Heathrow Interim H7 Price Control: Review of HAL's initial submission

28 February 2019

Civil Aviation Authority

PHASE ONE REPORT

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EXECUTIVE SUMMARY

CEPA has been commissioned by the Civil Aviation Authority (CAA) to review Heathrow Airport Limited (HAL)'s business plan for the interim price control, iH7. iH7 is due to run from 2020 to 2021, with a possible third year extension.

The CAA already consulted on HAL's headline price path during this period (at RPI-1.5%) in April 2018, but as part of its price review, it was also expecting to reset elements of the underlying building blocks that are typically used to calculate the price path. Under this arrangement, the rate of depreciation would be adjusted to match the underlying requirement with the headline price path.

In parallel to our study, HAL has been negotiating commercial pricing arrangements with airlines, with the intention of any agreement reached replacing the CAA's price review. As a result, this report will be used by the CAA to test whether any commercial arrangement agreed between HAL and airlines is in the interests of consumers.

Core assumptions and approach to forecasting

HAL has taken a relatively simple approach to forecasting each of the revenue building blocks that are being reset, forecasting forwards from a 2018 baseline using key drivers and then adjusting for any anticipated step changes. However, HAL provides little justification for its 2018 estimates. While we understand the desire to be proportionate, we do not consider that this displaces the requirement to be transparent.

Additionally, there is a material lack of evidence surrounding estimates for additional cost drivers, particularly the underlying calculations used to form the estimates. As a result, we have excluded many of these from our forecasts, with a view to incorporating them if better evidence is provided.

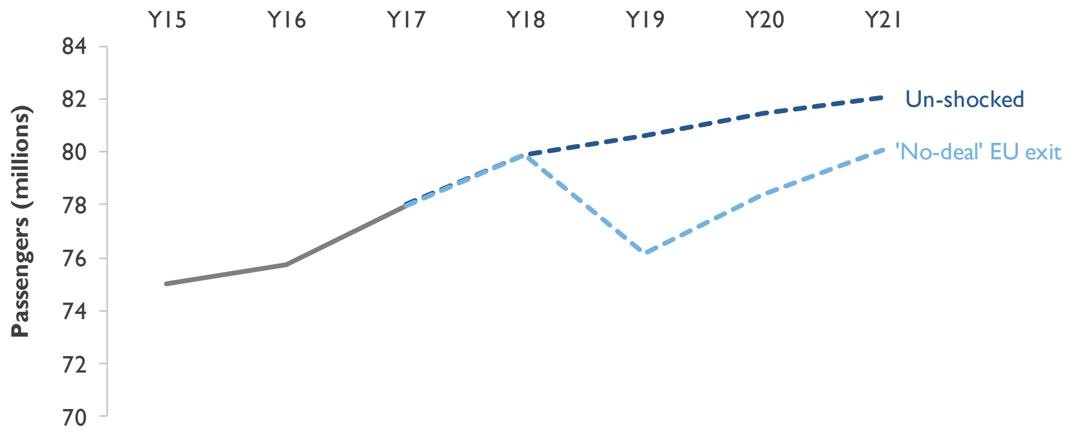
HAL uses a no-deal EU exit scenario as the basis of its forecasts. These have a significant impact on passenger numbers, as well as on non-aeronautical revenues and on inflation rates. Using this as the core scenario opens up the possibility of Heathrow receiving a windfall gain if a less negative outcome comes to pass. Clearly there is substantial uncertainty around the UK's exit from the EU. However, at this stage the **CAA has asked us to assume that the UK government will achieve its stated ambition to agree an orderly withdrawal, with a transition period.** Use of an orderly Brexit scenario in place of HAL's no deal assumption creates a significant difference between our forecasts and HAL's; this is the largest single amendment that we make. This assumption can be revised as necessary during Phase 2 of our study when there may be more certainty surrounding the outcome of EU exit negotiations.

Passenger forecasts

HAL has experienced strong passenger growth during Q6, amidst a backdrop of strong global economic growth and low oil prices. On the supply side, this growth has been driven by airlines moving to larger aircraft with more seats. HAL believe that this growth is unlikely to continue into iH7 and assumes that even in a scenario where the UK leaves the EU with a negotiated agreement, growth will be less strong during the period from 2019 to 2021 than has been the case in recent years.

In the event the UK leaves the EU without a deal HAL forecasts a substantial decline in passenger numbers in 2019 with a gradual recovery in 2020 and 2021. This scenario assumes that there will be a partial loss of traffic rights for airlines flying to and from the UK leading to a sharp reduction in passenger numbers. In this 'no-deal' EU exit scenario, HAL has also included a shock allowance to the forecast in 2020 and 2021, in line with the adjustment used in the Q6 determination. Figure 1.1 compares the no-deal EU exit scenario with a scenario where it is assumed there will be a negotiated withdrawal from the EU and no shock adjustment.

Figure 1.1: HAL forecast passenger numbers under 'negotiated withdrawal' and 'no-deal' EU exit (2015-2021)



Source: HAL iH7 submission (2018)

We consider this to be a rather extreme approach and as such we predict higher passenger numbers than assumed in HAL's no-deal EU exit scenario. Table 1.1 summarises the key differences in assumptions. We forecast stronger growth in passenger numbers than presented in HAL's un-shocked scenario, as we assume load factor growth will continue the recent trend rather than slowing down as assumed in HAL's submission. We believe this is more realistic given that load factors at Heathrow significantly trail other European airports with similar traffic profiles, and a number of external forecasts assume continued strong growth during this period.

We have included a shock allowance consistent with the principle set in Q6 but our allowance is smaller than the 1.07% estimated by Heathrow. Taking the Q6 allowance and updating it using assumptions around the existence of demand shocks since 2012, we have estimated it at around 1%. For consistency, we have applied this shock allowance to all forecast years, rather than just 2020 and 2021. **Our revised version of the shocked forecast is used as the core passenger forecast for each of the building blocks that we consider.**

Table 1.1: CEPA and HAL forecasts of passenger numbers, 2018-2021

	2018	2019	2020	2021
HAL				
Load factor (%)	79.2%	79.9%	79.7%	79.9%
Passengers, un-shocked (millions)	79.9	80.6	81.5	82.0
Shock allowance (%)	-	-	1.07%	1.07%
Passengers, shocked (millions)	79.9	80.6	80.6	81.2
Passengers, no-deal EU exit (millions)	79.9	76.2	78.4	80.1
CEPA				
Load factor (%)	79.2%	80.2%	81.2%	82.2%
Passengers, un-shocked (millions)	79.9	80.9	83.0	84.4
Shock allowance (%)	-	1.00%	1.00%	1.00%
Passengers, shocked (millions)	79.9	80.1	82.2	83.6

Source: CEPA analysis

Operating expenditure

In Q6 so far, HAL's actual opex has been consistently similar to, although somewhat higher than, the CAA's determination. During this period however annual opex has been declining, with a reduction of 5% per passenger occurring between 2014 and 2017.

HAL believes that this reduction in opex per passenger means that it now operates efficiently. As such, it has used 2018 estimates for opex as the basis for forecasting future expenditure. Figure 1.2 illustrates the approach taken by HAL to produce the opex forecasts (excluding inflation). HAL is forecasting an 18% increase in opex between 2018 and 2021, in nominal terms. The inflation assumptions used by HAL form the biggest single component of the forecast growth rate; in real terms, HAL forecast an increase of approximately 6%. HAL also use a different passenger forecast for estimating future opex, to what is used elsewhere in its submission. We do not believe however, that there is any justification for using different passenger forecasts for different building blocks.

Figure 1.2: Steps taken by HAL to forecast opex for iH7 (£m, 2016 prices)

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Source: CEPA analysis of HAL submission

Based on our analysis, we have adjusted HAL's methodology to establish a forecast which is more analytically robust, taking the following steps:

- Use HAL's 2018 forecast, with a catch-up efficiency adjustment, as our baseline;
- Using our shocked passenger growth forecasts alongside an elasticity value of 0.4 (same as HAL's); and
- Assuming an efficiency factor of 1.65% per annum, based on a frontier shift estimate of 0.9% and a catch-up efficiency estimate of 0.75%.

The result of our adjustments is a decrease in HAL's forecast operational expenditure, as shown in the table below.

Table 1.2: Summary of CEPA operating cost forecast (£m, 2016 prices)

Forecast	2018	2019	2020	2021
CEPA forecast	1,078.1	1,080.1	1,074.1	1,064.7
HAL forecast	1,086.6	1,128.0	1,136.3	1,149.3
Difference	**-8.5**	**-47.9**	**-62.2**	**-84.6**

Source: CEPA analysis

Non-aeronautical revenues

Overall, HAL is forecasting that non-aero revenues will grow from £1,217m in 2018 to £1,325m in 2021 at a compound annual growth rate (CAGR) of 3.2% in nominal prices. In real terms, this equates to a CAGR of -0.4%.

Although our benchmarking of Heathrow against other European airports found that HAL was already amongst the top performers in relation to non-aero revenues, our review has highlighted a number of areas where we consider that HAL's forecast is less ambitious than it could be. We have revised the forecast to address these issues. Our forecast assumes non-aero revenues of £1,205m in 2020 (8% increase on HAL's forecast) and £1,236m in 2021 (11% increase on HAL's forecast) in 2016 prices.

Table 1.3: Summary of CEPA non-aeronautical revenue forecasts (£m, 2016 prices)

Forecast	2018	2019	2020	2021
CEPA forecast	1,135.4	1,168.9	1,204.6	1,235.5
HAL forecast	1,135.8	1,123.9	1,116.6	1,111.3
Difference	**- 0.4**	**45.0**	**88.0**	**124.2**

Note: Difference in 2018 forecasts due to different estimates for 2018 inflation.

Capital expenditure and regulatory depreciation

HAL has not provided any detail of its non-expansion capex plans beyond headline estimates of future expenditure. This is because the pipeline of projects that is likely to be delivered during this period is uncertain and evolving. The headline estimates of non-expansion capex presented in the table below are based on what HAL believe is deliverable during this period, given the planning pipeline and resourcing requirements.

Category B expansion costs have been revised upwards very substantially. For both Category B and Category C costs, insufficient detail has been provided to warrant further analysis at this stage. The headline estimates are subject to potentially significant further revision for HAL's revised submission due in April 2019. As a result, we have not completed any detailed scrutiny of HAL's figures for reasonableness.

Table 1.4: HAL capex plans, 2018-2021 (£m, 2016 prices)

	2018	2019	2020	2021
Run the Airport		616	784	965
Masterplan		518	491	629
Non-expansion Sub-Total		**98**	**293**	**336**
Category B		177	69	33
Category C		144	347	865
Expansion Sub-Total		**936**	**1,200**	**1,862**
Total	**839**	**616**	**784**	**965**

We have considered the deliverability of HAL's non-expansion capex plans given the overall quantum being considered. Whilst HAL has shown historically that it is able to scale up capital expenditure over a short period, it is less clear whether the projects within the planning pipeline are sufficiently mature to actually be delivered during iH7.

We also believe that HAL's approach to capex for this submission assumes a significant departure from the current regulatory approach. If the CAA is willing to accept HAL's assertion that the capex plan should evolve over the course of the control period, we recommend greater scrutiny through the capex governance process. We also expect that CAA will want to take a view from airlines on this matter.

Notwithstanding that debate, further information will be required if the CAA is minded to set a capex envelope for iH7 that is meaningful at the outset. Doing so will require some further development of the analysis that currently sits behind the high-level numbers presented in HAL's submission.

Revenue requirement

As a result of the changes that we have made, and primarily driven by our use of a less negative EU exit scenario, our forecast revenue requirement is significantly lower than that estimated by HAL. Our forecasts are summarised in the table below and compared with a number of other scenarios:

- **Headline price path (RPI-1.5%)** presents the revenue requirement and maximum aeronautical yield under a scenario where the price path changes by RPI-1.5%;
- **CAP1658 (CAA capex)** presents the results of a scenario where there is a simple reset of some of the building blocks, as presented by the CAA in CAP1658;
- **HAL iH7 Submission** presents the impact of HAL's initial submission on the aeronautical yield; and
- **CEPA (CAA capex)** presents the results of a scenario using our forecasts of each of the building blocks, and the CAA's forecasts of capex as assumed in CAP1658.

Table 1.5: CEPA forecast revenue requirement, 2020-2021 (£m, 2016 prices)

	Headline price path (RPI-1.5%)		CAP1658 (CAA capex)		HAL iH7 Submission		CEPA (CAA capex)	
£ million, 2016 prices	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Total aero revenue requirement	1,614	1,596	1,447	1,492	1,537	1,601	1,345	1,328
Passenger numbers (million)	77.8	78.1	78	78	78	80	82	84
Required aero yield (£)	**20.74**	**20.43**	**18.59**	**19.10**	**19.60**	**19.99**	**16.37**	**15.88**
Additional revenue			167	104	77	- 5	269	268

1. INTRODUCTION

1.1. Background

CEPA has been commissioned to review and assess Heathrow Airport Limited's (HAL) business plan for iH7; the interim period before the main H7 regulatory price control starts in 2022.

HAL is subject to economic regulation by the Civil Aviation Authority (CAA) because it has substantial market power. The CAA regulates HAL using a price cap expressed in the form of RPI-X over a price control period. HAL's current price control, Q6, is due to end in December 2019 following a decision by the CAA to extend it for one year. The next price control, iH7, is due to run until at least the end of 2021 and is an interim control period designed to align the regulatory cycle with the timetable for expansion at Heathrow Airport. The CAA has indicated that it may extend this interim control further depending on how the timetable for expansion evolves.

For this interim price control, the CAA proposed a headline price path of RPI-1.5% in its April 2018 consultation document, CAP1658.[1] The CAA also proposed updating the assumptions applied to some of the underlying revenue 'building blocks' and adjusting the rate of depreciation to match the difference between:

(i) The updated building blocks; and
(ii) The proposed price path.

The regulatory process for the iH7 price control formally began with the submission of HAL's business plan in October 2018. This set out HAL's view of the business' underlying revenue requirement, supported by forecasts for each of the key revenue building blocks. The objective of this study is to independently review HAL's building block assumptions and to estimate the underlying revenue allowances.

While this study was originally intended to inform the CAA when it set the price control for iH7, HAL and some of the major airlines operating at Heathrow, have in parallel, been negotiating commercial pricing arrangements for the interim period. It is intended that the arrangements would replace the price review process. As a result, the study will now be used by the CAA to help assess whether commercial arrangements proposed by HAL and airlines are in the interest of consumers.

The study has two phases:

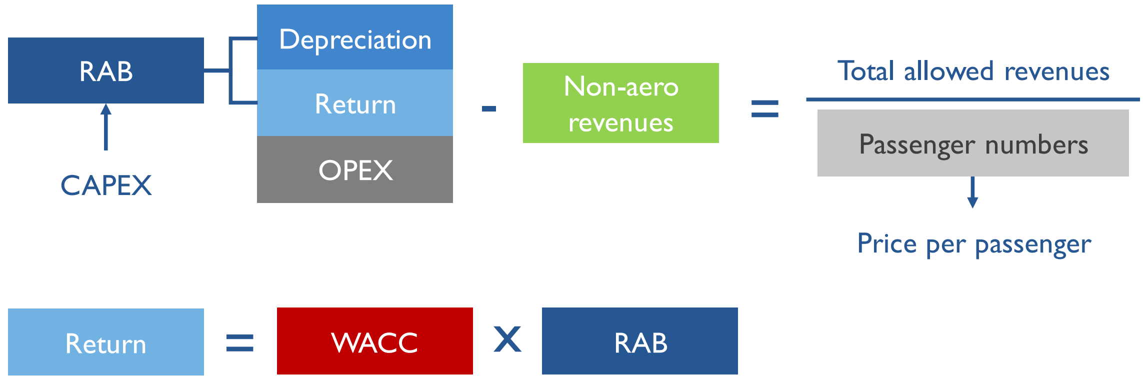
- **Phase one** is an assessment of HAL's initial submission (concluding in this report). The conclusions of phase one will be used to inform the CAA's initial consultation for the iH7 price control.
- **Phase two** will be to update this report following comments from HAL and other stakeholders in response to the CAA's consultation. The conclusions of phase two will be used to inform the CAA's final proposals for iH7.

1.2. Regulatory building blocks

Price caps, as applied at Heathrow, are set by reference to revenue building blocks. Figure 1.1 describes the building blocks used in the HAL price control and shows how they are used to calculate the revenue requirement, typically expressed in *price per passenger* form rather than *total allowed revenues* form.

[1] Civil Aviation Authority (2018) *Economic regulation of capacity expansion at Heathrow: policy update and consultation, CAP1658*

Figure 1.1: Airport price cap and the revenue building blocks



Source: CEPA

1.3. Scope of study

Our review has assessed the reasonableness of the assumptions and methodologies underpinning HAL's forecasts, considering the arguments made by HAL in support of its plans and the evidence that it has presented to support its forecasts. In certain areas we have undertaken additional benchmarking analysis and have reviewed previous consultancy studies commissioned by the CAA, which have assessed aspects of HAL's performance during Q6. We have also undertaken some stakeholder engagement, though we expect further comments in response to the CAA's consultation.

As part of this study, we have reviewed HAL's proposals for each of the following building blocks:

- Passenger forecasts
- Operating expenditure (opex)
- Capital expenditure (capex)
- Depreciation
- Non-aeronautical revenues

Whilst the CAA was also proposing to reset aspects of the cost of capital, reviewing HAL's proposals on these was outside the scope of this study.

This report details our findings, summarising stakeholder views on the submission and presenting our own alternative forecasts for each of the building blocks. It is structured as follows:

- In Section 2, we review the general approach HAL has used to produce their forecasts, including their assumptions regarding the UK's exit from the EU;
- In Section 3, we review HAL's passenger forecasts and provide our own forecasts;
- In Section 4, we review HAL's estimates for future operating expenditure and provide alternative forecasts;
- In Section 5, we assess HAL's forecasts for non-aeronautical revenues and present our own forecasts;
- In Section 6, we assess HAL's proposed treatment of capital expenditure for iH7;
- In Section 7, we present HAL's proposals for a partially reset cost of capital, and compare them against proposals from PwC;

- In Section 8, we present our estimates of the underlying revenue requirement based on our forecasts and compare them with HAL's proposals from its iH7 submission and the CAA's estimates in the CAP1658 consultation document on iH7; and
- In Section 9, we summarise the additional evidence we require from HAL for Phase 2 to effectively scrutinise their iH7 plans.

2. CORE ASSUMPTIONS UNDERPINNING FORECASTS

In this section we consider the forecasting approach taken by HAL for its iH7 submission and summarise our view of the quality of the evidence underpinning the forecasts. We also review HAL's treatment of the uncertainty surrounding the UK's exit from the EU in its forecasts.

2.1. FORECAST APPROACH

HAL has taken a relatively simple approach to forecasting operating expenditure and non-aeronautical revenues. They have used their 2018 forecasts as a base year and then projected forwards using some high-level drivers and adjustments. These include:

- adjustments related to macroeconomic indicators such as inflation, exchange rates and GDP growth;
- impacts from changes in passenger numbers;
- step changes arising out of additional cost items or revenue drivers; and
- adjustments to reflect estimated efficiency or productivity improvements.

As this is an interim price control, and given the CAA's desire to take a proportionate approach, we believe this is a logical approach to take. However, we do have concerns about the use of an incomplete year, 2018, as base year. This may not reflect an appropriate baseline to project from. We have therefore undertaken a review of the 2018 forecasts and assessed whether they are reflective of an efficient baseline for the forecasts being made.

Although the approach taken to forecasting is generally proportionate, in many areas HAL has provided insufficient evidence to justify its key assumptions. In particular, HAL has provided little in the form of justification for additional cost items and has not provided the calculations underlying adjustments to the forecasts. Without evidence, we are unable to effectively scrutinise these adjustments or additional calculations, and as a result, we have used our own analysis in those areas.

While we understand the desire to be proportionate, we do not consider that this displaces the requirement to be transparent. For Phase 2, further scrutiny in those areas where there has been insufficient evidence from HAL to justify the inclusion of their estimates will be necessary.

2.2. EU EXIT SCENARIO AND ECONOMIC ASSUMPTIONS

The final year of Q6, 2019, coincides with the UK's exit from the European Union. The short and medium-term implications of the UK's exit on Heathrow are presently uncertain and dependent on parliamentary processes that are yet to be completed.

Given the uncertainty surrounding Brexit, HAL has proposed using a 'no-deal' EU exit scenario as the core underpinning assumption of the iH7 submission. Such a scenario inevitably assumes lower GDP growth, higher inflation and a weaker pound than alternate scenarios that assume agreement between the UK and EU. The scenario additionally assumes a sharp reduction in supply in April 2019 resulting from a partial loss of air traffic rights, and a smaller reduction in demand, leading to a substantial decrease in passenger numbers. Under the scenario, Heathrow recovers from the shock by 2022.

The reduction in passenger numbers which is one of the key revenue building blocks, also indirectly affects assumptions around likely operating expenditure and non-aeronautical revenues. The economic impacts that HAL assume arise from a 'no-deal' EU exit, are summarised in Table 2.1. These have been taken directly from, or adapted from, forecasts produced by Oxford Economics. The inflation assumptions shown in the table affect each of the building blocks, whilst the GDP growth and exchange rate impacts, affect forecast non-aeronautical revenues.

Table 2.1: Economic assumptions in iH7 submission

	2018	2019	2020	2021
RPI growth (year average), %	3.5%	4.6%	3.6%	2.7%
UK GDP growth, %	1.3%	0.5%	1.0%	1.6%
US $ per £	1.32	1.16	1.27	1.37
Euro per £	1.12	1.02	1.06	1.12

Source: HAL submission

The scenario proposed by HAL is negative, heading towards the most extreme of possible scenarios arising from the UK's exit from the EU. Using this as the core assumption raises the possibility of Heathrow receiving a windfall gain if a more positive outcome is achieved. Conversely, we recognise that using a scenario that assumes the status quo could lead to windfall losses for Heathrow.

We have therefore agreed with the CAA that we will, for now, assume that the UK achieves a planned and orderly exit from the EU. Consequently, we adopt an alternative set of economic assumptions. However, we consider that there may be greater certainty by April 2019 when Phase 2 of this study will commence. As such, the chosen EU exit scenario and related economic assumptions can be revisited for Phase 2.

2.3. Price base

The CAA has historically modelled each of the building blocks in real terms, with the adjustment for inflation made when calculating the price path. We have followed this approach in our forecasts, presenting them in 2016 prices. Whilst we do not explicitly use any of the economic assumptions in our forecasts, in Table 2.2 we present for comparison with those proposed by HAL, economic forecasts under a 'negotiated withdrawal' EU exit scenario.

Table 2.2: Economic assumptions under a 'negotiated withdrawal' EU exit scenario

	2018	2019	2020	2021
RPI growth (year average), %	3.5%	3.1%	3.1%	3.2%
CPI growth (year average), %	2.6%	2.0%	2.0%	2.1%
UK GDP growth, %	1.3%	1.6%	1.4%	1.4%

Source: Office for Budget Responsibility (2018) Economic and Fiscal Outlook

3. PASSENGER AND TRAFFIC FORECASTS

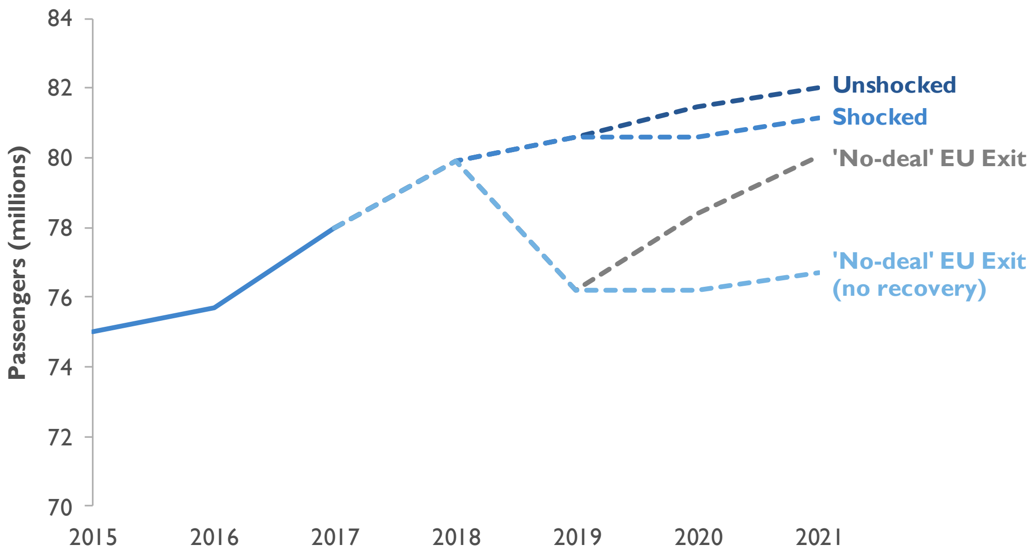
In this section we review historic passenger numbers at Heathrow and HAL's forecast for iH7. We consider the methodology and assumptions used to construct HAL's forecasts. We also consider alternative forecasts for passenger numbers at Heathrow before presenting our forecasts.

3.1. HAL PROPOSALS

HAL has produced four different passenger forecasts for its submission, presented graphically in Figure 3.1:

- An **un-shocked forecast** produced using HAL's standard modelling suite and assuming an EU exit with a deal between the UK and the EU. This forecast is used for operating expenditure.
- A **shocked forecast**, which is an annual adjustment to the un-shocked forecast to reflect that, as a capacity constrained airport, non-economic passenger shocks affect Heathrow asymmetrically (i.e. whilst negative demand shocks reduce passenger numbers, positive demand shocks do not increase passenger numbers significantly as Heathrow is capacity constrained). As such, the mean number of passengers at the airport would be lower than estimated in the un-shocked forecast.
- A **'no-deal' EU exit forecast**, which as discussed earlier is the core scenario in HAL's submission and the scenario used by HAL for planning purposes.
- A **'no-deal' EU exit forecast with no recovery in air traffic rights**, which is used only as an illustrative scenario of an alternative outcome. In this scenario, there is no recovery of flight numbers or demand following a 'no-deal' EU exit.

Figure 3.1: Passenger numbers at Heathrow, 2015-2021



Source: HAL iH7 submission

3.1.1. Business as usual (BAU) forecasts

Two different models have been used by HAL to produce the un-shocked forecasts; a medium-term model used for the 2019 forecast and a long-term model used to produce the estimates of passenger numbers in 2020 and 2021.

The medium-term model derives passenger numbers via a bottom-up assessment of:

- **Total ATMs**, using published schedules for the winter 2018/19 season and discussions with airlines regarding their intentions for the summer season and subsequent winter season. HAL adjust the number of ATMs downwards to reflect typical airline slot utilisation rates. In other words, not all routes will run fully to schedule due to cancellations or changes in airline plans.
- **Average seats per ATM,** using a mixture of historic trends, published schedules and discussions with airlines.
- **Average load factors per ATM**, using assumptions that reflect historic load factors and cross-checked against the results of econometric demand modelling

These assumptions are set separately for each route / airline combination, and then aggregated to estimate total passenger numbers.

The long-term model separately estimates passenger numbers using both a 'bottom-up' supply model and a 'top-down' demand model. The supply model takes a similar approach to modelling available seat capacity and load factors as the medium-term model, but at a less granular level. To reflect the uncertainty in the forecasts, the supply model uses Monte Carlo analysis to produce a range of possible outcomes (with the central scenario being the 50th percentile of possible outcomes).

The demand model uses econometric analysis to estimate how key explanatory variables (such as GDP levels) affect the demand for air travel between the UK and international markets, and the demand for transfer air travel via hub airports. The model then estimates the share of such demand Heathrow can expect to gain both for UK origin and destination travel and for transfer traffic, given capacity constraints. We have been informed by HAL that both the demand and supply models have produced similar forecasts for the years in question, though we have not had access to the model outputs to confirm this.

3.1.2. Shocked forecasts

As noted above, a shock adjustment was introduced in the passenger forecasts underpinning the Q6 determination.[2] This adjustment reflects an observation that Heathrow as a congested airport is affected by exogenous demand shocks asymmetrically, in the sense that Heathrow is less able to capitalise on positive demand shocks due to capacity constraints but is still exposed to the full effect of negative demand shocks. Without an explicit allowance for such shocks there may be an upward bias to the passenger numbers. These shocks include large events such as 9/11 and the volcanic ash cloud, as well as events that had a smaller impact on passenger numbers, such as the SARS outbreak. The shock adjustment is an allowance for the existence of such shocks, recognising that the passenger numbers in any one year will be closer to the un-shocked forecast but the mean number of passengers over a period of time will be closer to the shocked forecast.

Using data from 1991 to 2012, the adjustment was calculated at 1.2% per annum for the Q6 determination by the CAA.[3] HAL has revised this assumption using data from Q6 and estimated it to be 1.07%, but have only applied it from 2020 onwards.

[2] See Civil Aviation Authority (2013) *Economic regulation at Heathrow from April 2014: initial proposals, CAP1027* and Civil Aviation Authority (2013) *Economic regulation at Heathrow from April 2014: final proposals, CAP1103*

[3] HAL had originally estimated the shock adjustment to be 1.4% per annum, but this was revised down by the CAA.

3.1.3. EU exit forecasts

Both EU exit forecasts assume that, following a no-deal exit from the EU, there will be a partial loss of air traffic rights between the UK and certain countries for which the rights are currently exercised via the UK's membership of the EU. These countries include both EU countries, such as Germany, France, Italy and Belgium, and non-EU countries for which traffic rights are negotiated via the EU, such as the USA.

In its core scenario, HAL assumes that in the first week of April 2019 there will be a 35% reduction in capacity on affected routes, varying levels of demand and capacity reductions on routes dependent on transfer traffic or cargo volumes, and a general 2% demand reduction on all routes. For the remainder of 2019, this is followed by a 10% capacity reduction on affected routes, smaller reductions in demand and capacity on routes dependent on transfer traffic and cargo volumes, and a 2% demand reduction on all routes. These assumptions lead to an overall reduction in passenger numbers of 5.5% in 2019.[4]

Both demand and supply are expected to gradually recover through 2020 and 2021, and the EU Exit impact dissipates by 50% and 75% respectively. The effect of this is summarised in Table 3.1.

Table 3.1: 'No-deal' EU exit assumptions, 2018-2021

	2018	2019	2020	2021
Reduction in passenger numbers, %	-	5.5%	2.7%	1.4%
Reduction in passenger numbers, millions	-	4.4	2.2	1.1

Source: HAL iH7 submission

HAL also presents an alternative scenario to illustrate the potential impact of an even more negative EU exit outcome. In this scenario, the reduction in seat capacity and demand is not expected to recover in 2020 and 2021 and instead leads to permanently lower passenger numbers.

3.2. CEPA ANALYSIS

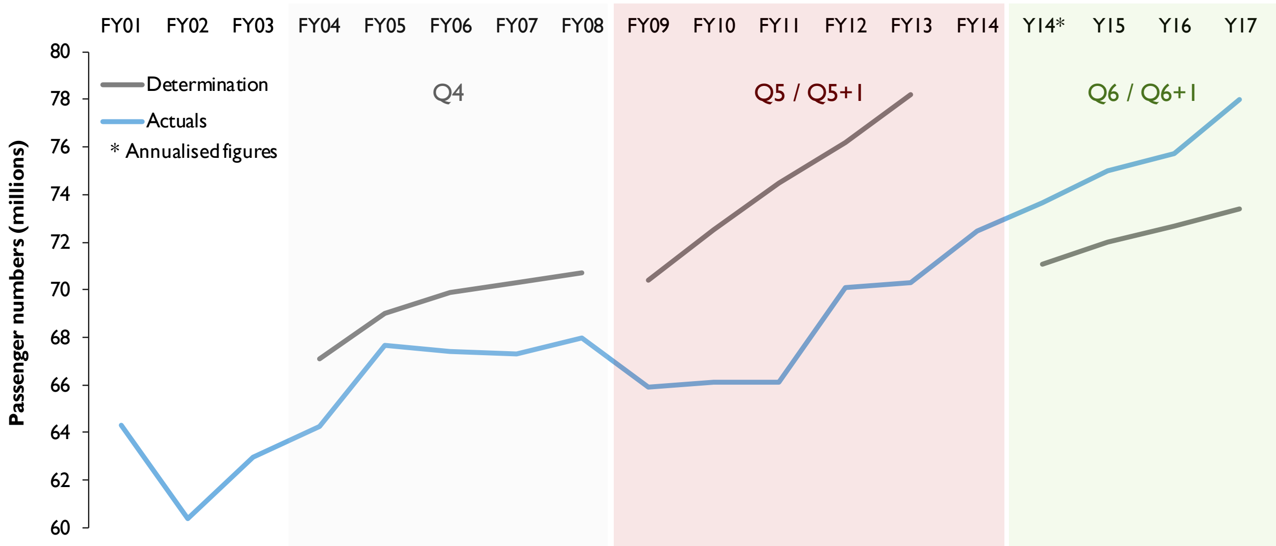
3.2.1. Review of historic passenger growth

A planning cap of 480,000 air transport movements (ATMs) per annum exists at Heathrow airport. For several years the airport has operated at close to this cap, which has left limited room for further growth in passenger numbers through more ATMs. However, passenger numbers in recent years have continued to grow through a gradual move towards higher capacity planes achieving higher load factors.

As shown in Figure 3.2, passenger growth has exceeded the forecasts assumed in the CAA's Q6 determination but was below the forecasts assumed in Q4 and Q5. Lower passenger numbers during Q4 and Q5 were largely the result of increased oil prices and the 2008 recession, whilst a strong recovery in global economic growth and a period of low oil prices have led to stronger demand for air travel from Heathrow during the Q6 price control.

[4] The original HAL submission stated the reduction was 5.7% but we believe this is a calculation error.

Figure 3.2: Historic growth in passenger numbers, 2000/01 to 2017



Sources: CEPA analysis of HAL iH7 submission; CAA Q4, Q5 and Q6 determinations; and CAA airport statistics

HAL's submission, as shown in Table 3.2, indicates that the period from 2013 onwards coincided with an increase in average seats per ATM, and more recently in an increase in average load factors. Growth in average seats per ATM arose out of a shift from short-haul to long-haul services typically employing larger planes; greater use of the A380 which carries significantly more passengers than alternative aircraft, and seat densification strategies implemented by some airlines operating from Heathrow (namely British Airways). Load factors grew following the introduction of charging incentives and efforts between Heathrow and airlines to improve average loads.

Table 3.2: Historic growth in seat capacity and load factors at Heathrow, 2012-2017

	2012	2013	2014	2015	2016	2017
Average seats per movement	197.3	202.8	204.5	208.7	211.5	212.3
Growth from previous year, %	-	*2.8%*	*0.8%*	*2.1%*	*1.3%*	*0.4%*
Average load factors. %	75.6%	76.4%	76.6%	76.5%	76.0%	78.0%
Growth from previous year, %	-	*1.1%*	*0.3%*	*-0.1%*	*-0.7%*	*2.6%*

Source: CEPA analysis of HAL iH7 submission

3.2.2. Review of HAL forecasts

Our review of HAL's forecasts cover the key assumptions used by HAL when producing its passenger numbers:

- The choice of EU Exit scenario
- The size of the shock adjustment
- Forecast number of ATMs under a standard 'negotiated withdrawal' EU Exit scenario
- Forecast growth in seats per movement (i.e. average aircraft capacities)
- Forecast growth in passenger load factors

EU Exit scenario

As stated in Section 2, we disagree with the use of a no-deal EU exit scenario as the basis of passenger forecasts for iH7. Additionally, as the general shock allowance is designed to reflect that Heathrow is exposed to passenger shocks, including an additional allowance for a no-deal EU exit is in effect double-counting the potential effect. The impact of a no-deal EU exit on passenger numbers can be considered a specific shock event.

At this stage therefore, we consider that the shock adjustment is the most appropriate allowance for a no-deal EU exit given the inherent uncertainty around the likeliest UK withdrawal scenario. For Phase 2 of our review, there may be greater certainty around both the nature of the UK's exit from the EU and the impact of such an exit on air travel to and from Heathrow. If there is a shock over and above any economic effects; the size of the shock is significantly larger in terms of its effect on passenger numbers than any previous event; and/or the shock is likely to persist for several years, the forecasts would require a specific adjustment beyond the existing shock allowance that we have allowed.

Shock adjustment

The existence of a shock adjustment has been previously accepted by the CAA and was used in the passenger forecasts for the Q6 determination. We understand that HAL have used the same methodology to update their estimates of the shock adjustment and as such we have not reviewed the methodology in significant detail. We do note that the adjustment is lower than what was estimated in Q6, implying that the average demand shock between 2012 and 2017 has been 0.5% per annum.

The reduction is consistent with our expectations given that air traffic demand has been relatively stable both at Heathrow and elsewhere throughout the Q6 period. However, we have not had access to the calculations underlying the new estimate. If we were to assume that there have been no demand shocks during the Q6 period, then the updated shock adjustment would be closer to 0.97% rather than the 1.07% assumed by HAL.[5] In the absence of concrete evidence surrounding the size of any demand shocks experienced since 2012, we have used a shock allowance of 1% per annum (rounded up from our estimate of 0.97%).

ATMs

Given Heathrow's capacity is capped at 480,000 ATMs, and it is currently operating at over 98% capacity, there is limited room for further growth in the number of flights. HAL assume some level of continued growth within the cap, at a rate that is broadly consistent with the average growth seen since 2012. HAL assume a small decline in ATMs in 2019, but this is reversed in 2020 and 2021.

Heathrow's ATM forecasts assume Heathrow will be operating at 99.4% capacity by 2021. Given a certain number of flight cancellations will be inevitable, it is unlikely that significant further growth in movements is achievable within the cap. We do not anticipate a lifting of the ATM cap prior to Heathrow obtaining consent for the third runway. Therefore, we conclude that HAL's ATM forecasts for iH7 are appropriate.

Seats per movement

The assumptions regarding average seats per ATM are partially based on actual schedules (where schedule data is available). These are then forecast using assumptions around the growth of average seat capacity by airline and route groupings. The distribution of growth rates used in the Monte Carlo analysis is constructed using data from 1991 to 2017, with the mean based on an average over the period. Whilst we

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[5] The 1.2% average demand shock was calculated using data from 1991 to 2012. Assuming that the average demand shock between 2012 and 2017 has been 0%, then the demand shock averaged from 1991 to 2017 would be 0.97% (1.2% × (2012-1991) ÷ (2017-1991)).

believe that this broad approach is sensible, it does not explicitly include any allowance for stretch which HAL could incentivise through different charging mechanisms.

Additionally, the distribution is constructed using data covering periods where Heathrow was less capacity constrained (with utilisation rates of less than 90%) and as such, there was less of an incentive for airlines to increase average seats per movement. HAL has attempted to account for this by making manual adjustments to the assumed mean growth in average seat capacity, removing any perceived outlier years or one-off effects, and sometimes using a narrower time period.

These adjustments have been only partially documented in spreadsheets provided to us and not consistently so. Having reviewed the manual adjustments, it seems the net effect has been to create higher seat capacity growth rates compared with a simple 1991-2017 mean, but lower growth than a 2003-2017 mean. We believe that the latter in most circumstances will more closely reflect expected growth in seats per movement at a capacity constrained Heathrow.

The combined effect of these assumptions is that for both the medium and long-term models, HAL assume much lower growth in seat capacity than the trend seen during Q6. To provide additional evidence in support of their approach, HAL note a number of trends that suggest smaller increases in seat capacity going forward:

- Limited growth in A380 movements – HAL point to airlines that have recently downgauged from the A380s to 787s and other aircraft that have much lower seat capacity.
- Completed phasing out of smaller regional aircraft following BA's takeover of BMI.
- Tailed-off airline seat densification strategies – HAL believe that airlines are reaching the end of several rounds of seat densification on their aircraft, which mean that growth in average seats per movement from more densely packed aircraft should slow down.

There is an initially compelling narrative around HAL's assumptions which is supported by evidence in some areas. Whilst expectations of slower economic growth suggest that growth in seat capacity might be slower than that experienced in recent years, many airlines continue to have expansion plans for the near future and in recent months, expectations of oil prices have remained at moderate levels.[6] It is unclear the extent to which airline plans have been incorporated into HAL's forecasts (such as through the manual adjustments described above). We have therefore considered alternative sources of evidence as a comparison to HAL's assumptions (see benchmarking below).

Load factors

HAL has taken a similar approach the forecasting growth in average load factors, basing them on historic growth rates, with manual adjustments to remove perceived outliers. On average, HAL assumes a tail-off in load factor increases from 2019 to 2021. This partially reflects the short-term trade-off between increases in average seat capacity and increases in average load factors. Therefore, over any one year, a larger increase in seat capacity is likely to be associated with constant or falling load factors. However, over a longer period, we would expect both load factors and seat capacities to continue to grow.

Again, the evidence supporting HAL's assumptions is lacking in part. We have not had any detailed explanation of the manual adjustments made to the data. In some cases, the adjustments are inconsistent with those made in seat capacity growth, by using a different time period for example. We believe the net

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[6] IATA (2018) *Cautious optimism extends into 2019*

effect of these adjustments has been to create a downward bias in load factor growth, with the assumptions used in HAL's modelling consistently lower than what would be assumed if we take a simple average of growth for either of the 1991-2017 or 2003-2017 time periods.

Additionally, the approach taken to forecasting load factors has not taken into consideration any measures HAL could put in place to incentivise higher load factors. We understand from discussions with HAL and with airlines that such charging mechanisms have been introduced historically to encourage greater utilisation of aircraft.

However, we believe load factors will grow at a stronger rate than that assumed by HAL, for a number of reasons:

- Alternative sources of evidence show continued strong demand for air travel to/from Heathrow and more generally from the south east;
- Slower growth in seat capacity will (in the short to medium term) put greater emphasis on higher utilisation of aircraft;
- HAL's assumed rates of load factor growth are lower than the historic trend seen both in the short and long term;
- Heathrow's average load factors are low compared with other hub airports; and
- HAL has not included enough consideration of the impact of charging incentives it can introduce to increase load factors.

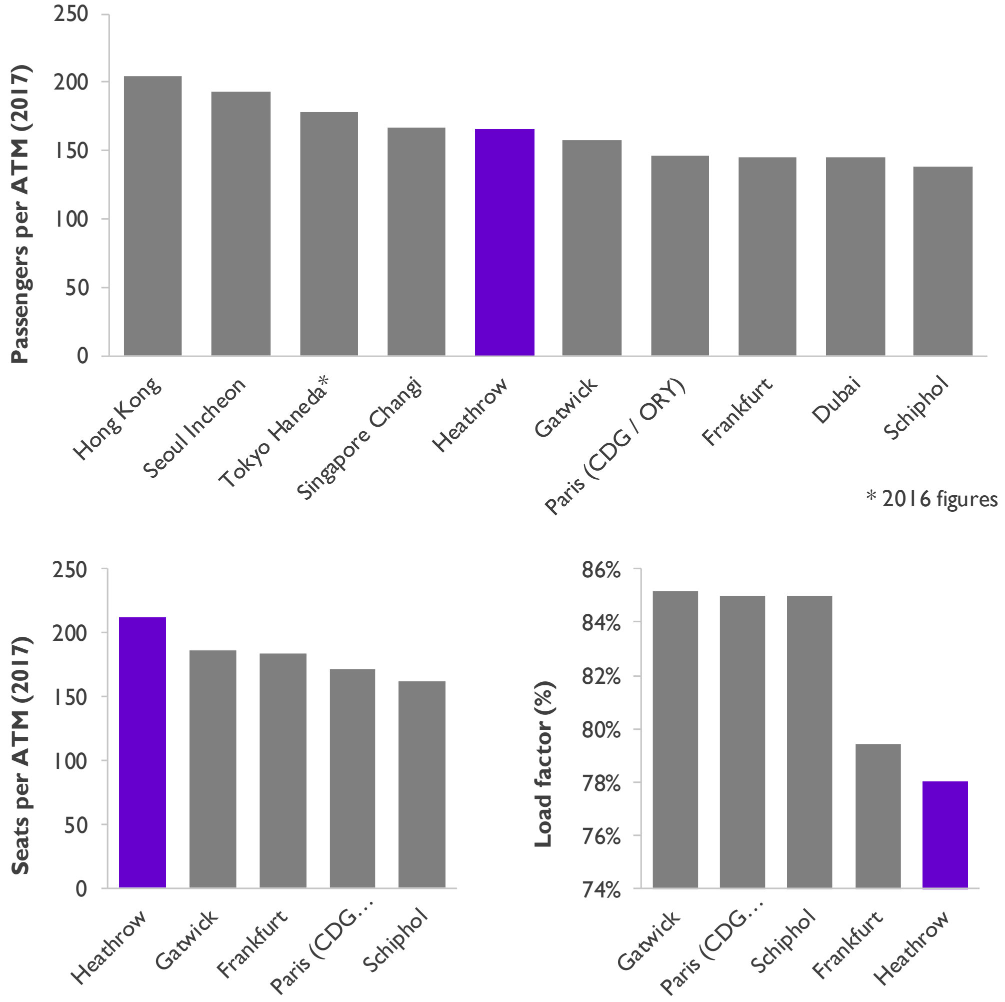
As a result, we have adjusted the load factor assumptions in our forecasts. We assume load factors grow at the rate assumed by HAL in 2018, but then continue to grow to 82.2% by 2021 (reducing the current gap with other airports by three quarters).

Benchmarking

To better understand the potential for further growth in passenger numbers, we have benchmarked average seats per movement, load factors, and average passengers per movement with other airports. As Figure 3.3 shows, average seat capacity at Heathrow is substantially larger than other hub competitors within Europe, though the average load factor is substantially lower than the same competitors.

Overall however, the average number of passengers per ATM is larger at Heathrow than at these airports. This suggests it may be reasonable to expect slower growth in passenger numbers going forward. However, when comparing average passengers per movement with a wider range of airports, Heathrow is benchmarked lower than some East Asian hub airports. This suggests there remains some potential for growth in passenger numbers within the ATM cap in the longer term.

Figure 3.3: Benchmark seats per ATM, load factors, passengers per ATM, 2017



Source: CEPA analysis of airport accounts and website data

3.2.3. Third-party forecasts and stakeholder views

There are other forecasts of airport traffic or passenger growth (all assume a negotiated withdrawal from the EU). These are presented in Figure 3.4.

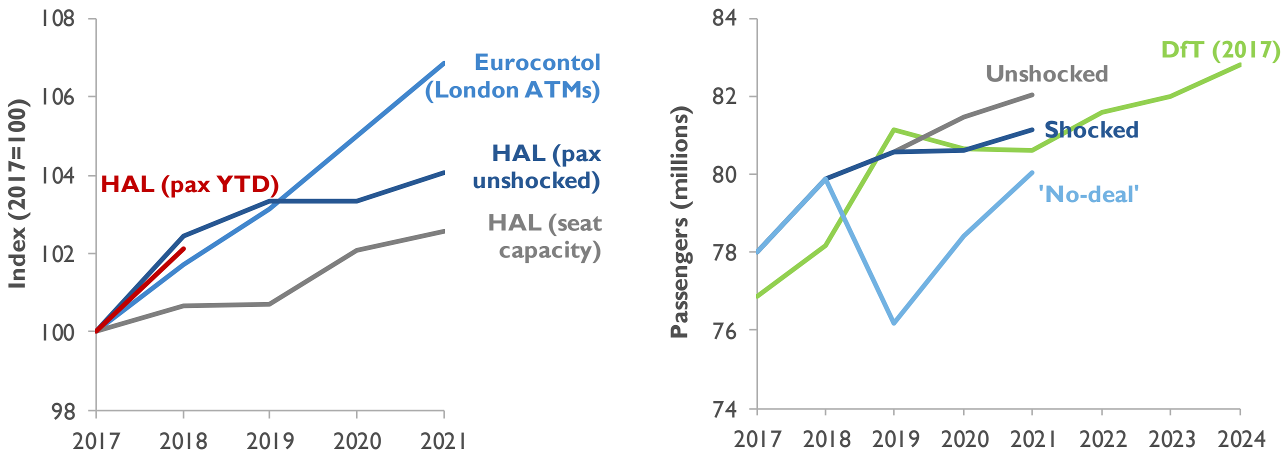
The Department for Transport's forecasts look at longer-term passenger growth across UK airports.[7] Whilst they are less helpful in understanding short term growth in passenger numbers, they are useful in determining the scope for continued growth within the ATM cap. As shown in the figure, growth in passenger numbers to 82 million is achievable in the medium term.

The Eurocontrol forecasts,[8] which are of air transport movements at the London airports, cannot strictly be applied to Heathrow as it is the subject of an ATM cap. However, they again illustrate the strength of demand for travel to and from London and through London airports.

[7] Department for Transport (2017) *UK aviation forecasts 2017*

[8] Eurocontrol (2018) *EUROCONTROL Seven-Year Forecast October 2018*

Figure 3.4: DfT, Eurocontrol and HAL forecasts 2017-2024



Note: The HAL passenger year to date figures for 2018 has been estimated by applying the annual growth in actual passenger numbers from January to September 2018 to the rest of 2018.

We also asked airlines who operate at Heathrow to comment on the scope for growth considering their plans. Discussions raised the following issues:

- Heathrow recently surpassed 80 million passengers over a 12-month period, which is significantly higher than the forecast number of passengers in 2019 under HAL's core scenario.
- Airlines also believe that whilst some carriers are downsizing from A380s, they expected to continue to see a general trend towards greater usage of the aircraft specifically at Heathrow, given capacity constraints.
- Heathrow has historically worked with airlines to improve load factors, which airlines would expect to continue as a way of increasing passenger numbers.

3.2.4. CEPA forecasts

In our forecasts, we have opted to:

- Assume a 'negotiated withdrawal' from the EU as our core scenario
- Keep HAL's assumptions on growth in ATMs and average seats per movement, though noting that the assumptions underlying these forecasts need better justification
- Assume stronger growth in load factors
- Assume a lower shock adjustment

The table below, compares the assumptions made by HAL with the assumptions we have used in our forecasts.

Table 3.3: Summary of key assumptions made in HAL and CEPA forecasts, 2018-2021

	2018	2019	2020	2021
ATMs [a, b]				
HAL & CEPA	474,570	474,455	476,934	477,222
Average seats per movement				
HAL & CEPA	213.5	213.6	215.4	216.3
Average load factors, %				
HAL	79.2%	79.9%	79.7%	79.9%
CEPA	79.2%	80.2%	81.2%	82.2%
Shock adjustment, %				
HAL	-	-	1.07%	1.07%
CEPA	-	1.00%	1.00%	1.00%

Source: HAL iH7 submission; CEPA analysis

Notes:
[a] The ATM estimates presented in this table are inclusive of cargo only ATMs. In the forecasts, cargo-only ATMs are assumed to remain constant.
[b] There is a discrepancy in the data for 2017 ATMs between what was presented in HAL's submission and what is in the CAA's airport statistics, which is currently being investigated. For our forecasts, we have used the figures included in HAL's submission.

The result of our adjustments are to increase passenger numbers by 3.8 million in 2020 and 3.5 million in 2021, as shown in the table below.

Table 3.4: Summary of HAL and CEPA forecasts

	2018	2019	2020	2021
HAL				
Passengers, un-shocked (millions)	79.9	80.6	81.5	82.0
Passengers, shocked (millions)	79.9	80.6	80.6	81.2
Passengers, no-deal EU exit (millions)	**79.9**	**76.2**	**78.4**	**80.1**
CEPA				
Passengers, un-shocked (millions)	79.9	80.9	83.0	84.4
Passengers, shocked (millions)	**79.9**	**80.1**	**82.2**	**83.6**

Source: HAL iH7 submission; CEPA analysis

Note: The forecasts highlighted in bold reflect the core scenario used to calculate revenue per passenger.

4. OPERATING EXPENDITURE

In this section, we review HAL's forecasts for operating expenditure (opex) from 2018 to 2021. We first consider their historic performance, then review the methodology and assumptions behind their forecasts, and finally present our own forecasts of HAL's efficient opex.

4.1. HAL PROPOSALS

Table 4.1 provides a summary of Heathrow's forecasts for opex for iH7, as presented in their submission.[9] HAL is proposing a 17.7% increase in opex between 2018 and 2021, in nominal terms, the majority of which (65%) is due to inflation. In real terms, as shown in Table 4.2, operating expenditure is forecast to increase by 5.8% over the same period.

HAL has then adjusted its opex estimates for expected growth using un-shocked passenger forecasts, rather than the no-deal EU exit passenger forecasts that it uses elsewhere in its submission. They have also included an allowance for frontier shift efficiency, applying a factor of 0.9% per annum.

Table 4.1: Summary of HAL operating costs (£m, nominal)

Cost Category	2018	2019	2020	2021
People	✂	✂	✂	✂
Operational	✂	✂	✂	✂
Facilities & maintenance	✂	✂	✂	✂
Rates	✂	✂	✂	✂
Utilities	✂	✂	✂	✂
Consultants & marketing	✂	✂	✂	✂
General Expenses	✂	✂	✂	✂
Intercompany	✂	✂	✂	✂
Total	**1,164.5**	**1,264.2**	**1,318.8**	**1,370.2**

Source: HAL iH7 submission

[9] Over the course of our review, we identified some small errors in HAL's production of the forecasts. Whilst we've corrected these errors when producing our own forecasts, Table 4.1 and Table 4.2 match what was in HAL's original submission.

Table 4.2: Summary of operating costs (£m, 2016 prices)

Cost Category	2018	2019	2020	2021
People	✂	✂	✂	✂
Operational	✂	✂	✂	✂
Facilities & maintenance	✂	✂	✂	✂
Rates	✂	✂	✂	✂
Utilities	✂	✂	✂	✂
Consultants & marketing	✂	✂	✂	✂
General Expenses	✂	✂	✂	✂
Intercompany	✂	✂	✂	✂
Total	**1,086.6**	**1,128.0**	**1,136.3**	**1,149.3**

Source: CEPA analysis of HAL iH7 submission

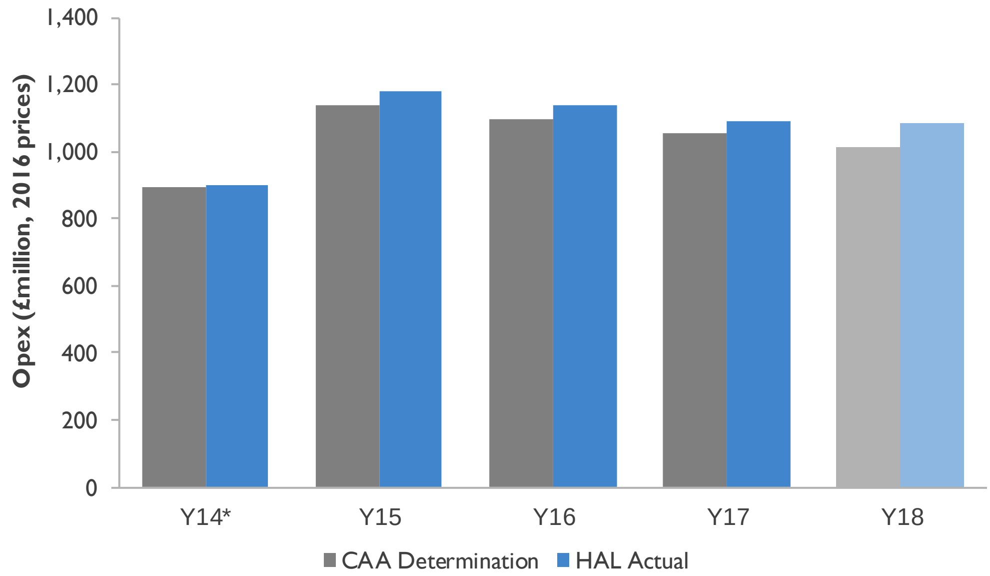
4.2. Review of HAL forecasts

4.2.1. Historic performance

Examining operational expenditure over a long time period reveals that HAL's opex grew by a compound annual growth rate of approximately 1% between 2008 and 2017 in real terms. Given the growth in passenger numbers, opex per passenger has declined by approximately 3% per annum in real terms over the same period.

HAL's total opex allowance over Q6/Q6+1 is £6.3bn (2016 prices), which has a falling profile over time due to the CAA's efficiency targets. In each of the individual years of Q6 so far, HAL's actual opex has been consistently similar to, although somewhat higher than, the CAA's determination. Total opex overruns were around 1% in 2014, 4% in 2015 and 2016, and 3% 2017.

Figure 4.1: HAL outturn opex against Q6 allowance (£m, 2016 prices)



Source: CEPA analysis of HAL regulatory accounts

Note: 2014 is 9 months of cost data due to a switch from financial year reporting to calendar year.

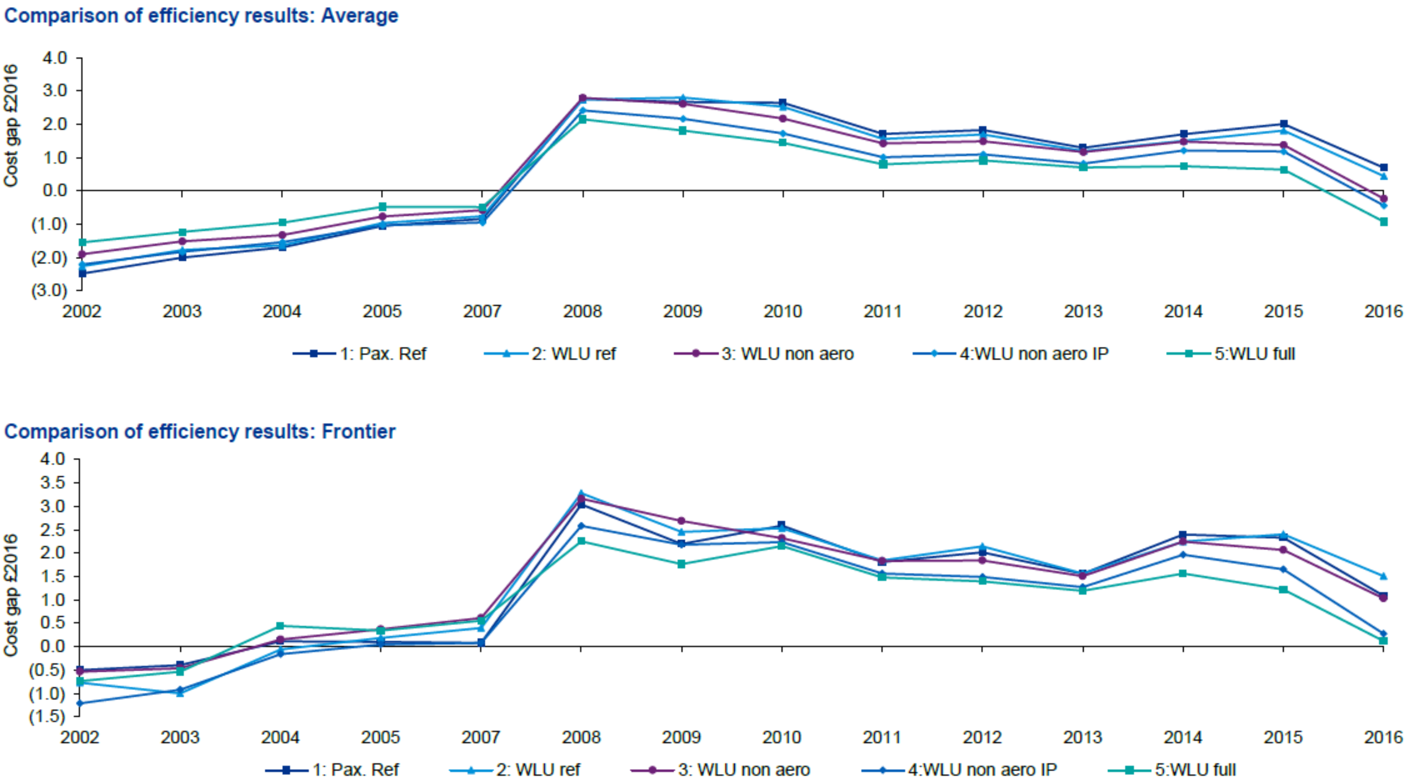
4.2.2. Baseline operating expenditure and catch-up efficiency

HAL uses its estimates for 2018 expenditure as the basis of its forecasts for 2019 to 2021. HAL argues this is an accurate reflection of an efficient cost base. To support this assumption, HAL refers to the results of a study from KPMG, commissioned by HAL. This study uses econometric benchmarking to compare Heathrow's opex efficiency performance against 28 international and UK airports (see Appendix A.1 for more information).

The results in Figure 4.2 show the cost gap between modelled efficient costs for HAL and both the average efficient level and the upper quartile (frontier) calculated in KPMG's work. In KPMG's preferred model (Model 4), HAL has been outperforming the average since 2016. The cost gap against the frontier reduced in 2016 but, HAL was still marginally underperforming against this benchmark. The underperformance against the average and frontier have been, in part, attributed to the opening of T5 in 2008 and a decline in passenger numbers between 2007 and 2010. KPMG concludes that the reduction of the efficiency gap is due to rising passenger numbers, increasing non-aeronautical revenues and decreasing opex per passenger levels. It is also noted that HAL's opex is relatively low considering its scale, passenger numbers and quantity of cargo handled.

In its initial submission for iH7, HAL conclude that the KPMG study indicates there is no scope for catch-up efficiency. HAL also undertook a comparison of outturn opex against the Q6 determination and determined that the efficiency challenge, set in 2013, has been achieved.

Figure 4.2: KPMG trend efficiency results



Source: KPMG Benchmarking Study

CEPA analysis

In our previous study for the CAA on the efficiency of Heathrow's operating expenditure, we identified some historic inefficiency. Whilst the KPMG study suggests that there has been some significant improvement in opex efficiency since our study, we would need to scrutinise their analysis further in order to confirm whether, as their study seeks to demonstrate, HAL is working from an efficient baseline.

We have reviewed the KPMG report, but we have not yet received the underlying dataset or full model specifications. It is not therefore possible for us to be fully assured of its methods or conclusions. Based on our understanding of the study, we have identified three main concerns regarding KPMG's methodology:

Econometrics. KPMG group the cost drivers, based on characteristics, and then model every possible permutation of the variable combinations from these groups (1,999 in total). These models are then narrowed down to a 'preferred' set through the application of quantitative and qualitative criteria. Without knowing the specification of the preferred model, or of other discounted models, is it difficult to assess the appropriateness of the chosen model specification.

Normalisation. KPMG undertakes a number of steps to normalise costs and revenues across airports in different countries, separating costs into 'core' and 'non-core' items and removing costs considered to be non-comparable. It adjusts for exchange rates, own-country inflation, and also for differences in factor input prices, e.g. 'other' costs are adjusted using purchasing power parity (PPP) ratios. Inflation and exchange rate adjustments are, in our experience, areas where errors of double-counting are relatively common, and ideally there should be some expert assurance that a consistent methodology has been applied.

Our main double counting concern regards adjusting for inflation in a consistent way, because relative inflation is picked up in a PPP correction. The PPP ratio converts market exchange rates to PPP exchange rates, but the KPMG report is not clear about whether point corrections or year-by-year corrections are used. Depending on which one is used, in conjunction with the approach taken to the inflation adjustments, could lead to double counting.

Non-aeronautical revenue as a cost driver. A large amount of HAL's non-aeronautical revenues come from parking, which is likely to have high capex requirements (building car parks, barriers, ticket detectors, and installing ticket machines) but relatively low opex (e.g. lift maintenance).[10] This may not be comparable to airports where a larger proportion of non-aeronautical revenue is derived from retail activities, which are likely to have higher associated opex, e.g. Hong Kong International.[11] In addition, such non-aeronautical revenue is likely to be sensitive to exchange rate fluctuations, particularly duty-free purchases.

Overall therefore, it is possible that the analysis 'over-accounts' for characteristics specific to Heathrow, capturing some of the inefficiency through normalisation adjustments or the choice of cost drivers. Such an approach would artificially reduce the estimated inefficiency at Heathrow.

To assess the validity of the conclusions of the KPMG study, we have updated some of the analysis conducted in our previous study into HAL's opex efficiency. We have compared the evolution of HAL's Real Unit Operating Expenditure (RUOE), a measure that includes all controllable operating costs, against comparator airports with similar characteristics. In our analysis, units are defined as passenger numbers (see A.2 for further details on our analysis).

In this section we show average annual productivity gains in RUOE over different time periods, showing the reduction in RUOE as a positive number. The chart below shows average annual RUOE productivity gains over 5-year time periods.

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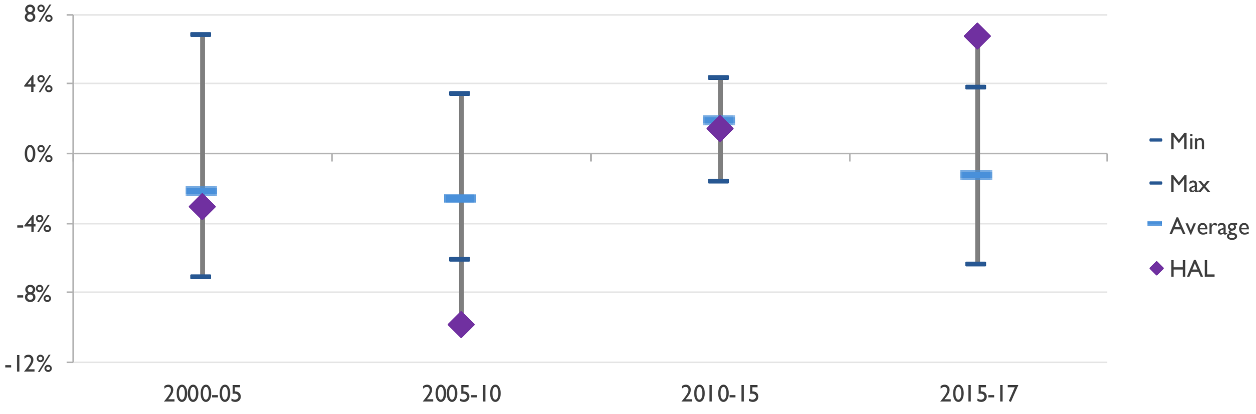
[10] HAL (2018) *Heathrow Airport Limited: Annual report and financial statements for the year ended 31 December 2017*, Page 12

[11] Hong Kong Airport (2018) *Hong Kong Airport Annual Report 2017/18*, Page 111

Figure 4.3: Average annual percentage reduction in RUOE, by time period (positive number = efficiency gain)*

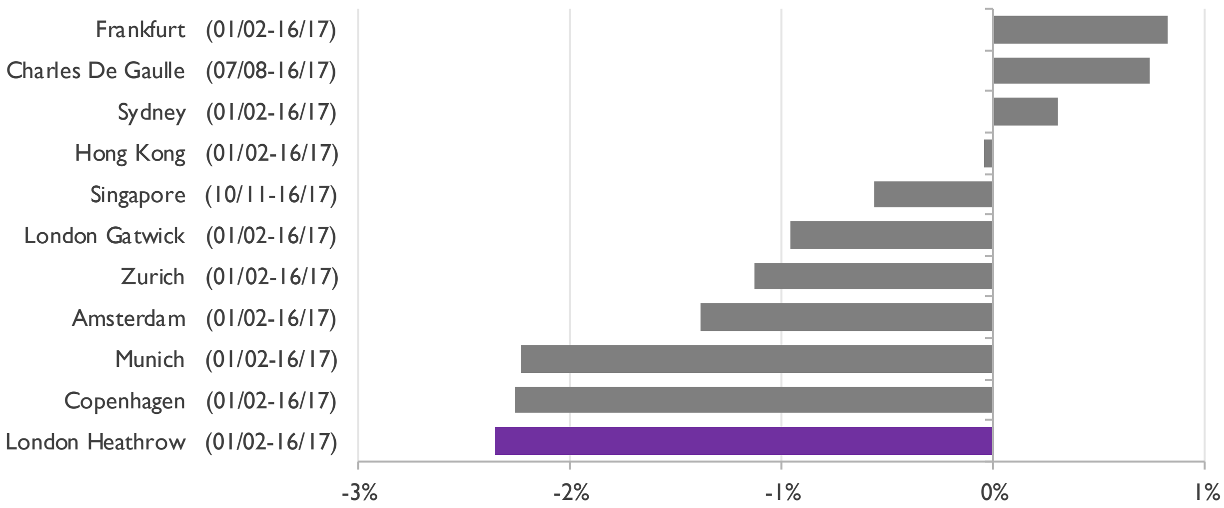


Source: CEPA analysis
**Geometric mean. The average of airports excludes HAL.*

The chart shows that between 2000 and 2010, HAL became increasingly less productive than comparator airports. In the period 2010-2015 however,[12] HAL had average annual operating productivity gains of around 1.5%, and other airports had a similar level of performance. In the last two years, HAL has made significant efficiency gains, becoming the top performer against comparator airports.

The chart below shows the average annual efficiency gains for airports for all years of available data (the same timeframe as used by KPMG).

Figure 4.4: Average annual percentage reduction in RUOE, 2001-2017 (positive number = efficiency gain)



Source: CEPA analysis

This chart above shows that most comparable airports experienced reduced productivity, i.e. real unit operating costs increased. The average change in unit operating productivity for the comparator airports is circa -0.7% per annum. However, HAL's unit operating productivity reduced by even more, at circa -2.4% per annum. This means that over the full period considered, HAL has become more inefficient relative to other airports, despite recent improvements in efficiency.

[12] The low performance by HAL in the period 2005-10 may have been due to increased security costs, which may have had a large impact on HAL due to it having a high proportion of international passengers.

Overall, the measures indicate that HAL became increasingly inefficient between 2000 and 2010 but has become more efficient in recent years. This supports the general narrative surrounding KPMG's analysis, but does not support its conclusion that HAL is now at the efficiency frontier.

We consider that there is likely to be continued scope for catch-up efficiencies despite the efficiency improvements made in recent years. In other words, the 2018 estimates used as a baseline for HAL's operating expenditure are likely to contain some continued inefficiency. Overall, HAL has been around 1.5% less efficient per year than the average comparator, over the same time period examined by KPMG.

We acknowledge that our analysis does not account for the fact that at the start of the time period examined, the airports in our comparator set are likely to have been at different stages in terms of efficiency, and as such may have had further scope for efficiency gains relative to Heathrow. Also, our RUOE analysis does not produce a precise value for the scale of HAL's catch-up efficiency potential.

Without access to the analysis underlying KPMG's study however, we do not believe it would be appropriate to use it as the sole basis for concluding that there is no scope for catch-up efficiency. We therefore propose to apply a catch-up efficiency factor of 0.75% per year, half of the difference between HAL and the comparator airports' average performance over the period we studied. This is applied to HAL's 2018 forecast and then used as our baseline from which our opex forecasts are calculated.

4.2.3. Growth from additional passengers

HAL has factored in the impact of changing passenger numbers on operating costs by using un-shocked, no-deal EU exit passenger forecasts and applying an elasticity of 0.4 to opex.[13] In other words, for each 1% rise in passenger numbers, opex is assumed to rise by 0.4%. HAL have identified this elasticity value as lying at the mid-point of the CAA's Q6 elasticity range of 0.3-0.5.

The increase in expenditure from higher passenger numbers has been applied to all opex categories, apart from rates and intercompany costs.[14] The un-shocked forecasts have been used to estimate the increase in opex as HAL believes this increase would be required regardless of whether there is a demand shock, and as a result the un-shocked forecasts are a more accurate driver than the shocked or EU exit forecasts.

CEPA analysis

CEPA's view on the passenger numbers forecast by HAL is discussed in Section 3. We do not believe there is any justification for using different passenger forecasts for different building blocks. Therefore, we use our own version of the shocked passenger forecasts in our analysis of Heathrow's operating expenditure.

In terms of the elasticity value applied to the passenger numbers, the CAA previously used a value of 0.3. We have conducted our own econometric analysis on opex elasticity, using data from a sample of UK and European airports, and found that a value of 0.4 is more appropriate. Therefore, we retain HAL's elasticity value in our analysis.

[13] HAL's original submission implied that it forecast future opex using passenger numbers from the un-shocked forecast shown in Figure 1.1. However, HAL have actually used an alternate variant of the no-deal EU exit scenario, which excludes the shock allowance but includes the impact of EU exit in 2020 and 2021.

[14] In its submission HAL did not apply the cost elasticity to facilities and maintenance costs in 2020 and 2021, though HAL have confirmed that this was an error.

4.2.4. Specific additional costs

HAL also identified several specific additional cost drivers commencing in 2019. Some of these costs are expected to be recovered through direct charges to airlines (and are therefore reflected in the non-aeronautical revenue forecasts):

- The majority of the costs recovered in revenue arise from the transfer of hold baggage screening to HAL from the airlines, which is anticipated to result in a £✂ increase in opex from 2019 onwards. This will be recovered through commercial arrangements with airlines. A further £✂, due to be recovered through Other Regulated Charges, is due to additional maintenance costs arising from the transfer of hold baggage screening.
- In 2018, HAL outsourced the operation of Heathrow Express (HEX) to Great Western Railway (GWR), this avoided the need for HAL to raise capital to finance renewal of the fleet. HAL states that the result is an increase in opex from 2019 onwards of £✂, related at least in part to funding GWR to finance the fleet replacement, which would often be done through a train leasing company
- HAL has also included additional resilience costs of £✂, relating to cyber security, increased counter terrorism costs and increased landside security and training.
- HAL note that the impact of the EU exit is hard to predict, but have included an additional £✂of opex in response. This additional expenditure is attributed to actions that HAL will be required to take in any potential EU exit scenario, where HAL predict there will be a requirement for additional staff at border control and for processing cargo.
- Additional costs arising from pre-expansion growth have been attributed to additional expenditure on, and compensation for, the local community and a change in status of some expansion costs relating to Category B. HAL has clarified that the inclusion of these cost in opex, instead of Category B capex, is a result of the CAA's rules for Category B and C expenditure. These additional costs are not classified as Category B and therefore, have been considered separately within opex.

  HAL states that growth can only happen at the airport if the impacts on the community are addressed and, therefore, aim to implement a 7-year plan to deliver the required noise insulation ahead of the new runway opening. The plan will commence in 2019 and slowly ramp up to 2024, reflected through the increasing level of noise insulation cost in iH7. The additional noise insulation costs have been included as opex although HAL consider that treating these costs as early Category C is more reasonable but that opex is not currently included in the Category C definition.

Table 4.3 below provides a breakdown of each component across the years included in the forecast.

Table 4.3: Summary of additional costs (£m, nominal)

Cost Category	2019	2020	2021
Additional costs recovered in revenue	✂	✂	✂
Additional HEX	✂	✂	✂
Additional Resilience	✂	✂	✂
Brexit	✂	✂	✂
Growth/Expansion	✂	✂	✂
Noise Insulation	✂	✂	✂
Total	✂	✂	✂

Source: HAL iH7 submission

CEPA analysis

Whilst HAL has provided a breakdown of the additional costs identified for each forecast year, it has yet to provide the calculations and evidence that would sufficiently justify their inclusion. Those costs that will subsequently be recovered via non-aeronautical charges (£✂relating to hold baggage screening), are included in our opex forecasts to ensure consistency with the non-aeronautical revenue forecasts. However, there is little explanation for how these estimates were put together and as a result, it is unclear whether they can be deemed to be an accurate estimate of the efficient cost of providing such services.

For the noise, resilience and EU exit preparation costs, we believe HAL has a strong narrative to justify the allowance of efficient costs in these areas. However, we have not been able to assess whether HAL's estimates of these costs are reasonable and efficient. In particular, it is not clear how the proposed increase in noise insulation expenditure compares with existing expenditure. Airlines noted that HAL already spent significant sums on noise insulation and had not presented any evidence to justify the scale of the increase. Because of this, we do not feel able to include noise insulation costs in our opex estimates until we have further evidence on the efficiency of the cost estimates.

With the remaining additional opex items, HAL has not provided sufficient explanation for their inclusion, or for the reasonableness of the cost estimates and as a result they have not been included in our estimates of future opex.

4.2.5. Frontier shift efficiency

In addition to assessing whether there was any need for HAL's opex allowance to be adjusted to reflect inefficiency in historic expenditure (catch-up efficiency), HAL also considered the potential for frontier shift efficiency (i.e. on-going efficiency improvements as would be expected in any competitive business).

HAL have taken a simple approach to estimating the potential for frontier shift efficiency, assuming that the historic different between RPI and CPI reflects on-going efficiency improvements at the firm. In other words, whilst the general cost of inputs relating to Heathrow's opex (materials, wages, etc.) are increasing by RPI, Heathrow is assuming this is offset by productivity improvements that mean the net impact on opex costs is closer to CPI. HAL believes that this is likely to overestimate their potential for frontier efficiency at the airport, due to Heathrow more closely reflecting a service business and therefore, having a lower efficiency potential than the average business.

CEPA analysis

No evidence was provided by HAL to suggest that its input costs increase by RPI and that their outturn costs increase by CPI. We believe that HAL has used these indices as broad-based assumptions for cost growth as a way of proxying on-going productivity improvements (i.e. frontier shift efficiency). However. there is little economic rationale behind this approach; the difference between RPI and CPI bears little resemblance to on-going productivity improvements in the wider economy. Without any evidence supporting HAL's approach, it is difficult to support their conclusions without considering alternate sources of evidence.

In our previous work on HAL's operating efficiency for the CAA,[15] our analysis indicated a frontier-shift efficiency value of up to 1%. We estimated this by doing a bottom-up assessment of HAL's frontier shift efficiency potential, considering historic productivity growth in various industrial sectors across Europe, and applying it to HAL's cost structure (e.g. considering productivity improvements in HAL's IT costs by looking at historic productivity improvements in the IT sector). Our estimate of up to 1% compares with the OBR's estimate of 1.2% per annum productivity growth in the wider economy.[16]

Whilst we have doubts about HAL's methodology, its estimate for frontier-shift efficiency of 0.9% per annum is broadly in line with our previous estimates. We therefore use the same frontier-shift efficiency value as HAL in our forecasts. This, combined with the discussion above regarding catch-up efficiency, results in an annual efficiency factor of 1.65% being applied when calculating CEPA's opex forecasts.

4.3. CEPA FORECASTS

Based on the analysis above, we adjusted HAL's methodology to establish a forecast which we consider to be more analytically robust. The result of our adjustments is a decrease in HAL's forecast operational expenditure, as shown in the tables below.

[15] CEPA (2017) *Review of efficiency of operating expenditure of Heathrow Airport.*

[16] OBR (2018) *Fiscal sustainability report – July 2018.* Box 3.1: Productivity growth in the long-term

Table 4.4: Summary of CEPA operating costs forecast (£m, 2016 prices)

Cost Category	2018	2019	2020	2021
People	✂	✂	✂	✂
Operational	✂	✂	✂	✂
Facilities & maintenance	✂	✂	✂	✂
Rates	✂	✂	✂	✂
Utilities	✂	✂	✂	✂
Consultants & marketing	✂	✂	✂	✂
General Expenses	✂	✂	✂	✂
Intercompany	✂	✂	✂	✂
Total	**1,078.1**	**1,080.1**	**1,074.1**	**1,064.7**
HAL Forecast	**1,086.6**	**1,128.0**	**1,136.3**	**1,149.3**
Difference	**-8.5**	**-47.9**	**-62.2**	**-84.6**
CEPA Opex per passenger (£)	13.6	13.5	13.1	12.7
HAL Opex per passenger (£)	13.6	14.8	14.5	14.3

Source: CEPA analysis of HAL iH7 submission

5. NON-AERONAUTICAL REVENUES

In this section we review HAL's forecasts for non-aeronautical ('non-aero') revenue growth from 2018 to 2021 and propose our own forecast adjustments where we have identified a more appropriate approach.

5.1. HAL PROPOSAL

Non-aero revenue is split into six categories covering retail (duty free, catering, bureaux de change and other specialist shops), services (advertising, car rental and car parking), property (rental income from property or office space), rail (Heathrow Express (HEX)), and other regulated or miscellaneous charges.

Table 5.1 summarises HAL's actual and forecast non-aero revenues over the period 2014 to 2021. HAL has generally followed a forecasting approach which is consistent with other areas of its plan with some minor aspects which are specific to non-aero revenues. These are summarised as follows:

- Retail, services, property and rail income were adjusted for the impact of other macro-economic (mainly exchange rate) effects under HAL's 'no deal' Brexit scenario.
- Retail, services and rail income were adjusted for the elasticity of income to increased passenger numbers.
- Rail income is reduced from December 2019 to reflect the introduction of Crossrail services to Heathrow which takes passengers away from HEX services.
- An overall 'management stretch' factor of 1% per annum is applied to reflect HAL's historic performance with respect to growing retail revenues.
- ORCs are adjusted in 2019 to account for additional hold baggage screening and baggage facilities & maintenance costs. This is partly offset by a reduction in ORCs due to the impact of the specific 2019 pricing schedule now in place.

Table 5.1: HAL actual and forecast non-aeronautical revenues, nominal (£m)

	2014	2015	2016	2017	2018[f]	2019[f]	2020[f]	2021[f]
ORCs	231.9	238.9	232.0	239.6	246.1	✂	✂	✂
Retail	369.9	399.7	433.8	468.4	498.0	✂	✂	✂
Services	153.1	168.7	178.6	190.2	203.5	✂	✂	✂
Property	116.4	121.1	126.4	129.7	131.8	✂	✂	✂
Rail	128.8	131.5	133.7	136.5	136.4	✂	✂	✂
Other	7.6	6.0	3.6	3.9	1.4	✂	✂	✂
Total revenue	**1,007.7**	**1,065.9**	**1,108.1**	**1,168.4**	**1,217.2**	**1,259.5**	**1,296.0**	**1,324.8**

Source: HAL iH7 submission

Table 5.2: HAL forecast non-aeronautical revenues, 2016 prices (£m)

	2014	2015	2016	2017	2018[f]	2019[f]	2020[f]	2021[f]
ORCs	237.6	243.1	232.0	231.3	229.6	✂	✂	✂
Retail	379.0	406.7	433.8	452.2	464.7	✂	✂	✂
Services	156.9	171.6	178.6	183.6	189.9	✂	✂	✂
Property	119.3	123.2	126.4	125.2	123.0	✂	✂	✂
Rail	132.0	133.8	133.7	131.8	127.3	✂	✂	✂
Other	7.8	6.1	3.6	3.8	1.3	✂	✂	✂
Total revenue	**1,032.4**	**1,084.5**	**1,108.1**	**1,128.0**	**1,135.8**	**1,123.9**	**1,116.6**	**1,111.3**

Source: CEPA analysis of HAL iH7 submission

In summary, HAL is forecasting a growth in non-aeronautical revenues between 2018 and 2021 of 8.8% in nominal terms, but in real terms it is forecasting a reduction of 2.2% over the same period. This is driven by lower rail revenues due to the loss of Heathrow Express (HEX) passengers once Crossrail commences services to Heathrow Airport. This is partly offset by an increase in 'Retail', 'Services' and 'Other' revenues.

5.2. Review of HAL forecasts

There are a number of areas of HAL's proposal where we disagree with their assumptions and analysis, which have a significant impact on the forecast. These are explored in the sub-sections below.

Macroeconomic assumptions

Under HAL's Brexit scenario it forecasts a deterioration in the GBP-USD and GBP-EUR exchange rates during 2019 and 2020, and an increase in RPI inflation. The impact of these macroeconomic factors on non-aeronautical revenue is shown in Table 5.3 below.[17]

Table 5.3: Impact of macroeconomic factors on HAL non-aero revenues under Brexit scenario, from 2018 estimates (£m, nominal)

	2019	2020	2021
Retail	24.8	-19.8	-20.2
Services	24.8	5.0	-15.2
Property	1.2	1.2	-1.5
Rail	-4.3	-7.3	-8.1
Total impact	**0.0**	**0.0**	**0.0**
CEPA's assumed impact	**24.8**	**5.0**	**-15.2**

Source: HAL 'Retail Macro summary.xls' and email from HAL to CEPA dated 11 December 2018

The results show (somewhat counterintuitively) an increase in retail income in 2019 followed by a large fall in 2020 and 2021. The increase in income is driven largely by the deterioration of the GBP, making retail spending more attractive for international passengers in 2019, with the GBP's recovery in 2020 and 2021

[17] The figures presented Table 6.3 reflect updated figures and supporting commentary from HAL received by email on 11 December 2018. These figures were not included in HAL's document 'iH7 initial submission v2'.

making retail spending less attractive. The services and property income forecasts are also affected, but the impacts are less pronounced.

In its submission, HAL also presents a set of alternative forecasts showing the incremental effect on non-aero revenues under a 'negotiated withdrawal' scenario, as shown in Table 5.6. These assume a much steeper decline in non-aero revenues, arising from a relative strengthening of the GBP.

Table 5.4: Impact of macroeconomic factors on non-aero revenues under 'negotiated withdrawal' scenario, from 2018 estimates (£m, nominal)

	2019	2020	2021
Retail	-16.0	-23.8	-26.7
Services	-1.2	-1.8	-1.7
Property	-2.2	-4.3	-5.6
Rail	0.0	0.0	0.0
Total impact	**-19.4**	**-29.9**	**-34.0**
CEPA's assumed impact	**0.0**	**0.0**	**0.0**

Source: HAL iH7 submission

We reviewed HAL's estimates of the impact of its exchange rate assumptions on retail revenue and assessed the impact of using our own exchange rate assumptions with HAL's proposed elasticities.[18] The impact of our alternate assumptions are shown in Table 5.5 below.

Table 5.5: YoY impact of macroeconomic factors on retail revenues (£m, nominal)

	2019	2020	2021
HAL exchange rate assumptions			
Duty- and Tax-Free Income	10.2	3.6	-4.2
Specialist Shops Income	20.0	3.8	-12.6
Catering Income	-4.5	-2.4	1.1
Bookshops	-0.8	0.1	0.6
(1) Total retail impact	**24.8**	**5.0**	**-15.2**
CEPA exchange rate assumptions			
Duty- and Tax-Free Income	1.5	2.8	3.9
Specialist Shops Income	2.6	3.5	2.7
Catering Income	-0.8	-1.9	-3.2
Bookshops	0.0	0.3	1.0
(2) Total retail impact	**3.3**	**4.9**	**4.7**
Difference (2) – (1)	**-21.5**	**-0.1**	**19.8**

Source: CEPA analysis of 'Retail Macro summary.xls'

However, since we have not had access to key pieces of supporting evidence – specifically, the econometric model which HAL has used to estimate the sensitivity of retail revenues to changes in key exchange rates –

[18] We used the OBR's market-derived assumptions on the USD-GBP and EUR-GBP exchange rates from the *Economic and fiscal outlook – October 2018*

we have not incorporated the revenue impacts in our forecast. We also consider that HAL's commentary to support the proposed impact of macroeconomic factors on services and property income lacked sufficient detail. Therefore, we have removed all estimated impacts on revenue from macroeconomic variables.

Impact of passenger growth

To forecast the impact of passenger growth in future years, HAL assumes that retail, services and rail income have elasticities (with respect to changes in passenger numbers) of 0.8, 0.4 and 0.8 respectively. We understand that these forecasts have not been analytically derived, but instead are assumptions based on HAL's judgement. The elasticity of 0.8 is based on the view that the marginal passenger is less valuable (in terms of non-aero revenue) than the average passenger, and that not all retail revenue is driven by passenger numbers, though no justification is offered for this. HAL also argues that there is a lower ceiling on service revenues, e.g. because there is a limit on the availability of car parking spaces.

We tested this assumption using outturn data on passenger numbers and commercial income from HAL's regulatory accounts (data on commercial revenues are available back to 2008) and the historical data (back to 2014) provided by HAL to support its iH7 submission. Our regression analysis showed that retail, services and rail income all exhibit an elasticity with respect to passenger numbers in excess of 1. This estimate can be considered both the elasticity of non-aeronautical revenue with respect to passenger growth and the estimate of 'management stretch', which is covered in further detail later in this section.

Our results lead us to conclude that whilst HAL's elasticities for retail and rail income could be considered slightly conservative, there is little evidence to justify an elasticity for service income significantly below 1. In our forecast of non-aero revenues therefore, we apply an elasticity of 0.8 to HAL's shocked forecast of passenger numbers as part of the calculation of retail, service and rail revenues. The impact of this approach compared to HAL's is shown in Table 5.6 below.

Table 5.6: Impact of passenger growth forecasts on HAL non-aeronautical revenues, nominal (£m)

		2019	2020	2021
Retail	HAL	- 18.5	12.0	9.2
	CEPA	5.0	11.5	8.1
Services	HAL	- 3.8	2.5	1.9
	CEPA	2.0	4.7	3.3
Rail	HAL	- 5.1	3.0	1.8
	CEPA	1.4	3.2	2.2
Total	**HAL**	**- 27.4**	**17.5**	**12.9**
	CEPA	**8.4**	**19.4**	**13.6**

Source: CEPA analysis and HAL iH7 submission

Introduction of Crossrail services

To support its submission, HAL provided a report by Laser Strategy Ltd (with modelling and analysis provided by Jacobs) which outlined the optimal future price of HEX services given the potential impact of competing Crossrail services from December 2019. The Laser/Jacobs analysis concludes that HEX should reduce fares to a price around £✂to maximise yield, based on a modelled reduction in passenger numbers of ✂ in 2019, ✂ (cumulative) in 2020 and ✂ (cumulative) in 2021.

HAL estimate that the reduction in price and passenger volumes will reduce HEX revenues by ✂ by 2021, though we note there is an arithmetic error in the calculation that means this is an overestimate. We have confirmed with HAL that this is an error and show both HAL's original estimate and the corrected calculation, in Table 5.7 below.

Table 5.7: Percentage reduction in HEX revenue due to competition from Crossrail services

		2019	2020	2021
Price reduction		✂	✂	✂
Volume reduction		✂	✂	✂
Combined reduction	**Original**	✂	✂	✂
	Corrected	✂	✂	✂

More significantly, in a written statement to Parliament on 10 December 2018, the Government confirmed that the opening of Crossrail has been delayed and that an extensive review of the remainder of the programme is currently being undertaken. [19] The emerging picture suggests an opening in 2019 is increasingly unlikely.

Although it is likely that Crossrail services will serve Heathrow Airport during the iH7 price control, it is uncertain exactly when new services will be introduced and therefore the consequential impact on HEX revenues is also uncertain. Therefore, we consider that it would be appropriate to remove the estimated impact of Crossrail services on HEX revenues until the government has provided greater clarity on the revised opening date, as shown in Table 5.8 below.

Table 5.8: Impact of recalculated impact of Crossrail on HEX revenues compared with 2018 estimates, nominal (£m)

	2019	2020	2021
Impact on HAL revenue	✂	✂	✂
HAL forecast	✂	✂	✂

Source: CEPA analysis and HAL 'iH7 initial submission: CAA submission reference'

Other step changes in non-aeronautical revenues

HAL's submission did not include any step changes in non-aeronautical revenue beyond the impact of Crossrail and from services charged directly to airlines. However, discussions with airlines identified a number of new hotels that have recently opened or are due to open, which we would expect to result in additional non-aeronautical revenue. For example, two hotels opened up in Terminal 4 in the second half of 2018 with a further two hotels due to open in 2019 and 2021.

In the time available we have not been able to separately assess the impact of these additional hotels and any other capital improvements with revenue implications. Instead, we have adjusted the management stretch factor (discussed in the following section) to reflect the additional revenue we would expect from new or improved revenue streams.

[19] Department for Transport (2018) *Crossrail update, 10 December 2018.*

Management stretch

HAL's forecast includes a "management stretch" factor to account for recent above inflation growth in non-aero revenues and strong recent performance in retail revenues per passenger relative to other European airports. To reflect this, HAL includes an additional 1% annual (above inflation) revenue growth in its retail, services, rail and property revenue.

We believe this so-called stretch factor is insufficiently challenging. Between 2008 and 2017, HAL has more than doubled commercial revenues in outturn prices, equating to an average annual growth rate of 5% per annum in real terms. Part of this increase is due to an increase in passenger numbers (which grew at c2% per annum over the same period), but this is not the full story. We think a more plausible management stretch factor lies in a range between 1% to 3% per annum in real terms. Our forecasts include a 2% annual management stretch assumption: an assumption we consider to be appropriate since it lies in the middle of the range.

Table 5.9: Impact of management stretch factor on non-aeronautical revenues, nominal (£m)

		2019	2020	2021
Retail	HAL	5.0	10.1	15.6
	CEPA	10.3	21.2	32.9
Services	HAL	2.0	4.1	6.3
	CEPA	4.2	8.7	13.4
Property	HAL	1.3	2.6	4.0
	CEPA	2.7	5.6	8.6
Rail	HAL	1.4	2.7	3.8
	CEPA	2.8	5.8	9.0
Total	**HAL**	**9.7**	**19.5**	**29.7**
	CEPA	**20.0**	**41.2**	**63.9**

Source: CEPA analysis of HAL iH7 submission

5.3. CEPA FORECASTS

Based on the analysis which is explained in Section 5.2 above, we have adjusted HAL's methodology to establish a forecast which we consider to be more analytically robust, making the following key adjustments:

- We removed the macroeconomic impacts on revenue which HAL included to account for the macroeconomic impacts of a 'no deal' EU exit scenario;
- We estimated the impact of the un-shocked passenger forecast on retail, services and rail revenue, as per Section 5.2 above;
- We recalculated the impact of Crossrail services on HEX income to address a miscalculation in HAL's forecast; and
- We revised the "management stretch" factor to account for a larger 2% increase in retail, services, property and rail income.

The result of our adjustments is an increase in HAL's forecast non-aeronautical (nominal) revenues of 2.1% in 2020 and 4.8% in 2021, as shown in Table 5.10 below.

Table 5.10: CEPA forecast of non-aeronautical revenues, 2016 prices (£m)

	2018	2019	2020	2021
Retail	✂	✂	✂	✂
Services	✂	✂	✂	✂
Rail	✂	✂	✂	✂
Property	✂	✂	✂	✂
ORCs	✂	✂	✂	✂
Other	✂	✂	✂	✂
CEPA forecast	**1,135.4**	**1,168.9**	**1,204.6**	**1,235.5**

Source: CEPA analysis of HAL iH7 submission

6. CAPITAL EXPENDITURE AND REGULATORY DEPRECIATION

In this section, we consider HAL's proposals for capital expenditure (capex). We have not reviewed estimates of capex at this stage, as the numbers provided are highly provisional with little evidential underpinning. We therefore discuss HAL's ability to deliver on the scale of capex they currently estimate.

6.1. HAL PROPOSALS

HAL's proposals for capex, summarised in Table 6.1, are split into estimates for runway expansion related capex and business as usual capex. HAL have indicated that the expansion estimates, Category B and Category C costs,[20] are preliminary with further updates expected in December 2018 and April 2019. They have also indicated that the estimates for BAU capex are provisional, with both the scale of the estimates and the projects to be delivered within the estimated cost, subject to change.

Table 6.1: Heathrow capital expenditure, 2018-2021 (£m, nominal)[21]

	2018	2019	2020	2021
Baggage		50	60	70
Passenger Experience		90	160	220
Airport Resilience		30	50	70
Asset Management		110	200	340
Q6 Rollover		300	100	50
Run the Airport Sub-Total		**580**	**570**	**750**
Masterplan		**110**	**340**	**400**
Category B		198	80	39
Category C		161	403	1,031
Expansion Sub-Total		**359**	**483**	**1,070**
Total	**899**	**1,049**	**1,393**	**2,220**

Source: HAL iH7 submission, HAL expansion CAT B budget 2019

The BAU capex is split into two main types of activities:

- **Masterplan**, covering enhancements to the airport that would enable continued passenger growth within a two-runway airport.
- **Run the Airport**, covering projects that are related to ensuring the efficiency of existing operations.

The scale of planned BAU capex is based on what HAL believe is within its capacity to deliver during the period from 2019 to 2021 and it has constructed a broad cost envelope accordingly. The estimate includes

[20] The CAA has defined *Category B* costs as capacity expansion costs that are, in general, incurred by HAL after the Government policy decision on the location of new capacity (i.e. 25 October 2016) and are associated with seeking planning permission. *Category C* costs are defined as construction costs incurred by an airport operator. These costs will typically be incurred after planning permission is granted and up to entry-into-operation.

[21] Following HAL's original iH7 submission, HAL revised their estimates for Category B expenditure, which are reflected in this table.

HAL's view on the specific projects it will deliver within this envelope, all of which are at varying levels of maturity. However, they have indicated that the specific projects within this envelope will evolve over time as each individual project progresses through the existing capex governance process.

With the exception of the Q6 rollover line item, most of the cost estimates within *Run the Airport* and *Masterplan* provide only a broad indication on the relative scale of capex by different types of activity. However, HAL has indicated that these are very high-level estimates and are likely to change as individual projects progress through the governance process. HAL intends to use the governance process to agree with airlines which specific capital projects to progress and to inform airlines of evolving cost estimates for individual projects. HAL has stated that the projects due to begin in 2019 have largely been confirmed and by the April 2019 update, planned projects for 2020 should also have been confirmed.

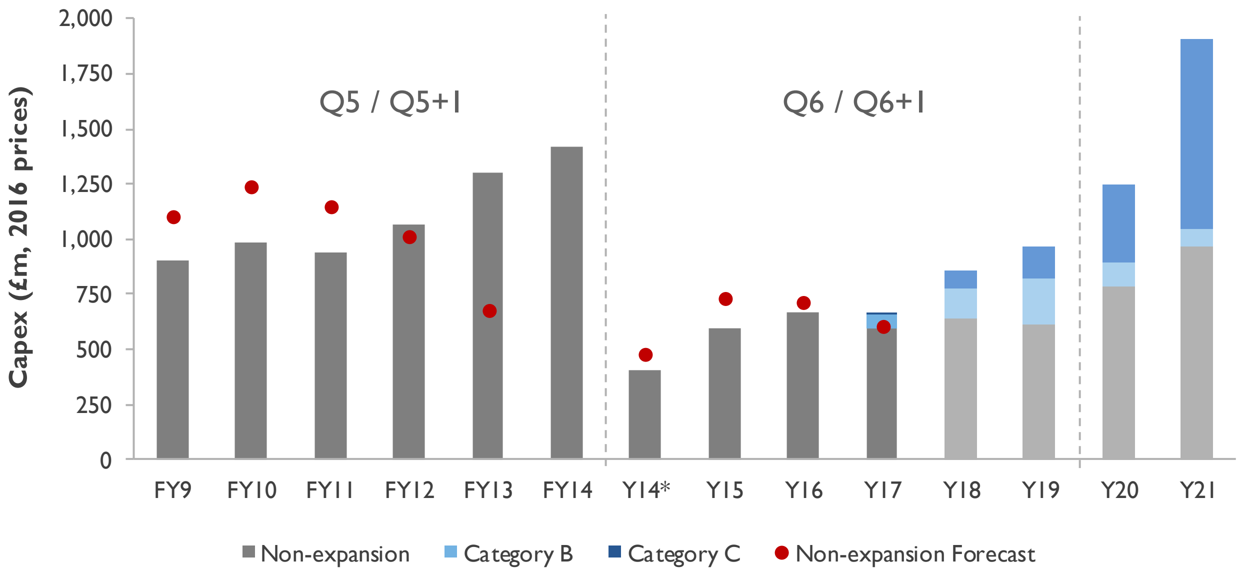
The Q6 Rollover estimates relate to projects that have already been approved, i.e. projects that have progressed through Gateway 2 of HAL's project gateway process. They include both projects that have started and are continuing into iH7, as well as projects that were delayed from Q6 into the iH7 period. Examples of the former include hold baggage screening and the Kilo taxiway works.

6.2. CEPA VIEW OF HAL BAU CAPEX ESTIMATES

As we have not had sight of the projects currently included within the capex estimates, it is not possible for us to assess the suitability of the portfolio or the appropriateness of cost estimates. Additionally, as HAL state the projects within the portfolio will be subject to change, any assessment we undertake on the current portfolio of projects may bear little resemblance of the actual portfolio HAL proceeds with.

We have reviewed historic capital expenditure to assess whether the overall envelope is consistent with historic patterns in deliverability of capital projects. As can be seen in Figure 6.1, HAL's forecast non-expansion capital expenditure in 2019 is of a similar scale as seen during Q6. This rises substantially however in 2020 and 2021, to levels not seen since Q5 with the construction of Terminal 2.

Figure 6.1: Historic and forecast capex at Heathrow (£m, 2016 prices)



Source: CEPA analysis of HAL iH7 submission and HAL regulatory accounts

Figure 6.1 also shows that HAL has consistently underspent its capex forecasts during the early years of a price control. The ramping up of capex during Q5 suggests HAL may be able to increase capital expenditure during iH7 at the scale anticipated. Our discussions with airlines did highlight however that the scale of capex (both expansion and non-expansion) was higher than experienced before at Heathrow. We believe HAL's ability to deliver such an increase in capex will depend on HAL's project pipeline; unless the planning of capital projects within the pipeline is relatively mature, it may be difficult for HAL to deliver the scale of capex estimated.

HAL has stated its view that the proposed approach to capex taken in the iH7 submission is an evolution of the process initially established for Q6. However, we believe this is a significant step change in the regulation of capex; the scrutiny of capex plans prior to the start of a price control determination is almost entirely removed. If this new approach is accepted by the CAA, we believe there is a greater need for closer monitoring of HAL's plans through the capex governance process and we expect that CAA would wish to take views from the airlines on the impact of starting the new control without an agreed list of projects to be delivered.

In particular, we believe there needs to be more scrutiny of the appropriateness of the overall capex envelope to ensure that it is set with reference not only to deliverability and affordability, but also with reference to the specific projects within the envelope. At some point in the regulatory process, the CAA will need to scrutinise whether the envelope as a whole delivers in the interests of users, both by prioritising user needs and by ensuring value for money.

Also, as identified in our previous review of the capex governance process at Heathrow, there is a risk that HAL responds to cost pressure in the capex programme through de-scoping of certain projects rather than focusing on efficient delivery of the programme. There is also a risk that HAL prioritises projects that may not be the highest priority for users, e.g. projects which produce opex savings over projects that produce greater benefits for airport users. We therefore recommend closer monitoring of the prioritisation of projects and the progression of individual projects through the governance process.

6.3. CEPA CAPEX FORECASTS AND REGULATORY DEPRECIATION

As we have not been able to produce an independent forecast of capex, we use HAL's forecasts merely as placeholders when calculating the revenue requirement and regulatory depreciation. In line with the approach taken in CAP1658, we have used HAL's capex forecasts for 2020 and 2021 only and have allowed all capex (expansion and non-expansion) to be added to the RAB with a return and with immediate depreciation. Whilst this is inconsistent with the CAA's policy on the regulatory treatment of Category B costs, it allows for direct comparability with the CAA's estimate of the underlying revenue requirement in CAP1658.[22]

[22] The CAA does not yet have a policy on the regulatory treatment of Category C or early Category C expenditure.

7. COST OF CAPITAL

In this section, we present HAL's proposals for the cost of debt and present the weighted average cost of capital (WACC) assumptions used in our analysis for calculating the revenue requirement. It should be noted that reviewing HAL's cost of capital is not within the scope of our work, but we have to include it in order to calculate the revenue requirement. We therefore draw on PwC's work for the CAA and the assumptions used by the CAA in its CAP1658 consultation document.

7.1. CAA PROPOSALS IN CAP1658

In CAP1658 the CAA undertook a technical reset of the WACC, adjusting it to reflect changes in the rate of corporation tax, and incorporating a revised assumption around the cost of new debt. The other elements of the WACC such as the post-tax cost of equity and gearing ratio, have not been updated.

Corporation tax – For the Q6 price control, the rate of corporation tax was assumed to be 20.2%. Since then, the rate has reduced to 19% and is currently expected to reduce further to 17% on 1st April 2020.[23] This gives a blended tax rate of 17.3% during the iH7 period. As the Q6 post-tax cost of equity was 6.84%, updating the tax allowance leads to a pre-tax cost of equity of 8.27% (falling from 8.57%)

Cost of debt – The CAA assumed the cost of new debt to be 0.25% (down from 2.5% assumed in Q6). No other elements of the cost of debt were updated, leaving a pre-tax cost of debt of 2.54% (down from 3.21%).

WACC – The overall impact of the CAA's changes was to reduce the pre-tax WACC estimate from 5.35% to 4.83%.

7.2. HAL PROPOSALS

HAL have opted to update all the elements of the cost of debt in their submission, estimating it to be 2.90%,[24] compared with 3.21% for Q6. Table 7.1 summarises the calculations underlying the revised estimate, and how it compares with the estimated cost of debt for Q6.

Table 7.1: Cost of debt calculation for Q6 (CAA) and iH7 (HAL)

	Q6		iH7	
	Cost	%	Cost	%
Pre-Q6 embedded	3.30%	(70%)	3.30%	(63% = 70% x 90%)
Q6 embedded	2.50%	(30%)	1.12%	(27% =30% x 90%)
iH7 new debt			0.87%	(10%)
Liquidity allowance	0.15%		0.30% (+0.135%)	
Cost of Debt	**3.21%**		**2.90%**	

Source: CEPA analysis of HAL iH7 submission

HAL has taken a somewhat novel approach to estimating the cost of embedded debt, using separate estimates for the cost for debt issued pre-Q6 and for debt issued during Q6. The estimated cost of debt

[23] https://www.gov.uk/government/publications/rates-and-allowances-corporation-tax/rates-and-allowances-corporation-tax

[24] HAL's original submission had a figure of 2.82%, though this has been confirmed with HAL as a calculation error

issued before the start of Q6 has been taken from what was assumed during the Q6 determination (3.30%). The ratio between pre-Q6 debt and Q6 debt has also been taken from what was assumed during the Q6 determination (70% to 30%). HAL's method for estimating the actual cost of debt is outlined in Table 7.2 and described below.

Table 7.2: Cost of pre-Q6 embedded debt and iH7 new debt calculation (HAL)

	Pre-Q6 embedded	iH7 new debt
Market basis	3.71%	3.25%
Forward adjustment		0.20%
New issue premium / halo adjustment	0.15%	0.15%
Index-linked debt premium adjustment	0.09%	0.09%
Nominal cost of debt	**3.95%**	**3.69%**
Inflation assumption	2.80%	2.80%
Real cost of debt	**1.12%**	**0.87%**

Source: CEPA analysis of HAL iH7 submission

To estimate the actual cost of debt issued during Q6, HAL started by estimating the market nominal cost of debt during this period. For this, they have taken the daily average of the iBoxx non-financials 10+ years A/BBB index for the period from 1st January 2014 to 21st December 2017, which broadly aligns with the Q6 period. To that, they have added an adjustment for a 'new issue premium' of 0.15%, as well as an adjustment for index-linked bonds of 0.09% (a premium for index-linked bonds of 0.3% and assuming 30% of bonds are index-linked). HAL then assume an inflation rate of 2.8%, leaving a real cost of debt of 1.12%.

HAL assume that the proportion of new debt during iH7 will be 10%. To estimate the cost of the new debt (summarised in Table 7.2), they have taken a similar approach. The market nominal cost of debt has been estimated using the iBoxx index for the period from 1st January 2018 to 30th September 2018. This has been adjusted to reflect the implied forward gilt curve, and then adjusted further to reflect a new-issue premium and a premium for index-linked bonds. Assuming an inflation rate of 2.8% leaves a real cost of new debt of 0.87%.

For the overall cost of debt, HAL assume a liquidity allowance of 0.3% (compared with 0.15% used in Q6). However, as the Q6 estimate of the cost of debt also included a liquidity allowance, this means the implied liquidity allowance is closer to 0.435%.

Using HAL's debt assumptions with the tax adjustment leads to a pre-tax WACC estimate of 5.05% and a vanilla WACC estimate of 4.48%.

7.3. Assumptions used to calculate revenue requirement

For the WACC assumptions used to calculate the underlying revenue requirement, we have followed the broad approach taken by the CAA in CAP1658 (as directed to do so). We have adjusted the pre-tax cost of equity to reflect changes in the rate of corporation tax, leaving an estimate of 8.27%.

Similarly, with the cost of debt, we have only updated the cost of new debt element taking the assumption from advice to the CAA by PwC. PwC has taken a similar approach to HAL when calculating the cost of new debt, as outlined in Table 7.3, but has not included any allowance for the new issue premium or for index-linked bonds. The forward adjustment has been estimated at 0.19% and inflation is assumed to be 3%.

PwC has also assumed a liquidity allowance of 0.15% rather than 0.3%. The combined effect of these assumptions is summarised in the tables below.

Table 7.3: Cost of pre-Q6 embedded debt and iH7 new debt calculation (PwC)

Market basis	3.43%
Forward adjustment	0.19%
New issue premium / halo adjustment	-
Index-linked debt premium adjustment	-
Nominal cost of debt	**3.63%**
Inflation assumption	3.00%
Real cost of debt	**0.61%**

Table 7.4: Cost of debt calculation for iH7 (PwC)

	Cost	%
Embedded	3.30%	(70%)
iH7 new debt	0.61%	(30%)
Liquidity allowance	0.15%	
Cost of Debt	**2.64%**	

Using PwC's debt assumptions with the tax adjustment leads to a pre-tax WACC estimate of 4.89% and a vanilla WACC estimate of 4.32%. This is higher from the pre-tax WACC estimate of 4.83% assumed by the CAA in CAP1658, due to higher estimates of the cost of new debt.

8. REVENUE REQUIREMENT

In this section we consider HAL's forecasts of the underlying revenue requirement in the round and present our forecasts. We also compare this against the estimates previously made by the CAA in CAP1658.

8.1. CAA FORECASTS IN CAP1658

The CAA in its consultation document on the extension of the price control beyond 2019, CAP1658, proposed two illustrative price paths when the underlying building blocks were reset. The first took HAL's capex plans (as they existed at the time) whereas the sensitivity adjusted HAL's capex plans to defer early Category C costs from 2019 to 2020 and defer any runway 3 capex to beyond 2021.

We have presented an alternative version of these forecasts with updated inflation estimates, which lead to a slightly higher price path than previously estimated.

8.2. HAL FORECASTS

HAL's proposals on the other hand, lead to a much smaller reduction in the underlying price path than has been forecast by the CAA. The biggest driver of this is higher capital spend, which leads to higher depreciation and a larger return on capital.

8.3. CEPA FORECASTS

Our forecasts lead to a lower price path than that that suggested by both HAL and the CAA. The difference is driven by our passenger forecasts, which assume stronger growth than both the CAA and HAL. Compared to the CAA, we additionally assume slightly lower operating costs and slightly higher non-aeronautical revenues.

Our treatment of capex differs from HAL's as we have used CAA's estimate of capex spend until the end of Q6, and HAL's estimate of capex spend for the two years of iH7. As stated in Section 6.3, we have also simplified the treatment of expansion capex to aid comparability with the CAA's estimates in CAP1658.

Table 8.1 compares each of the forecasts and their impact on the underlying revenue requirement.

Table 8.1: CAA, HAL, and CEPA forecasts of the revenue requirement, 2020-2021 (2016 prices)

	Headline price path (RPI - 1.5%)		CAA (HAL original capex)		CAA (CAA capex)		CAA (CAA capex & updated inflation)	
£ million, 2016 prices	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Operating costs			1,142	1,171	1,142	1,171	1,142	1,171
Non-aeronautical revenues			-1,162	-1,169	- 1,162	- 1,169	- 1,155	- 1,158
Depreciation			745	766	745	750	745	750
Return on capital			730	805	722	739	722	739
Total aero revenue requirement	**1,614**	**1,596**	**1,454**	**1,574**	**1,447**	**1,492**	**1,454**	**1,502**
Passenger numbers (million)	77.8	78.1	77.8	78.1	77.8	78.1	77.8	78.1
Required aero yield (£)	**20.74**	**20.43**	**18.70**	**20.15**	**18.59**	**19.10**	**18.69**	**19.23**
Additional revenue relative to headline price path			159	22	167	104	160	94

	HAL (initial iH7 submission)		CEPA (HAL iH7 capex)		CEPA (CAA capex)	
£ million, 2016 prices	**2020**	**2021**	**2020**	**2021**	**2020**	**2021**
Operating costs	1,137	1,149	1,074	1,065	1,074	1,065
Non-aeronautical revenues	- 1,117	- 1,111	- 1,205	- 1,236	- 1,205	- 1,236
Depreciation	745	750	745	770	745	750
Return on capital	772	813	741	781	731	749
Total aero revenue requirement	**1,537**	**1,601**	**1,355**	**1,379**	**1,345**	**1,328**
Passenger numbers (million)	78.4	80.1	82.2	83.6	82.2	83.6
Required aero yield (£)	**19.60**	**19.99**	**16.49**	**16.50**	**16.37**	**15.88**
Additional revenue relative to headline price path	77	-5	259	217	269	268

Source: CAA CAP1658; HAL iH7 submission, CEPA analysis

9. FURTHER EVIDENCE REQUIRED FOR PHASE TWO

In this section we summarise the evidence from HAL we believe is required to effectively scrutinise HAL's plans for iH7.

9.1. Passenger forecasts

Given the passenger forecasts are a core component of the calculations underpinning the revenue requirement, it is essential that both the methodology and inputs are effectively scrutinised. We believe this is most effectively done by having direct access to the models themselves to review how they function and their sensitivity to key assumptions.

Additionally, we require better documentation on the assumptions used to forecast growth in aircraft capacities in the supply model, particularly around the manual adjustments that have been made to the assumptions. Similarly, we require better documentation around the assumptions used to forecast growth in load factors.

9.2. Operating expenditure

HAL's operating expenditure forecasts include a number of additional cost items that have not been adequately explained. We require more evidence justifying these additional cost items including details on how cost estimates have been derived, before we can include them in our forecasts. Specifically:

- For the additional £10m arising from the outsourcing of Heathrow Express to the Great Western Railway, we require further evidence that the estimate is efficient and necessary;
- For the additional resilience costs of £5.6m, and the EU exit operational costs of £5.3m, we require more detail on how estimates have been derived;
- For the additional noise and capacity expansion costs, we require more evidence on what activities this specifically entails, how estimates have been derived, and why additional expenditure is needed beyond existing levels of spending.

As we have not had access to the econometric model used by KPMG, we have only partially used its analysis in our forecasts. If we were to accept the view that HAL's operating expenditure is currently at the efficiency frontier, we would need access to the KPMG modelling to review the approach and the data sources used.

9.3. Non-aeronautical revenue

We believe the most effective way of scrutinising HAL's non-aeronautical revenue forecasts is by directly reviewing the model through which the forecasts have been derived. We also require further detail on the extent to which new revenue streams from capex projects have been incorporated in the forecasts.

9.4. Capital expenditure

HAL's capex plans in its initial iH7 submission provided insufficient detail to effectively scrutinise those plans. The estimates provided HAL's view on the scale of capex it believes it is able to deliver but are not directly linked to individual projects that would be delivered. As a result, we have not been able to interrogate the estimates or lend much credence to them.

In the revised submission for BAU capex, we would much greater detail and evidence on how the estimated cost has been derived, including:

- A full list of projects or activities that are included within the spend estimate;
- Cost estimates for individual projects or activities, including details on cost maturity, expected cost ranges, details on how cost estimates have been constructed, and a planned spend profile; and
- Justification for each individual project or activity's inclusion within the programme and its prioritisation relative to others, including expected user benefits.

For Category B costs, in addition to the above, we would expect detailed programming of planning activities. We would also expect an explanation of why the activities are required either for DCO submission or for the efficient delivery of expansion.

Alternatively, the CAA may wish to give HAL a capex allowance and scrutinise the efficiency of spend as individual projects progress through the capex governance process.

APPENDIX A **EFFICIENCY ANALYSIS**

A.1. **KPMG BENCHMARKING REPORT**

KPMG used econometric benchmarking techniques to compare HAL's opex to other comparable airports between 2000 and 2017. The study was undertaken as a top-down analysis, i.e. not considering the unit costs of specific cost items individually, but instead looking at overall cost efficiency as indicated econometrically by relation to a top-down cost function. The study examined the following cost drivers:

- **Outputs** – Both quantifiable and other, outputs were split into three categories: operational (passenger numbers, etc.); non-aeronautical (duty-free, food sales, etc.); quality. In the study, the level of output is assumed to be outside of the control of the airport, i.e. it is used as an explanatory variable.
- **Input costs and price adjustments** – Inputs are split into capital, labour, energy, materials and services. There are differences in geographical areas/markets in terms of input costs (labour, utilities rates, rent, etc.), which KPMG adjust for in order to improve comparability between airports.
- **Input productivity** – Specifically capital and labour productivity. Any constraints on airports that affect the productivity/composition of these was taken into account (traffic density, runways, depreciation, total assets, fixed/core assets, etc.).
- **Special factors and costs** – Additional factors can influence the costs of an individual airport (security rules/requirements, regulatory activities, etc.). KPMG identified four main areas of special costs: social security; rents and rates; rail costs; impairments. These were not included in the 'core activities' of the airport.
- **Time** – Efficiency frontier shift (outputs produced more efficiently over time).

KPMG collected data for each of the airports from a range of public sources and created a dataset.[25] The data was normalised to account for different cost, asset and revenue definitions within each airport, with own-country inflation and non-core costs removed. Adjustments were made for utility costs, input prices, revenue and assets, and labour costs to remove the impacts different operating environments have. Once costs were converted to GBP the adjusted dataset was reviewed and validated.

All explanatory variables were grouped according to their characteristics, to prevent alike cost drivers being included in the same cost function and therefore, reducing the risk of multicollinearity in the models. Log-log was selected as the base functional form for the models[26] and every possible permutation of the cost drivers (1,999) were estimated. Each of these permutations was considered against three statistical model options (pooled OLS, fixed effect, random effect). Through the use of the Hausman and BP-LM tests[27], the appropriate statistical model for each permutation was identified. Out of the 1,999 options, the preferred set models were identified through the application of a series of qualitative and quantitative criteria.

[25] Technically this is known as an "unbalanced panel".

[26] Reasoning provided was that log-log provided more stable results compared to the other functional forms considered and it aligns with the Cobb-Douglas production function, often used in efficiency benchmarking.

[27] The BP-LM test aids in the choice between and OLS and random effects regression, and the Hausman test is used to differentiate between fixed effects and random effects models.

A.2. CEPA RUOE ANALYSIS

RUOE is a unit cost measure, calculated by dividing operating expenditure by a measure of output, and expressed in real prices to remove the effect of general inflation. We calculate the changes in RUOE over time, based on historical data, to provide a measure of changes in operating productivity. This measure takes into account both physical productivity gains – more effective use of inputs to produce a given level of outputs – and changes in input and output prices. If RUOE has fallen over time, this could imply an increase in operating efficiency.

RUOE changes are calculated for both for HAL and for a selection of comparator airports – to compare how HAL's operating productivity has changed over time. We have used passenger numbers as the measure of output in the analysis. By comparing historical productivity gains, we are able to draw out a sense of the potential scope for HAL to make efficiency savings in the future.

We note that the change in RUOE provides a proxy for cost efficiency, rather than being a precise measure, for a number of reasons:

- It includes the effect of price changes in inputs. This may sometimes provide an opportunity for the firm to change the ratio of inputs to improve productivity, but a simple price change, or with some factors of production being fixed, RUOE can change for reasons outside the firm's control.
- It excludes the effect of capital. Capital expenditure can substitute for operating expenditure. This may reduce RUOE, but it is not necessarily efficient.
- Individual airports have some specific characteristics.

We have calculated historical trends in RUOE over different time periods. The aim is, by comparing *historical* performance for HAL and other airports, to provide an indication of what HAL might be able to achieve *in the future*.

- If comparators have historically (on average) been able to achieve a certain level of efficiency over time, then it is reasonable to consider that this level of performance may be achievable by others in the near future.
- If HAL's performance has differed significantly from the comparators, then this may be considered an opportunity for catch-up efficiency.

In addition, by calculating changes over the time, rather than the level at a point in time, we mitigate one of the inherent difficulties with unit cost comparisons, which is that different airports operate under different operating and regulatory environments. Whilst these differences do exist, the *change* in these differences *over time* is not likely to be as severe.

A.2.1. Approach

Our methodology for using RUOE to estimate changes in efficiency consists of several stages:

- We collected comparator data, building on the 2013 Airport Opex Benchmarking Model developed by the CAA. We refined this existing data and collected new data for the years.
- We undertook the calculations of average annual changes in RUOE.
- We assessed the results and considered the potential for HAL to make future efficiency savings.

For airport comparators, we have selected large, international airports that offer a substantial level of long-haul flights and have good data availability. These are: Copenhagen, Gatwick, Hong Kong, Munich, Singapore Changi, Sydney, Charles De Gaulle, Amsterdam Schiphol, Zurich and Frankfurt.

Data Collection

Building on the 2013 Airport Opex Benchmarking Model developed by the CAA, we refined the existing data and collected new data. For the years 2013 to 2017, figures were obtained from Annual Reports published publicly by the airports. Where the CAA dataset did not contain data for the airports for the earlier years, data was sourced from a KPMG benchmarking model, where possible, although this was for only a few years of three comparator airports.

Exchange rate adjustments were made. First, we converted foreign currency figures into pounds using the 2017 exchange rate. Then we adjusted these new figures for inflation, using each country's standard inflation measure, usually termed CPI. However, for UK airports we used RPI inflation as this is the measure of inflation generally used for regulatory purposes. This allowed for consistent comparison across the airports, regardless of the country the comparator resides in. The choice of exchange rate year will affect absolute comparisons in RUOE, but not changes in RUOE.

Data Consistency

In order to ensure the validity of the analysis results, data consistency checks were conducted, and some years of comparator data excluded if their value was impacted on by external influences. The table below highlights areas of concern, found within the opex breakdowns of the airports, and the reasoning for these.

Table A.1: Airport Data Consistency Check

Airport	Opex Component	Years	Comment
Heathrow	Intergroup Costs	2013	Large drop in intergroup costs due to a change in company structure, which resulted in most of the intergroup costs now being charged directly to Heathrow SP Limited, as oppose to HAL.
	General Expenses	2013	Large rise, reason unclear.
	Other Costs	2008	Large rise. Terminal 5 opened March 2008 which may indirectly have impacted this.
Gatwick	Intergroup Costs	2010/11	No longer recorded within opex due to the sale of Gatwick by BAA in 2009 to GIP.
	Retail Expenditure	2010/11	Decreases considerably in the same year recording that car parking costs is introduced.
Heathrow & Gatwick	Aerodrome Navigation Charges	2008	ANS charges appear in opex from 2008 onwards due to NATS now charging the airports directly, who then recover these costs from the airlines.
Charles De Gaulle	All	2000 – 2005	No data available for these years.
	Various	2011	Large decrease in staff and raw materials and consumables, reason unclear.
	Sub-contracting	2017	Large increase in total sub-contracting costs on previous years, reason unclear.
Amsterdam Schiphol	Other subcontracted	2008	Cleaning and security costs recorded separately to other subcontracted costs from 2009 onwards.

	Various	Several components of opex are not available for all the years that data is recorded.	
Hong Kong	Staff	2009/10	Operational contracted services and other costs fall, and staff costs double, potentially due to the reallocation of expenses.
	Other operating expenses	2003/04	Experiences a large decrease as rents and rates and occupancy are now recorded separately.
Singapore Changi	All	2000/01 - 2009/10	No data available until 2009/10.

Source: CEPA analysis

It was difficult to adjust for these data difficulties for a number of reasons. First, the breakdown of opex for each comparator airport was not the same, so adjusting each airport's controllable opex to a common operating scope was not possible.

Second, it was also not possible to determine in certain instances whether costs had been reallocated to other components, as data was not received directly from the comparator airports. We also were unable to determine whether the data points listed above were in fact anomalies, or if they were genuine values not affected by internal and/or external factors. Therefore, it was ultimately decided that no adjustments should be made, and that the dataset should remain as was.

A.2.2. **Calculations**

Calculation of RUOE metric

The change in RUOE is the percentage change in real unit operating expenditure (costs) from one year to the next. The most simplistic calculation would be to calculate the change in RUOE between the year t+1 and the year t. However, where economies of scale are present within an industry (i.e. average costs fall as the scale of production increases), RUOE may fall simply because outputs have risen. In this case, the fall in RUOE is not a genuine efficiency saving. To correct for this effect, we use a Corrected RUOE in year t, which takes into account the growth in outputs.

$$\Delta RUOE_{t,t+1} = \left(\frac{RUOE_{t+1}}{O_{t+1}} \div Corrected\ RUOE_t\right) - 1$$

Where $Corrected\ RUOE_t = ROE_t \times (\frac{(1+\Delta O_{t,t+1} \times \varepsilon)}{O_{t+1}})$

Volume effect adjustment

We adjust RUOE measures for 'volume effect' in order to account for opex reductions that may occur as a result of economies of scale in opex, as oppose to genuine improvements in efficiency. This allows the results to take into account the marginal cost increases that arise through marginal increases in output, and thus provide a more accurate picture of the efficiency achieved by Heathrow and its comparators.

The adjustment was achieved through the application of a cost elasticity value of 0.5, specific to the airport industry, to the RUOE calculations. The cost elasticity represents the percentage change in costs that would arise from a one percent increase in output. This elasticity cost value has been used in our previous RUOE analysis and follows regulatory precedent.