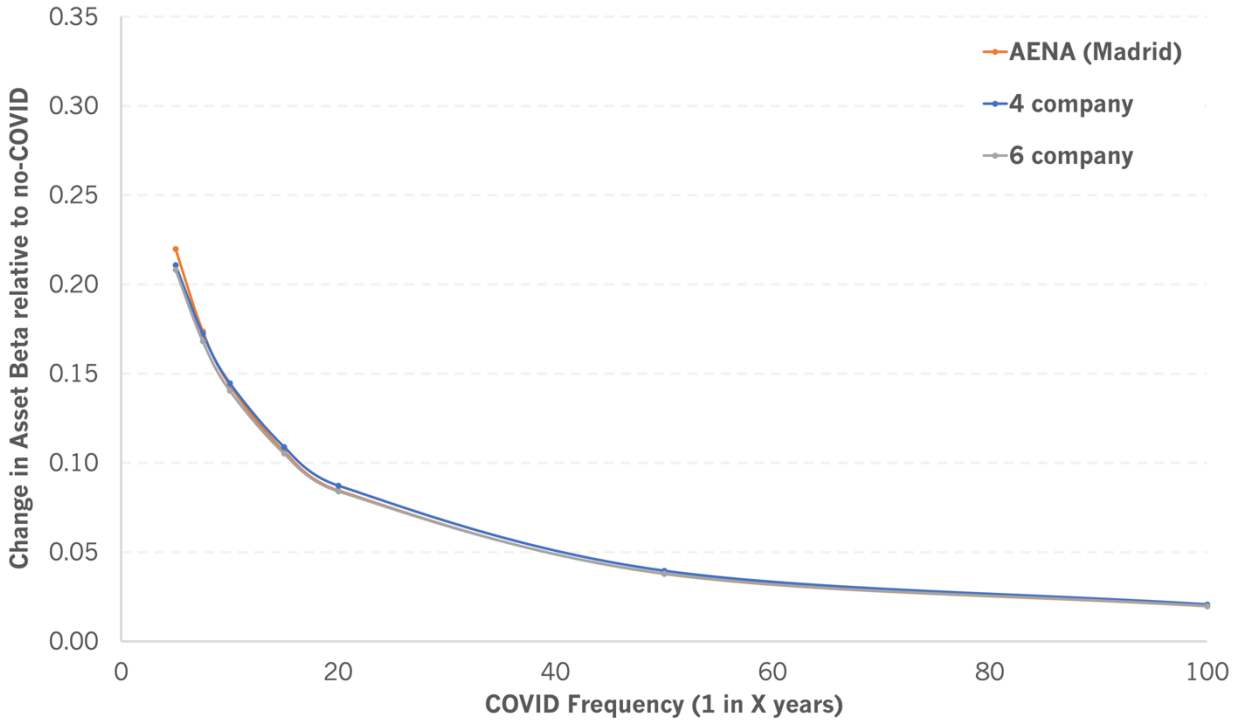


Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

Given the wide range of individual airports' beta responses, and recognising the potential risks of reliance on individual comparators, we blend these results into averages based on our proposed comparator sets. The outcomes show some alignment. Our four-company average and six-company averages are similar to one another, and line up well with our preferred comparator, AENA.

Based on this, we find an associated increase relative to the pre-COVID asset beta of between 4 and 9 basis points (i.e. an increase of 0.04 to 0.09), might be observed if we assumed: (i), a frequency of 'COVID-like' events of between one in 20 and one in 50 years; and (ii), that future events have similar market and airport effects to the COVID-19 experience from February 2020 to June 2021, lasting 17 months.

FIGURE 8: CHANGE IN ASSET BETA RELATIVE TO NO-COVID AT DIFFERENT FREQUENCIES OF COVID-LIKE EVENTS FOR OUR COMPARATOR SETS, REPORTED IN ABSOLUTE CHANGE IN BETA



Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

5.2 Upper-bound results

For our upper-bound results, we simulate COVID-like events which last 2.5 years, or 30 months, as opposed to the 17 months in our lower bound.

We consider that 2.5 years is a reasonable upper-bound of the duration of the effect of future COVID-like events on the beta for a variety of reasons. First, while COVID-like disruption to passenger numbers may persist for more than 2.5 years, a COVID-like event is not likely to affect daily share price and betas in such a prominent way for a prolonged period, since associated changes in prospective traffic would probably be largely integrated into investors' expectations as the confidence in expected impact grows. The lower short run betas observed for the airport comparators in recent months, and the fact that most of the observed pandemic impact is concentrated around major COVID-related news in February-March and November 2020 seems to provide support for this view. It certainly appears likely that the 'spikes' observed in 2020 will not be repeated even if COVID-19 lasts for a prolonged period – potentially meaning our assumption of continued elevation in beta characteristics, through a longer COVID-like event, may overstate the effect of a prolonged COVID-like disruption.

We also recognise that future COVID-like events may affect airport share prices and betas differently to COVID-19. This may be a real effect, because of more moderate actual disruptive effects. It might also be a market pricing effect – through speedier translation of future news into prices. While the former (real) effect would have a moderating effect on the airport beta response, this latter would not necessarily change the impact on beta – only changing the speed at which markets and share prices responded.

In order to simulate a 30-month COVID-like event, we rely on the same 5-years of daily data as in our lower-bound, but increase the relative weight on COVID-affected data for any given frequency of COVID-like event. Hence, for our "one in 5 year" beta below, we simulate a beta of 30 months of COVID-affected data and 30 months of non-COVID affected data.[17]

TABLE 3: REWEIGHTED ASSET BETAS FOR DIFFERENT FREQUENCIES OF COVID-LIKE EVENT OF 30-MONTH DURATION

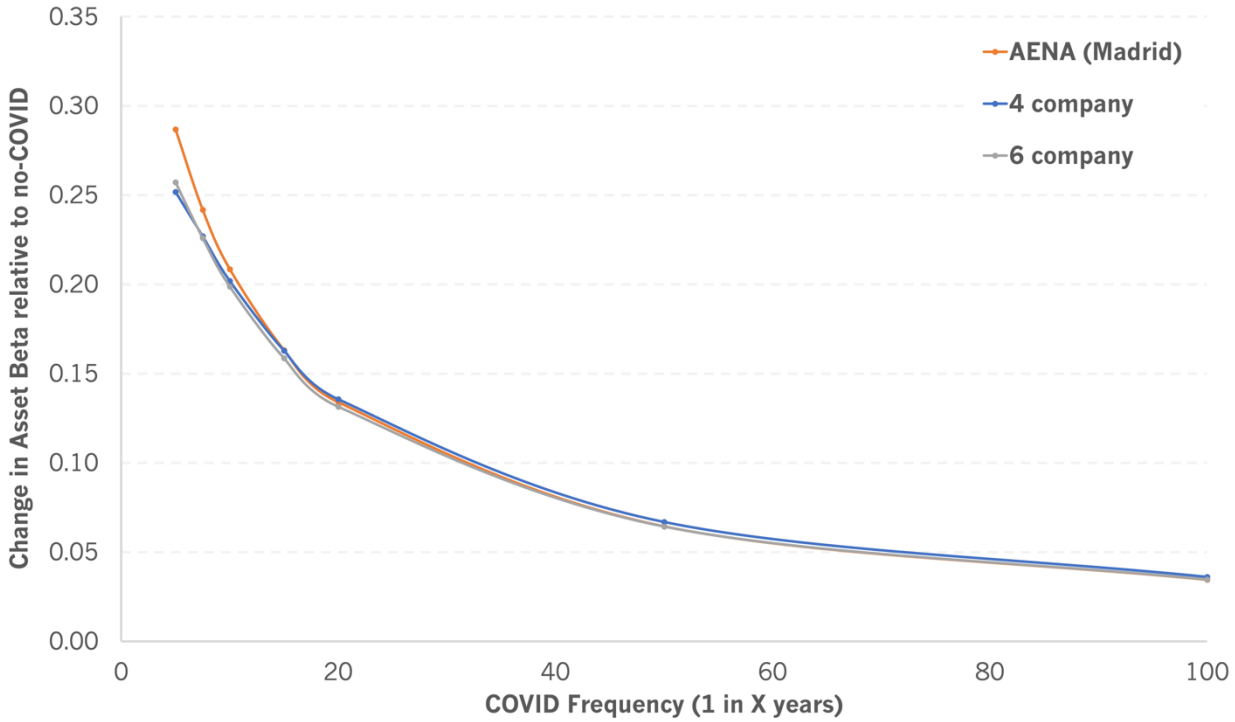
Freq. of COVID one in X years	AENA *Madrid*	ADP *Paris*	Fraport *Frankfurt*	Zurich	Vienna	Sydney	AENA	4 company	6 company
5	0.89	0.89	0.72	0.82	0.77	0.58	**0.89**	**0.83**	**0.78**
7.5	0.85	0.86	0.72	0.81	0.68	0.58	**0.85**	**0.81**	**0.75**
10	0.81	0.82	0.70	0.79	0.62	0.57	**0.81**	**0.78**	**0.72**
15	0.77	0.77	0.67	0.77	0.54	0.57	**0.77**	**0.74**	**0.68**
20	0.74	0.73	0.64	0.75	0.48	0.57	**0.74**	**0.72**	**0.65**
50	0.67	0.63	0.58	0.71	0.36	0.56	**0.67**	**0.65**	**0.59**
100	0.64	0.59	0.55	0.69	0.31	0.56	**0.64**	**0.62**	**0.56**
N/A	0.60	0.54	0.51	0.67	0.25	0.56	**0.60**	**0.58**	**0.52**

Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

Inevitably, compared to our stage one analysis above (based on COVID-like events of 17 months duration), the effect on beta increases. For a COVID frequency between 20 and 50 years, the beta effect over the same range of event frequencies is between six and 14 basis points.

[17] For this example, and since we rely on 17 months of COVID-affected data, we increase our weight on COVID-affected data to 2.63, relative to a weight of 1 on non-COVID data.

FIGURE 9: EFFECT OF COVID-LIKE EVENTS ON ASSET BETA RELATIVE TO NON-COVID EVENTS, FOR EVENTS OF 2.5 YEAR DURATION



Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

Table 4 below summarises the range of results for both our upper bound and our lower bound, for our different comparator sets, and for one in 20 and one in 50-year frequencies. As the table shows, these sensitivities would increase the range of effect to between four and 14 basis points.

TABLE 4: SUMMARY OF UPPER AND LOWER BOUND COVID ADJUSTMENT

Frequency of COVID one in X years	AENA	4 company	6 company
Lower-bound			
20	0.08	0.09	0.08
50	0.04	0.04	0.04
Upper-bound			
20	0.13	0.14	0.13
50	0.06	0.07	0.06
Overall range			
Min	**0.04**	**0.04**	**0.04**
Max	**0.13**	**0.14**	**0.13**

Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

5.3 Cross-check method

As a cross-check of the results above, we have considered an alternative method based on taking the average value of betas calculated over shorter sequential periods.

We can do this relatively simply, based on 'pure' betas that reflect our non-COVID data (i.e. daily data pre-COVID) and COVID data (i.e. daily data since the COVID outbreak), weighted according to our assumed COVID-like event frequency and duration.

As for our main approach, we:

- Use a panel of daily observations over 5-years ending at our cut-off date, 18th June 2021;
- Split our dataset into non-COVID and COVID data, before and after 1st February 2020 respectively; and
- Consider alternative assumptions about the frequency and duration of COVID-like events.

Whereas our primary approach reweights individual daily observations to simulate long-term betas, this alternative approach changes the relative weights on two separate beta estimates, which we combine to form an average. These two underlying betas, based on our three comparator sets, are shown in Table 5 below.

TABLE 5: ASSET BETA ESTIMATES FOR COVID AND NON-COVID PERIODS

Period of estimate	AENA	4 companies	6 companies
COVID Beta (17 months of data)	0.95	0.82	0.79
Non-COVID Beta (43 months of data)	0.60	0.58	0.52

Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

As an example, we calculate a beta for a COVID-like event of one in 5 year frequency by combining these two observations to form a 5-year beta, i.e. such that the COVID beta gets an initial weight of 17 months and the non-COVID beta gets a weight of 43 months (i.e. 5 years *minus* 17 months).[18] To simulate a beta for a one in 20 year frequency, we increase the relative weight on non-COVID data, such that it makes up 223 months (i.e. 20 years *minus* 17 months).

Detailed results from these calculations are set out in Appendix 5. The key results for COVID-like events of between one in 20 and one in 50 years are summarised below (relative to no COVID-like events), alongside the results from our primary method. Overall, the simple beta reweighting indicates smaller beta adjustments for COVID-like events compared with our preferred approach.

TABLE 6: COMPARISON OF RESULTS, COVID-ADJUSTMENT FOR EVENTS BETWEEN ONE IN 20 AND ONE IN 50 YEARS

	Preferred approach: Reweighting observations		Cross-check approach: Beta weighting	
	Minimum value	**Maximum value**	**Minimum value**	**Maximum value**
Lower bound	0.04	0.09	0.01	0.04
Upper bound	0.06	0.14	0.01	0.02
Overall	**0.04**	**0.14**	**0.01**	**0.04**

Source: Summary of Flint analysis.

The difference in results relative to our preferred approach arises due to differences in the underlying statistical features of each method. This alternative approach does not take account of

[18] For our upper-bound COVID-like event duration approach, we increase the weight on the COVID beta such that it gets a weight of 30 months, and reduce the weight on the non-COVID beta to 30 months.

the relative strength and influence of statistical relationship between observations within the beta, while our preferred approach does.

The data for the airport comparators during the COVID period reflects a series of unusual and extreme market and individual share price movements, observed consistently across the comparator set. The non-COVID data, on the other hand, exhibits fewer such extremes – with most of the daily data characterised by more moderate effects. Because of this, when the datasets are combined, the COVID data is more influential in defining the observed systematic risk relationship described by the beta. In simple terms, in the long-term beta calculation, the influence of the COVID data is amplified in line with its extremity. In the alternative approach, this effect is not present.

For this reason, we prefer our approach, though we recognise the useful simplicity and transparency of the alternative.

5.4 Summary of results

In this chapter, we set out the results of our analysis into the effect of future COVID-like events on estimates of systematic risk and beta for Heathrow.

Our approach involves the categorisation and reweighting of recent daily share price data for comparator airports to create prospective long-term beta estimates that reflect the risk of similar future events, under different scenarios – considering frequency, and duration of such events.

Based on our approach, and our preferred comparator weightings, we estimate that an event similar in nature and impact to COVID-19, occurring between once every 20 and once every 50 years would increase the comparator asset betas by between four and 14 basis points, compared to recent pre-COVID observed values. We believe it would be reasonable to infer a similar range of prospective increase for Heathrow under the same conditions.

We compare our results using an alternative method which considers simple averages of a 'pre-COVID' beta and a 'COVID beta' under the same range of assumptions. This approach suggests a smaller beta effect over time, of between one and four basis points for COVID-like event frequencies between one in 20 and one in 50 years.

The difference is largely driven by the greater statistical influence of observed share price behaviours during COVID-19. We believe this supports our preferred approach, which more faithfully reflects the weighting due to different future risks and the magnitude of their likely effect over time.

In the chapters below, we discuss how this evidence on the potential beta impact of COVID and potential future events might inform the CAA's estimate of the beta for setting the WACC allowance in H7.

6 Baseline beta

In the previous chapters we estimated a range for the COVID adjustment. In this chapter we set out the baseline beta, which represents the which reflects the value of beta that would prevail for if an event like COVID-19 did not happen again.

6.1 Previous analysis

In our report in April 2020, we estimated a range for the asset beta for Heathrow of between 0.5 and 0.6, drawn from an assessment of the three comparators in Table 7 below. Our range reflected our assessment of the overall evidence and the recent decision, at that time, from the CMA in relation to the NERL price control appeal.

We considered AENA, ADP and Fraport the most relevant comparator airport groups. We considered that the main airports in these stocks, Madrid-Barajas, Paris-CdG and Frankfurt respectively, were reasonable comparators to Heathrow Airport given their prominence in European aviation in terms of size, traffic mix and hub behaviour. Moreover, AENA and ADP also had similar regulatory regimes to Heathrow – this was less the case for Fraport. Due to limited listing history we were unable to draw from longer-term evidence for AENA. However, we placed our recommended lower bound slightly above the minimum of the estimated range of betas, given by Fraport.

We recommended the CAA take a midpoint of the range, at 0.55.[19] In that analysis, we explicitly avoided accounting for any effect of COVID-19 on betas, and our cut-off date was aligned with the CMA's pre-COVID time period in its NERL appeal provisional findings, end-February 2020.

TABLE 7: FLINT APRIL 2020 ASSET BETA ESTIMATES

	Fraport	ADP	AENA
2-years, daily frequency			
Spot	0.58	0.59	0.57
2Y Average	0.56	0.56	0.60
5Y Average	0.49	0.54	
5-years, daily frequency			
Spot	0.50	0.56	0.52
2Y Average	0.47	0.53	
5Y Average	0.48	0.53	

Source: Flint (April 2020), Business as Usual WACC for H7, p.18.

[19] In our previous beta estimate we assumed: Daily observations and an estimation horizon of 2-years and 5-years; STOXX 600 as the relevant market index; Spot values and 2-years / 5-years rolling averages; Specific levels of gearing at comparator companies to de-gear the equity beta; Debt beta of 0.05, in line with the CMA provisional findings at the NERL/CAA appeal for the same airport comparators.

6.2 Updated views

Since our April 2020 analysis, we have considered whether this estimate for a pre-COVID baseline remains appropriate.

First, we have considered at which point COVID-19 was likely to have begun to affect airport betas. As we discuss above, while we consider that COVID's effect on betas first becomes apparent in February 2020, we find that the choice of this date has little effect. As we show in Table 8 below, the 43-month (i.e. almost four years) period before February 2020, which we rely-upon for the non-COVID data in our 5-year reweighted beta, supports beta estimates that are not inconsistent with our range for comparator betas, of 0.50 to 0.60, estimated based on data to March 2020.

Second, we have considered whether the comparator set remains appropriate given our assessment into airports' regulation and operations. In light of our more recent analysis, we now consider that AENA is Heathrow's closest comparator and would place slightly less weight on ADP and Fraport. However, we note that the range of beta estimates for AENA, of between 0.52 and 0.60, sit close to both ends of our existing range in any case.

We considered the further inclusion of Zurich in our baseline comparator set, which would likely increase the upper-bound of our range. However, we are cautious to include Zurich in arriving at our pre-COVID beta estimate. In its provisional findings for the NERL/CAA appeal, the CMA decided "*not to use smaller European airports, because their smaller size made us more concerned that company-specific issues or a lack of liquidity would distort the betas. There seems to be some evidence [...] that both Vienna and Zurich's betas included an outlier either based on 2-year or 5-year data.*"[20]

TABLE 8: RECONCILIATION OF COVID AND PRE-COVID ASSET BETA ESTIMATES WITH OUR APRIL 2020 REPORT

Spot, daily	Fraport	ADP	AENA	Average
August 2021 report (this report)				
COVID, 17-months (02/20 to 06/21)				
Spot, daily	0.65	0.87	0.95	**0.82**
Pre-COVID, 43-months (06/16 to 01/20)				
Spot, daily	0.51	0.54	0.60	**0.55**
April 2020 report				
Pre-COVID, 2-years (02/18 to 02/20)				
Spot, daily	0.58	0.59	0.57	
Pre-COVID 5-years (02/15 to 02/20)				
Spot, daily	0.50	0.56	0.52	

Source: Flint (April 2020), Business as Usual WACC for H7, p.18; and Flint analysis based on Thomson Reuters data as of 18th June 2021.

[20] CMA (Mar 2020), NATS (En Route) Plc / CAA Regulatory Appeal, Provisional findings report, p.144, para 12.67.

7 CAA's risk sharing proposals

In the chapters above, we calculate a 'COVID adjustment' based on the observed effect of COVID on comparator airport's asset betas, and present our 'baseline' beta based on pre-COVID assumptions which we assume would prevail if a COVID-like event were not to occur again. In this chapter we discuss the impact of proposed changes to Heathrow's regulatory framework on the risk faced by its investors.

7.1 CAA proposals

In its CAP2139 (April 2021), the CAA confirmed its intention to introduce new arrangements for risk sharing mechanisms to protect the interest of consumers by:

- Limiting risks of significant gains or losses due to the recovery pace of traffic volumes, but not protecting Heathrow from all traffic related risk;
- Avoiding unnecessary upward pressure on Heathrow's cost of capital passed through charges; and
- Diminishing stakeholder's uncertainty surrounding financial returns by clarifying the risks Heathrow will be expected to bear.

We also note the CAA's proposals to adopt additional mechanisms to address risk, of which the reflection of systematic risk in the WACC estimate (through the beta) is only one.

- The CAA has set out proposals for traffic risk sharing mechanisms, which will reduce the proportionate burden of significant traffic deviations from forecast on Heathrow.
- The CAA has also historically adopted a 'shock factor' which anticipates the possibility of adverse traffic and adapts forecast / planned passenger numbers in this light. In H7, it proposes to include an allowance to compensate H7 for asymmetric risk associated with exposure to traffic shocks.

In its April Consultation, the CAA also announced that it would apply a £300m uplift to the RAB from H7.[21] We view this intervention as essentially one-off in nature, though recognise that it may have changed investors' expectations of potential future interventions. The primary change to risk sharing in future would seem to be driven by the proposed changes to traffic risk sharing arrangements, which should (by design) largely obviate the need for such ad-hoc interventions in future.

Our proposed range stated thus far does not explicitly consider the CAA's proposal to introduce a new mechanism for traffic risk-sharing at H7.

[21] CAA (May 2021), Economic regulation of Heathrow Airport Limited: response to its request for a covid-19 related RAB adjustment.

7.2 Implications for beta estimation

The use of our estimates and beta values used to underpin the WACC allowance should link to the CAA's decision on the traffic risk sharing mechanism and evolution of other aspects of the price control methodology and assumptions, in a way that avoids under or over-compensation for future risks faced. If significant adjustments are made to the share of risk faced by Heathrow, this may point towards values for any beta adjustment being lower.

In the first instance, we have considered the extent to which our betas based on comparator airports' stock movements before and during COVID-19 might reflect mechanisms which systematically mitigate the risks associated with COVID-19 (and similar future COVID-like events).

We generally do not find systematic evidence of such mechanisms. Whilst regulators of our comparator set may have responded with ad hoc adjustments or announcements, we believe that these are unlikely to have had a significant effect on observed betas during our COVID window (due to their similarly ad hoc likely impact on daily share price movements).

A possible exception to this is ADP, where we understand there was a pre-existing mechanism to provide a form of risk sharing. We note, however, that this provides only limited (c.20%) downside protection for ADP, had it come into play, and that it has not applied mechanistically in practice. Other changes implemented in ADP's regulation since the pandemic began may blur the mechanistic effect of this arrangement in any case, which makes interpretation difficult. We are not aware of such protections for other comparators within our comparator set.

In light of this we assume that the beta effects that we observe resulting from the COVID period describe a broadly 'raw' impact of COVID – i.e. where the effect of all (or at least the significant majority) of COVID risks to airport cashflows remain with the airport.

In making its final decision for H7, the CAA should also make allowance for other changes to the regulatory framework (such as those under consideration for traffic risk sharing) that may effectively be addressing some of the same risks. If so, the adjustment to the beta (and potentially also the underlying 'pre-COVID' beta) should be moderated to avoid double counting.

Because the COVID beta impact is dominated by the traffic and revenue effects – this makes a high level assessment and adjustment to our range (for the impact of COVID) broadly feasible.

The basis for any such adjustment should reflect the extent to which the adverse long-term cash flow consequences (specifically, the present value of these) associated with extreme events are effectively moderated by new risk sharing arrangements. Therefore, for example, if the new risk sharing mechanism effectively insulates Heathrow from 50% of the adverse consequences on net cashflows of a 'COVID-like' event, then we believe a reasonable approach would be to mitigate the beta adjustment by the same proportion, 50%.

Assessment of a similar adjustment that might be applied to the pre-COVID beta is more complex. The risk sharing proposals under consideration may exhibit more limited (or no) effect in benign periods, which are a significant driver of the observed pre-COVID beta. Factors other than traffic risk (for example, broader global macroeconomic drivers, political risk, cost risks, taxation) will also have been significant in defining the pre-COVID beta but may be entirely unaffected by the new traffic risk sharing arrangements.

We therefore do not see a meaningful evidence base on which to rely in adjusting the pre-COVID beta, and in any case, this is beyond the scope of our report. However, we recognise that the CAA's proposed mechanism may indeed affect the risk borne by Heathrow's investors in non-COVID times, and hence reduce the pre-COVID beta.

8 Conclusions

Background

We have reviewed the impact of COVID-19 on the risks faced by Heathrow, based on share price and beta analysis for comparator airport groups over the past five years. The impact has been significant.

This analysis of 'backward-looking' information contains important information about the past. However, it does not faithfully portray forward-looking risks, that form the appropriate basis of the cost of capital allowance at H7.

Assessing the effect of COVID-19 on future beta estimates is challenging. However, it is important that the risks faced by Heathrow are fairly assessed and reflected in regulated prices in future to provide Heathrow's investors with a 'fair bet', meaning that:

- First, the forecasts used by the CAA in establishing the price controls at H7 should reflect expected values (of traffic, revenues, costs etc.) allowing for a range of outcomes, including low probability, high impact events (such as a 'COVID-like' event). Put simply, projected cashflows should *fairly reflect* the range of possible outcomes.
- Second (and the main focus of this report), the systematic risks of likely returns around this set of expected values is also faithfully captured, reflecting the extent to which these risks are borne by Heathrow's investors, after adjusting for any regulatory mechanisms that provide for risk sharing. Put simply, the allowed rate of return should *fairly reflect* the risks faced.

Approach

We have developed an approach which makes full use of the recent data – both before and since COVID-19. We use it to develop forward-looking beta estimates, combining the data according to assumptions about the potential mix of future risks faced. We reflect a range of scenarios for the future occurrence of similar events – and weight the post-COVID-19 / pre-COVID-19 evidence accordingly. Our approach treats COVID-19 as a systematic risk.

Using our approach, we estimate the value of beta that would prevail for each comparator if an event like COVID-19 never happened again (the baseline beta). We then consider the effect of an event like COVID-19 occurring again in the future – for example once every 50 years. We then calculate a 'COVID adjustment' that represents the difference between this value and the baseline beta.

In considering risk, we reviewed the comparators proposed by the CAA for suitability as indicators of the risks faced by Heathrow before and during the pandemic. In light of this, we made some changes to the CAA's initial comparator set, while keeping it broad to avoid overreliance on specific airports. That said, the comparator choice did not significantly affect our results.

We developed an analytical framework which deconstructs the recent historical share price data for the comparator airport groups and then reweights this data to provide estimates of forward-looking betas that reflect assumptions about potential similar events the future (frequency and duration of disruptive impact). Our approach sits between the proposals suggested by LACC and Heathrow.

Findings

As a baseline beta, we retain our April 2020 (pre-COVID) beta range of 0.50 to 0.60, based on observed pre-COVID betas for AENA (Madrid), ADP (Paris) and Fraport (Frankfurt), the set of comparators which we consider are most similar to Heathrow prior to COVID-19.

We find that a COVID-like event every 20 to 50 years would lead to an increase in asset beta of between 0.04 to 0.14, relative to the pre-COVID value. This estimate of the beta impact of COVID does not depend upon the assumption regarding Heathrow's pre-COVID asset beta.

TABLE 9: FLINT ESTIMATES OF PRE-COVID-19 ASSET BETA AND COVID ADJUSTMENT

	Lower Bound	Upper Bound
Baseline beta	0.50	0.60
Beta adjustment for COVID	0.04	0.14

Source: Summary of Flint analysis.

Our recommendations on the CAA's use of this range

The lower bound of our range for the beta adjustment reflects an event like the one we have seen occurring every 50 years, with airport share price behaviours exhibiting elevated beta characteristics in line with those already observed (between February 2020 and June 2021).

The upper bound of our range reflects an event like the one we have seen, with a longer sustained impact on the beta characteristics of share prices (30 months), occurring once every 20 years.

While we do not have a robust analytical basis for adjusting it downwards, we believe the upper end of our (COVID adjustment) range may be generous. In arriving at our upper bound value, we assume that all future events are characterised by a similar set of market and company share price responses. We believe that – should such major events be observed more frequently in future, the likely response might be more moderate – with affected sectors adapting and dealing with disruption more effectively than during the COVID-19 pandemic. The upper end of our COVID adjustment range should be viewed cautiously, for this reason.

We also carry out a cross-check which takes a simple weighted average of a 'pure' COVID beta and a 'pure' non-COVID beta. Using this simple approach, we observe a lower and narrower range of COVID adjustment (on asset beta) of 0.01 to 0.04. The difference is mainly for statistical reasons, and we believe our approach offers a more robust reflection of the mix of systematic risks faced.

In making its assessment of the WACC for H7, the CAA should also make allowance for changes to the regulatory framework (such as those under consideration for traffic risk sharing). These changes may address some of the same risks and change the burden borne by Heathrow's investors. If so, the adjustment to the beta (and potentially also the underlying pre-COVID beta) should be reduced to avoid double counting. If the traffic risk sharing proposals give rise to Heathrow bearing meaningfully lower risks in future, then CAA should adopt a lower beta adjustment than suggested by our range.

The basis for any such reduction should reflect the extent to which the adverse long-term cash flow consequences (specifically, the present value of these) associated with extreme events are

effectively moderated by new risk sharing arrangements. Short-term cash flow consequences are likely to be dominant in such a calculation.

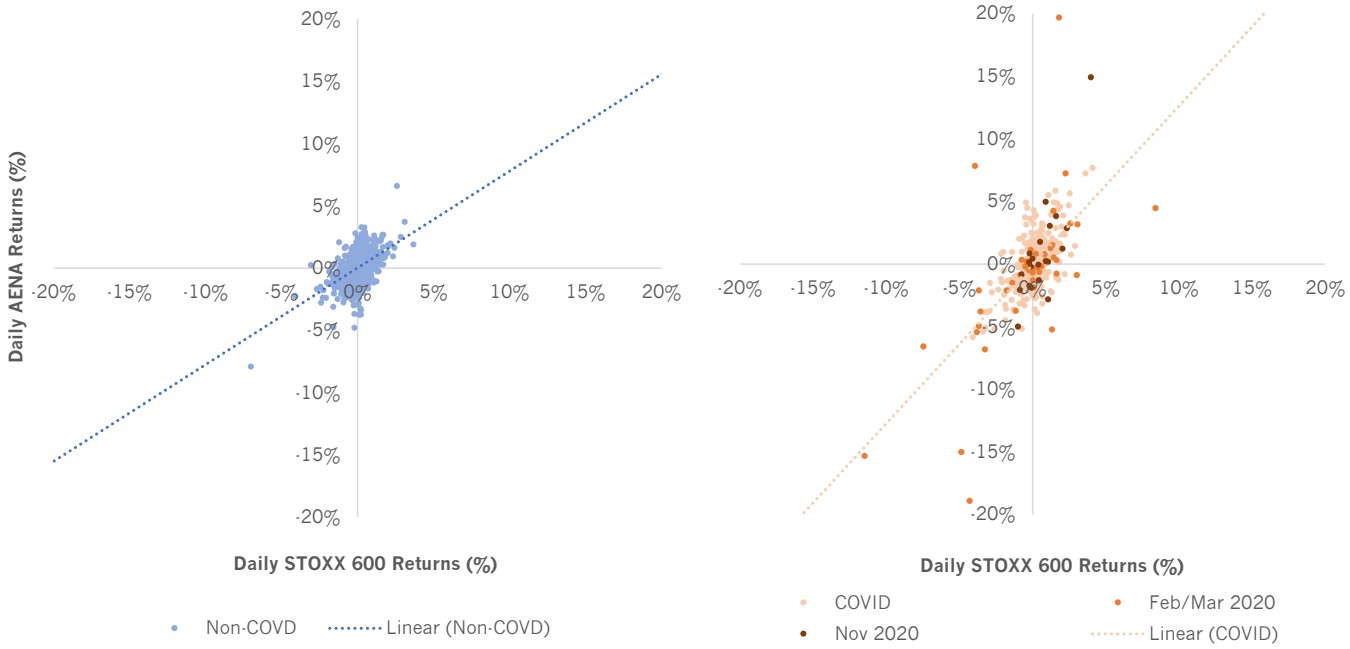
Therefore, for example, if the new risk sharing mechanism effectively insulates Heathrow from 50% of the adverse consequences on net cashflows of a 'COVID-like' event, then a reasonable approach would be to mitigate the beta adjustment by the same proportion, 50%.

The impact of new risk-sharing arrangements on the pre-COVID beta is harder to evidence. The new risk sharing mechanism may also reduce Heathrow's underlying pre-COVID beta, albeit to a lesser proportionate degree, and in a way that is harder to substantiate.

Appendices

Appendix 1: Daily share price movements for AENA

FIGURE 10: DAILY SHARE PRICE MOVEMENTS VERSES MARKET INDEX FOR AENA PRE-COVID (LEFT) AND SINCE COVID (RIGHT)



Source: Flint analysis of Thomson Reuters data as of 18th June 2021.

Appendix 2: Reliability of comparators' beta estimates

In this appendix we discuss the reliability of beta estimates for each comparator in the CAA's proposed set in more detail.

To estimate betas for comparator airport groups, the underpinning share price and index data must be reliable. To this end, the following criteria must be met:

- The relevant market index should reflect a diversified portfolio, and
- The share prices should be a fair reflection of market value, and not be undermined by low liquidity, or infrequent trading.

We apply this second criterion relatively strictly in our analysis in this report, because our assessment of the COVID-19 period needs to rely on daily share price data. In other contexts, we could address illiquidity concerns by estimating weekly or monthly betas but cannot do so here because of the short duration of the COVID period.

Relevant market index

The portfolio theory on which the CAPM is anchored suggests that (marginal) investors rationally hold a fully diversified portfolio of stocks, so as to optimise the trade-off between risk and expected

return. As in our April 2020 report, we favour the index which is likely to reflect the marginal investor in each airport.

We exercise caution when using asset betas of comparator airport groups traded in a different stock market that is not the STOXX 600 because estimates may be affected by the constituency of the specific stock markets indices. The particularities of each index may be misleading of the true risk faced from the marginal investor perspective.

Our preferred market index for European groups is the STOXX 600, which reflects the high degree of European integration. For Sydney and Auckland, we use the largest available local indices, the All Ordinaries and the NZX All, respectively. We show the diversification of our preferred indices in Table 10 below.

TABLE 10: AUCKLAND AIRPORT IS ONE OF THE TOP (AND MOST SIGNIFICANT) CONSTITUENTS OF THE NZX ALL INDEX MARKET CAPITALISATION

Index	Number of Constituents	Top 10 Constituents (% market capitalisation)	Airport included in top 10
STOXX 600	600	Below 20%	None
All Ordinaires	498	Above 40%	None
NZX All	120	Above 50%	Auckland

Source: Factsheets for S&P/NZX All, All Ordinaires, and STOXX 600.

The NZX All index is dominated by its top 10 constituents which together make up over 50% of the index returns. Auckland airport alone represents around 6% of the NZX All market capitalisation. This creates a circularity in the Auckland airport beta calculation and may bias our estimate of its exposure to systematic risk.

Moreover, the Auckland airport business has a portfolio of activities which includes significant investment in wider commercial property. For example, the airport reported that 2020 was an exceptional year for this part of the business, and it accounted for a significant proportion of group operating profits[22]. Auckland's share price may not, therefore, reflect the risks of aviation alone.

Given Auckland's beta does not capture aviation risk alone, and since the estimate of its daily beta may be unreliable, we exclude Auckland from our comparator set.

We note that the All Ordinaries index used for our analysis of Sydney airport is also a more concentrated index than the STOXX 600. The betas that we calculate for European airports are therefore potentially more reliable than that calculated for Sydney.

Volume of free-floating shares

A low proportion of free-floating shares may be linked to lower frequency of trading. If so, stocks with low free-float can exhibit lower (and more unreliable) correlation with the market, particularly when looking at daily data. We assess the proportion of free-float for each listed comparator group in Table 11 below.

[22] Auckland Airport, Annual Report 2020, p.29.

TABLE 11: COPENHAGEN HAS A SIGNIFICANTLY SMALL PROPORTION OF FREE-FLOAT

Airport group	Free float
Heathrow	**0%**
ADP	26%
AENA	49%
Copenhagen	1%
Fraport	40%
Sydney	99%
Vienna	10%
Zurich	58%

Source: Thomson Reuters.

For five of the seven remaining comparators, at least a quarter of shares are free-floating.

To avoid understating the systematic risk to which Heathrow is exposed, we exclude comparators with a very low proportion of free-float – for example Copenhagen. Vienna has somewhat higher free-float than Copenhagen – but at 10% free-float it is somewhat smaller than our other comparators – so we also place less weight on its beta.

Appendix 3: Operational and regulatory features of comparators

In this appendix we discuss in more detail the regulatory and operational features of the comparators, up to and during the COVID-19 period, to assess their appropriateness as comparators.

Regulatory framework and response to the pandemic

The CAA carried out a review of the regulatory regimes at the proposed comparators, based on discussions with regulators and airport operators.

We use this research to assess the comparability of each airport's regulatory framework to Heathrow. We focus on three main aspects described in Table 12 below. These three characteristics are aligned with those previously used by other advisors in their cost of capital assessments in aviation.[23] Given the prominence of COVID-19 in driving aviation betas, we also consider the regulator's response to the pandemic, and how this may have affected the airport's risk, and investors perception of risk.

[23] See for example:
- NERA (Feb 2018), Cost of Equity for Heathrow in H7, A Report for Heathrow Airport.
- PwC (Nov 2018), Estimating the cost of capital for H7
- Swiss Economics (Sep 2019), Dublin Airport Cost of Capital for 2019 Determination
- Swiss Economics (Jan 2020), Assessment of airport characteristics that capture differences in Beta risk
- CEPA (Aug 2020), Response to CAP1940: Financial issues

Most of the listed comparators in our set are part of listed airport groups, i.e. owning stakes in more than one airport, as opposed to a single airport listing. Our analysis of the regulatory framework is limited to the main airport of the group. We consider the extent to which holdings in other jurisdictions and regimes may affect observed betas in the subsequent section.

TABLE 12: CHARACTERISTICS OF THE REGULATORY FRAMEWORK WHICH AFFECT AIRPORTS' EXPOSURE TO RISK

Regulatory Framework for Main Airport		Sources
Length of control period	Short regulatory periods reduce owners' exposure to exogenous risks to a greater degree, but also provide less potential for out- or under-performance, as prices are 'reset' more often. Short regulatory periods also allow more rapid true ups to significant deviations from forecasts e.g. of passenger numbers.	CAA's research and discussions with regulators and airport operators, unless otherwise stated.
Form of regulation & till	Form of regulation can range from monitoring and approval, to explicit constraints on charges. Airports subject to price caps are constrained in how much they can charge passengers. This cap limits their flexibility to adapt prices in downturn times. "Till" refers to the types of revenues which are considered in establishing an airport's price cap. Single till considers the revenues from all airport activities (aeronautical and commercial), dual till considers revenues from aeronautical activities only.	CAA's research and discussions with regulators and airport operators, unless otherwise stated.
Flexibility of framework	Flexibility of the framework reflects the ability of the framework to allow for in-period adjustments when traffic materially deviates from the forecasts used to design the price control. Stricter regulatory frameworks allow for less effective in-period adjustments.	CAA's research and discussions with regulators and airport operators, unless otherwise stated.
Response to the pandemic	In light of the COVID-19 pandemic, some (but not all) regulators made changes to the regulatory framework or introduced ancillary mechanisms to lessen the financial impact of the pandemic on airport owners.	CAA's research and discussions with regulators and airport operators, unless otherwise stated.

Airport and group operational features

We primarily focus on the airport and group characteristics considered in the Table 13 below.

TABLE 13: AIRPORT AND QUOTED GROUP CHARACTERISTICS

	Airport & Group Characteristics	Source
Airport traffic mix	We consider traffic characteristics which affect demand risk, for example: domestic/regional/international traffic and direct/transfer traffic. The impact of traffic mix may be significant. For example, COVID-19 risk was potentially magnified for airports with a higher proportion of international, long-haul and transfer flights, while traffic impact may be more moderate for airports which operate more regional or domestic flights.	Annual reports, other investor publications and traffic statistics.
Airport capacity utilisation	There are several approaches to measure capacity utilisation, i.e. the amount of traffic relative to available capacity. We use the method adopted by CEPA. In normal times, capacity utilisation is an important driver of demand risk and airports with higher capacity utilisation are more insulated against demand risk. However, since demand has fallen dramatically during COVID, traffic has fallen at capacity constrained and unconstrained airports alike; therefore we place less weight on this criterion, because during COVID disruption it is a less prominent determinant of risk.	CEPA (Nov 2020), H7 cost of capital estimation.
Geographical diversification of group holdings	Holdings in geographies which had a more contained outbreak of COVID, or which controlled outbursts more effectively, may have been less affected by COVID. This diversification may materially influence the observed betas. We estimate the proportion of group holdings based on the number of passengers per airport in the group weighted by the proportion of the airport the groups own.	Annual reports, other investor publications and traffic statistics.
Enterprise value	Airport stocks with higher enterprise value may offer more reliable beta estimates.[24]	Thomson Reuters.
Observed group operational leverage	Healthy positive cash flow may allow an airport to more effectively deal with large demand shocks. We have considered airports' EBITDA/Revenue as a proxy for this.	Annual reports and other investor publications.
Group ownership	A degree of state ownership may have influenced investors perceptions of risk, and potential for state support during the pandemic.	Thomson Reuters.

We note that single points of comparison do not provide a complete framework to judge each airport's (group's) comparability to Heathrow. The comparability of the other airports is best considered in the round. We also recognise other characteristics might be considered.

[24] In its provisional determination for the NERL/CAA appeal, the CMA stated airports of "*smaller size made us more concerned that company-specific issues or a lack of liquidity would distort the betas.*"

Assessment of comparators

Heathrow

Heathrow owns and operates a single airport in London, one of the largest hubs in Europe – according to 2018 figures (prior to the pandemic), Heathrow's five most popular destinations spanned four continents, and of its total number of passengers 94% were international and 30% transfers.[25] Heathrow is 100% privately owned and its current RAB is towards the high end of the comparator set, around EUR 19bn.

During the pandemic, Heathrow's passenger volumes decrease by around 70%, and its EBITDA / Revenue ratio dropped from around 60% pre pandemic to close to 25% in 2020.

As shown in Table 14, Heathrow's regulatory framework since the pandemic remained broadly unchanged from the one in place prior to the pandemic. However, the CAA is proposing to implement a risk sharing mechanism at H7, as we discuss in Chapter 7 above.

TABLE 14: REGULATORY FRAMEWORK OF HEATHROW AIRPORT PRIOR AND DURING THE COVID-19 OUTBREAK

	Length	Form & Till	Flexibility
Prior	5 years (2022-26)	Price cap Single till	Strict. We understand the CAA provided a shock factor adjustment which reflected material deviations relative to long run historic traffic forecasts in subsequent price control periods. However, it did not seem to allow for in-period changes to the current price cap. The CAA also did not respond with specific adjustments to previous shocks such as the 9/11 or ash clouds.
During	5 years (2022-26)	Price cap Single till	Strict, however, the CAA is proposing a re-design of the risk sharing mechanisms in the formal price control framework. It has also announced a £300m uplift to the RAB, following a request from Heathrow.

AENA, Madrid-Barajas Airport

AENA owns stakes in several Spanish airports, notably Madrid-Barajas and Barcelona-El Prat, but also smaller airports throughout mainland Spain and in the Canary and Balearic Islands. These account for a large majority (>80%) of AENA's revenue and profits. AENA also owns a controlling stake in London Luton airport, and stakes in a number of Latin-American countries. We estimate around 20% of AENA holdings to be outside the EU. AENA has the highest enterprise value in our comparator set (EUR 29bn) and is half owned by Spanish governmental agencies.

Madrid and Barcelona were the fourth and fifth largest airports in the Europe Union in 2019. Together, they represent 40% of AENA's operations, and Madrid-Barajas alone, with 62m passengers in 2019, represented slightly over 20% of total passengers. Of Madrid's traffic in 2019,

[25] Heathrow 2018 Facts and Figures

73% was international and 27% was domestic. Only around 1% of Madrid's passenger traffic were transfers.

Madrid-Barajas suffered a drop of around 70% in passengers during the pandemic, similar to Heathrow. Like Heathrow, Madrid-Barajas Airport did not see significant changes to its regulatory framework during the pandemic, as shown in Table 15.

TABLE 15: REGULATORY FRAMEWORK OF MADRID-BARAJAS AIRPORT PRIOR AND DURING THE COVID-19 OUTBREAK

	Length	Form & Till	Flexibility
Prior	5 years (2017-21)	Price cap, Dual till	Strict. We understand from the CAA that the framework did not include any explicit risk sharing, although there was a provision for its regulator to amend the agreement in the event of exceptional circumstances (including traffic shocks beyond 10% of forecasts). The airport regulation document (DORA) did not seem to be prescriptive on how the regulator should modify the agreement.
During	5 years (2017-21)	Price cap, Dual till	Strict. We understand from the CAA that, while a new DORA for the period 2022-2026 is expected to be approved by the Council of Ministers before September 2021, there are no signals of major changes to the previous regulatory framework. We understand that changes cannot, however, be entirely ruled out prior to 2022.

Similarly to the CAA, we understand the Spanish Civil Aviation Authority did not intervene during the pandemic. However, AENA has recently submitted a proposal to modify the existing DORA, which terminates in 2021, and a proposal for the new DORA. These proposals are under discussion at the Council of Ministers and the Spanish competition authority.

Despite the diverse holdings across Spain and abroad, we consider AENA provides a good indication to Heathrow's beta due to its size and traffic mix. Moreover, AENA ranks as the largest airport management company in the world in terms of traffic, and is the largest comparator in our set. AENA's EBITDA / Revenue margin also dropped in line with Heathrow's, from around 60% prior to the pandemic to 30% in 2020.

ADP, Paris-Charles de Gaulle (CdG) Airport

ADP group has shareholdings in airports all over the world, most notably in Turkey and India. These shareholdings are often minority stakes, meaning that ADP's Paris airports (Paris-CdG and Paris-Orly) still account for the majority of its revenue and profits. By holdings, we estimate ADP now has around 45% business holdings outside the EU,[26] a significant increase from the 30% prior to the pandemic. This significant proportion of holdings outside the EU suggests ADP is somewhat exposed to economies effected by COVID to a different extent that European airports.

[26] Based on passenger numbers, weighted by shareholding, in cases where group owns less than 100% of an airport.

ADP's enterprise value of EUR 20bn is similar to Heathrow's, but its EBITDA / Revenue margin was below Heathrow's both before and during the pandemic. Like AENA, ADP is also half owned by governmental agencies.

In 2019, Paris-CdG was the largest airport in the European Union in passenger numbers (76m), and Paris-Orly the 9th (32m). Together, the Paris airports had 15% domestic flights, 44% European flights and 41% other international flights in 2019. The Paris airports proportion of connecting passengers is 11%. This is line with Heathrow's traffic mix prior to the pandemic.

Paris-CdG airport was also hit similarly to Heathrow in terms of passenger volumes, with a drop of slightly over 70% during the pandemic.

Since the COVID-19 pandemic began, ART, the regulator, significantly shortened the regulatory period at Paris-CdG (the largest airport in the set, and the one most similar to Heathrow), as shown in Table 16 below.

TABLE 16: REGULATORY FRAMEWORK OF PARIS-CHARLES DE GAULLE AIRPORT PRIOR AND DURING THE COVID-19 OUTBREAK

	Length	Form & Till	Flexibility
Prior	5 years (2016-20)	Price cap, Single till	Flexible. We understand from the CAA that the framework contained a number of provisions that allowed for adjustments to the cap, including for when demand outturns deviated from forecasts. However, we also understand from the CAA that the use of these provisions had been very limited in practice, and that the legal framework prevented large price increases from year-to-year.
During	1 year	Price cap, Single till	Flexible. ADP requested disapplication of the ERA in 2020 due to the COVID pandemic, and the ART subsequently determined a new price cap that is 1-year in duration, without any mechanistic risk sharing.

Unlike the CAA, the French regulator (ART) has made amendments to the regulatory framework. Although we do not have information as to whether the change to a short regulatory period is permanent, we can reasonably interpret that the regulator intervention to manage the aviation downturn may have conditioned the response of ADP's group share price. Even if it is not permanent, investors may expect the regulator to introduce similar mechanisms in the case of any future highly unusual events such as COVID-19.

Fraport, Frankfurt Airport

Fraport is half owned by German governmental agencies, and has shareholdings in airports all over the world, most notably in Greece, Peru, and China (ranging from minority stakes to full ownership). The effect of Fraport's cross-geographies holdings is a substantial degree of diversification, with 50% of the group holdings outside of Europe and 10% in other European countries and the UK. This diversification will have influenced Fraport's exposure to COVID-19 related risk. For example Xi'an airport (24.5% owned by Fraport) serves a lot of domestic flights in a country relatively unaffected by COVID-19 and suffering a decline in passenger numbers of only 34% between 2019 and 2020.

Fraport's enterprise value is below Heathrow's at EUR 12bn. Fraport also had (and still has) significantly lower EBITDA / Revenues ratios than Heathrow, which have fallen negative during the pandemic.

Fraport's largest airport, Frankfurt, is the third-largest airport for traffic in the European Union, with 71m passengers (in 2019). Frankfurt's breakdown of 10% domestic and 90% international traffic is similar to Heathrow. However, unlike Heathrow, we understand Frankfurt has very few transfer passengers. Frankfurt Airport's 70% decline in passenger numbers was also in line with Heathrow.

Frankfurt Airport did not see significant changes to its regulatory framework during the pandemic, as shown in Table 17. It is likely to be less exposed to risk than Heathrow due to the flexibility on the length of the control periods and in setting the regulatory parameters which it must conform to.

TABLE 17: REGULATORY FRAMEWORK OF FRANKFURT AIRPORT PRIOR AND DURING THE COVID-19 OUTBREAK

	Length	Form & Till	Flexibility
Prior	Operator discretion	Approval, Dual till	Flexible. We understand from the CAA charges were approved annually by the Hesse Ministry for Economics, Transport and Regional Development, but the Ministry does not, generally, set explicit price caps.
During	Operator discretion	Approval, Dual till	Flexible. The latest set of charges were approved and took effect in January 2021. We understand there has been no material change in the underlying regulatory framework due to COVID-19.

The Department for Aviation Safety and Security did not intervene during COVID-19 and, we understand, noted that German Civil Aviation Act is a federal law that cannot be changed for a single airport. Frankfurt has however asked to be reimbursed for the operational losses from fulfilling its obligation to stay open during the Spring 2020 lockdown.

Zurich

Zurich airport group is relatively small (its enterprise value of EUR c.6bn is less than half of Heathrow) and is 40% owned by Swiss government agencies. The decline in Zurich Airport's

EBITDA / Revenues ratio during the pandemic, from 50% to 30%, was less severe than for other comparators.

Zurich airport group has shareholdings in a number of airports in Latin America, the majority of which it owns outright, amounting to 40% international holdings beyond Europe. These airports may have been less exposed to COVID-19, for example, Iquique airport in Chile lost only 44% of its passengers between 2019 and 2020, compared to a loss of 74% of passengers at the principal airport, Zurich. Moreover, in November 2019 the group won a contract to construct and operate a new airport in New Delhi, India.

Zurich Airport has similar traffic mix to Heathrow, with 30% transfers and a low proportion of domestic flights. However, Zurich had only 32m passengers in 2019, less than half of Heathrow.

In terms of regulation, Zurich Airport's regulatory framework did not materially change during the pandemic, as shown in Table 18. However, we also understand the regulator did not intervene to moderate Zurich's risk during the COVID-19 pandemic.

TABLE 18: REGULATORY FRAMEWORK OF ZURICH AIRPORT PRIOR AND DURING THE COVID-19 OUTBREAK

	Length	Form & Till	Flexibility
Prior	Negotiated up to 4 years (2016-20)	Backstop, N/A	Strict. We understand the Federal Office of Civil Aviation authority was given the authority to adjust tariffs in case revenues start to diverge too much from underlying costs, e.g. due to unexpected demand outturn. However, the airport may only trigger a new determination of charges in the event of unexpected costs or unexpected regulatory interventions but not in the case of demand fluctuations.
During	Conditional on net losses recovery but up to 5 years (2020-25)	Backstop, N/A	Strict. We understand that the charges for the new period were agreed as an extension of the previous price control period and remained unchanged from 2019 and that the duration of this extension will be driven by the speed of recovery from COVID-19 losses. The next procedure for adjusting charges will be initiated as soon as the expected net losses in the regulated segment, counting from September 2016, are recovered. However, the recovery period will not extend beyond 2025.

Zurich concluded negotiations with users last July, as is the usual procedure, and did not require intervention from the Federal Office of Civil Aviation (FOCA). However, shortly prior to the pandemic, FOCA was planning to intervene and set new price controls. We understand this proposal was contentious, but that the agreement for an extension of the current price controls with users following the pandemic obviated the need for this process. However, should FOCA move to a price cap regime, Zurich may become closer to Heathrow in terms of its regulatory model.

Sydney

Sydney is similar in size to Heathrow with around EUR 15bn enterprise value. However, Sydney Airport has not been regulated, before or after the COVID-19 pandemic.

TABLE 19: REGULATORY FRAMEWORK OF SYDNEY AIRPORT PRIOR AND DURING THE COVID-19 OUTBREAK

	Length	Form & Till	Flexibility
Prior	1 year	Monitoring, N/A	Not regulated.
During	1 year	Monitoring, N/A	Not regulated.

We have not identified any evidence of explicit intervention by the Australian Competition and Consumer Commission (ACCC) in light of COVID-19, consistent with its yearly monitoring responsibilities. Due to the absence of formal regulatory controls, we consider Sydney is a distant comparator to Heathrow.

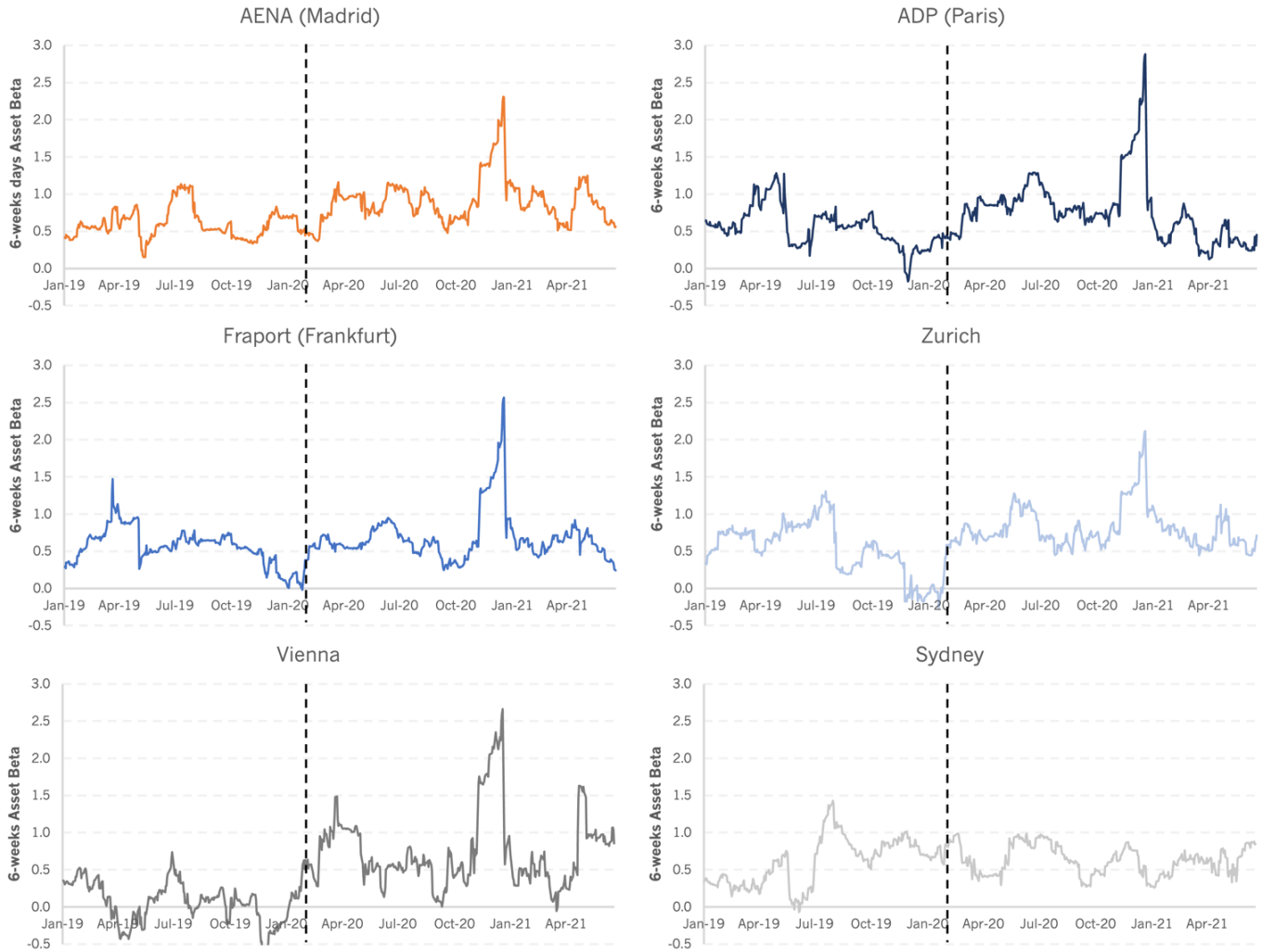
As for the other European airports, Sydney experienced slightly over 70% fall in passenger volumes during the pandemic. However, its EBITDA / Revenue ratio did not suffer from the pandemic, unlike all the other airports in our comparator set.

Sydney registered 44m passengers in 2019, and its traffic mix was different from Heathrow's, with 60% domestic flights and 40% international. This difference may set each airport on a different path and pace of recovery after the pandemic.[27]

Moreover, Sydney has had a different experience to European airports, as shown by short-term asset betas in Figure 11 below. Sydney's experience differed both in terms of the size of its post-COVID asset beta relative to the pre-COVID period, but also in terms of its response to key events, at the start of the pandemic and in late 2020.

[27] Sydney Airport Traffic Performance December 2019

FIGURE 11: SHORT-TERM ROLLING ASSET BETA ESTIMATES



Note: Dotted lines intercept the graph on the 1st February 2020, the date we use as the start of our COVID window.
Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

Due to the differences set out above, and the fact that its beta is measured against a less diversified index, we place very limited weight on Sydney's asset beta estimate.

Vienna

Vienna's enterprise value is small compared to Heathrow, at EUR 3bn. However, its EBITDA / Revenue ratio is only slightly below Heathrow's, despite being 40% owned by governmental agencies.

Vienna registered a slightly higher loss in passenger volumes of 75% during COVID. Its pre-pandemic annual traffic was around 32m, of which 23% were transfers.

Vienna has limited group holdings beyond Austria, with only c.10% in other European countries (Malta and Slovakia) likely affected by COVID similarly to Austria.

Vienna Airport did not see significant changes to its regulatory framework during the pandemic, as shown in Table 20.

TABLE 20: REGULATORY FRAMEWORK OF VIENNA AIRPORT PRIOR AND DURING THE COVID-19 OUTBREAK

	Length	Form & Till	Flexibility
Prior	1 year	Price cap, Dual till	Flexible. We understand there were adjustments in place for volume risk as long as they did not result in additional revenues.
During	1 year	Price cap, Dual till	Flexible. We have seen no evidence of specific intervention during the pandemic so we assume adjustments remain possible.

Source: CAA and Swiss Economics (Sep 2019), Dublin Airport Cost of Capital for 2019 Determination.

Similarly to Sydney, we have not identified any evidence that Austria's Civil Aviation Authority intervened in light of COVID-19. Furthermore, its regulatory framework provides higher risk protection than Heathrow's due to its flexibility and shorter regulatory periods.

Appendix 4: 'COVID window' start date sensitivity

We tested two alternative assumptions about the start date of our 'COVID window'. Reviewing stock-market data and COVID-related news does not provide us with a precise date at which COVID-related events were sufficiently widespread to affect airport share prices and betas. To isolate the impact of the start date, we use a fixed end date at June 2021, consistent with our lower bound results.

In our base case above, we assume COVID begins to affect betas from 1st February 2020. However, we consider sensitivities around this, moving the date by a month either side:

- 1st January 2020, reflecting the earliest date at which a virus was identified in Wuhan; and
- 1st March 2020, reflecting a date at which COVID-related news is widespread, stock markets are experiencing increased volatility, and the pandemic is affecting airports directly.

These alternative assumptions about the start date of COVID would lead to only small changes in our estimate of the effect of COVID-like events, as summarised in the table below.

We therefore chose to rely on our base-case start date, of 1st February 2020. We also note that if we were to assume a 1st March 2020 start date, the pre-COVID beta would increase slightly for our 4-company and 6-company average (relative to in the 1st February results), suggesting that we would be including COVID-affected data in our pre-COVID window.

TABLE 21: COMPARISON OF COVID ADJUSTMENT FOR DIFFERENT COVID WINDOW START DATES

Frequency of COVID	AENA	4 company	6 company
1st January 2020			
1 in 20 years	0.08	0.09	0.08
1 in 50 years	0.04	0.04	0.04
1st February 2020			
1 in 20 years	0.08	0.09	0.08
1 in 50 years	0.04	0.04	0.04
1st March 2020			
1 in 20 years	0.08	0.07	0.07
1 in 50 years	0.03	0.03	0.03

Source: Flint analysis.

Appendix 5: Alternative approach detailed results

In this appendix we show the detailed results from our cross-check, which reweights a single pre-COVID and COVID beta to capture the effect of different frequencies of COVID in the beta.[28] We show our wider set of results for the two COVID tails in Table 22 and Table 23. Our approach to the COVID tails in described in more detailed in Appendix 3.

TABLE 22: REWEIGHTED COVID BETA ESTIMATES, FOR DIFFERENT FREQUENCIES OF COVID-LIKE EVENTS, FOR EVENTS LASTING 17 MONTHS

Freq. of COVID once in X years	AENA Madrid	ADP Paris	Fraport Frankfurt	Zurich	Vienna	Sydney	AENA	4 company	6 company
5	0.70	0.63	0.55	0.71	0.43	0.56	**0.70**	**0.65**	**0.60**
7.5	0.67	0.60	0.54	0.69	0.37	0.56	**0.67**	**0.62**	**0.57**
10	0.65	0.58	0.53	0.69	0.34	0.56	**0.65**	**0.61**	**0.56**
15	0.64	0.57	0.53	0.68	0.31	0.56	**0.64**	**0.60**	**0.55**
20	0.63	0.56	0.52	0.68	0.29	0.56	**0.63**	**0.60**	**0.54**
50	0.61	0.54	0.52	0.67	0.27	0.56	**0.61**	**0.59**	**0.53**
100	0.61	0.54	0.52	0.67	0.26	0.56	**0.61**	**0.58**	**0.53**
N/A	0.60	0.54	0.51	0.67	0.25	0.56	**0.60**	**0.58**	**0.52**

Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

[28] For example, as mentioned in Chapter 3, subsection 3.7, to calculate a 5-year asset beta using a COVID and non-COVID asset beta estimate, we weight each according to the period they represent, i.e. the COVID asset beta gets an initial weight of 1.4-years while the non-COVID asset beta gets a weight of 3.6-years.

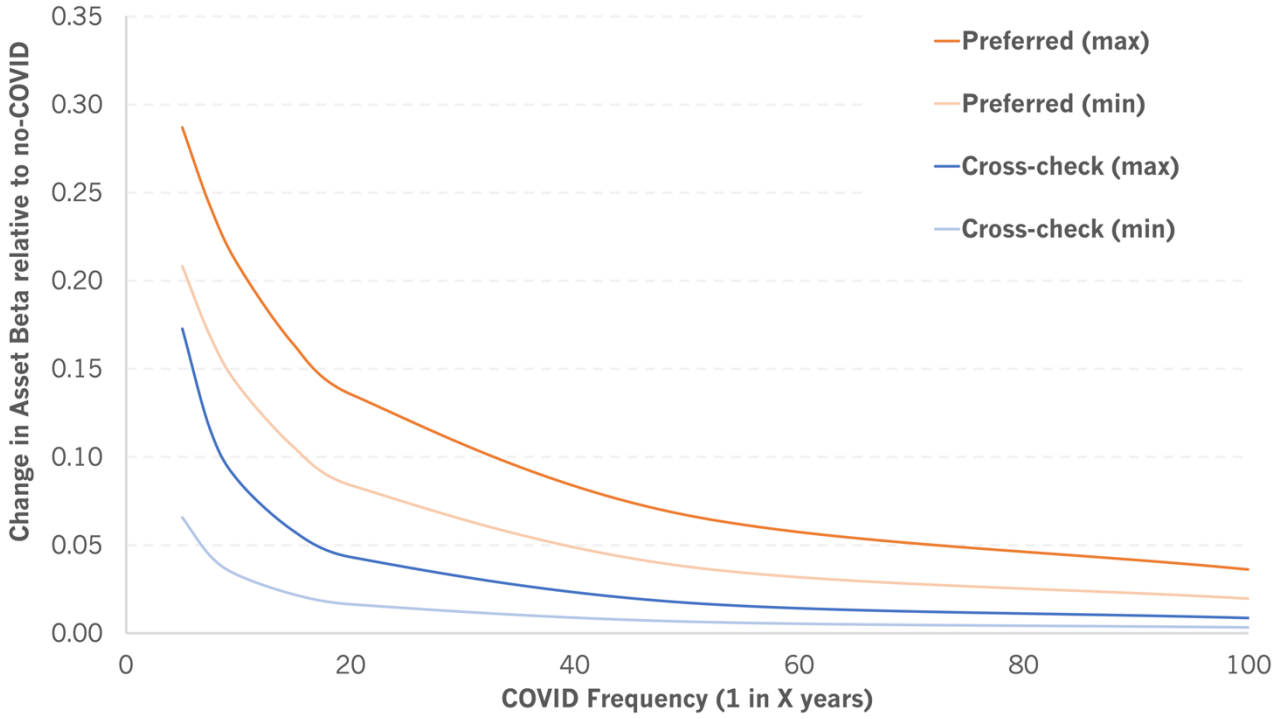
TABLE 23: REWEIGHTED COVID BETA ESTIMATES, FOR DIFFERENT FREQUENCIES OF COVID-LIKE EVENTS, FOR EVENTS LASTING 30 MONTHS

Freq. of COVID once in X years	AENA Madrid	ADP *Paris*	Fraport *Frankfurt*	Zurich	Vienna	Sydney	AENA	4 company	6 company
5	0.78	0.70	0.58	0.74	0.57	0.57	**0.78**	**0.70**	**0.66**
7.5	0.72	0.65	0.56	0.71	0.46	0.56	**0.72**	**0.66**	**0.61**
10	0.69	0.62	0.55	0.70	0.41	0.56	**0.69**	**0.64**	**0.59**
15	0.66	0.59	0.54	0.69	0.36	0.56	**0.66**	**0.62**	**0.57**
20	0.65	0.58	0.53	0.68	0.33	0.56	**0.65**	**0.61**	**0.56**
50	0.62	0.55	0.52	0.67	0.28	0.56	**0.62**	**0.59**	**0.54**
100	0.61	0.54	0.52	0.67	0.27	0.56	**0.61**	**0.59**	**0.53**
N/A	0.60	0.54	0.51	0.67	0.25	0.56	**0.60**	**0.58**	**0.52**

Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

The cross-check results suggest a smaller COVID beta adjustment to our baseline beta than our preferred approach, as shown in Figure 12 below and explained in Chapter 5.

FIGURE 12: CONTRASTING CHANGE IN ASSET BETA BETWEEN OUR PREFERRED APPROACH AND CROSS-CHECK



Source: Flint analysis based on Thomson Reuters data as of 18th June 2021.

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