



REVIEW OF EFFICIENCY OF OPERATING EXPENDITURE OF HEATHROW AIRPORT

REPORT FOR THE CIVIL AVIATION AUTHORITY

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Final Report

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EXECUTIVE SUMMARY

Introduction

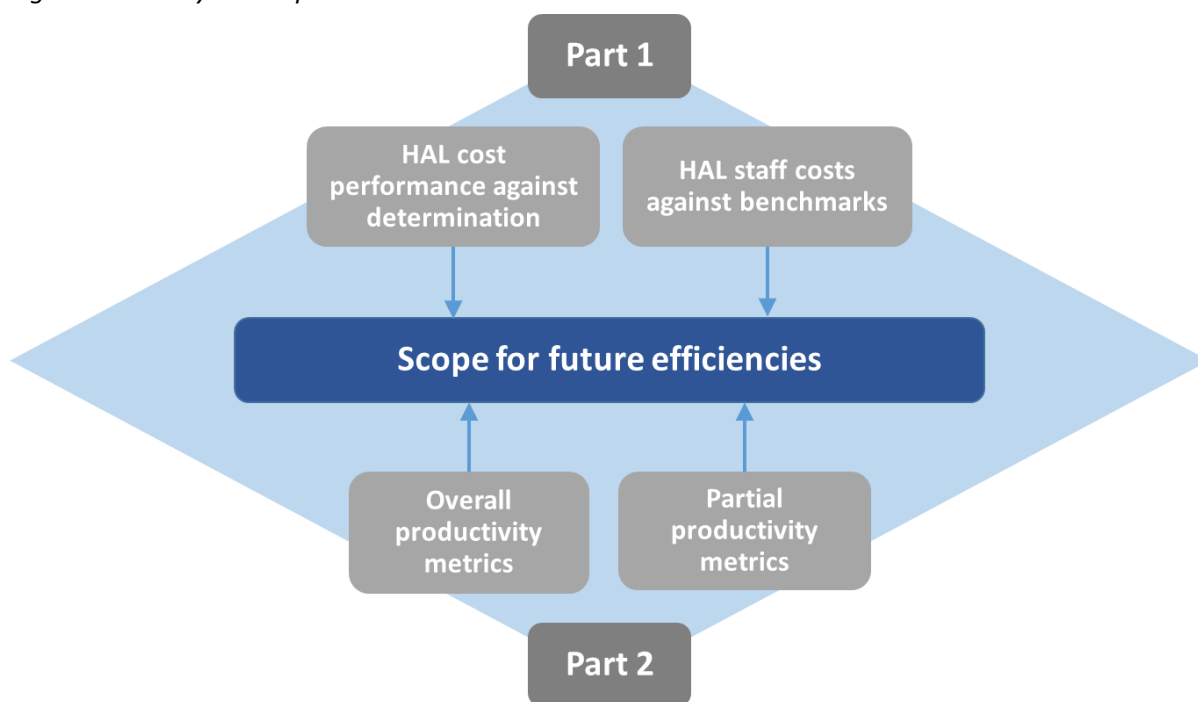
The Civil Aviation Authority (CAA) has commissioned CEPA to report on the efficiency of operating expenditure (“opex”) at Heathrow Airport Limited (HAL). It is intended to form part of the evidence base that the CAA will use in preparing for the next price control process (H7).

Approach

Our approach has been to undertake a range of different analyses of operating costs and consider them in the round, in order to make an overall assessment of HAL’s performance in the control period to date and assess the potential for greater efficiency.

In Part 1 we consider HAL’s performance to date through analysis of its opex against the CAA’s determination and its staff costs (the largest sub-category of operating costs) against publicly available benchmarks. In Part 2 we consider HAL’s productivity using a series of top down metrics which assess its efficiency against other airports and other business sectors. The components of our analysis are illustrated below.

Figure E.1: Analysis components



Our analysis in Part 1 is predominantly backwards looking. Therefore, our assessment is predominantly based on an analysis of actuals up to, and including, 2015.

Quality of service

An important factor in considering efficiency is the impact that quality of service has on the ability to make savings. Airports are not simply commoditised service providers with

uniformity across locations, rather there are variations in each service offering that should be taken into account i.e. captured in the *quality* of service provided, impacting on the level of operating costs required.

We have considered a range of publicly available service quality data to assess where HAL sits in relation to its peers. Data availability is limited, and we note that they are somewhat subjective, so some caution is required. The available information suggests HAL is a high-quality airport which, in performance terms, sits around the middle of its peer group. While this might imply higher costs than would be the case for other Airports which provide a different level of service, we consider that HAL's costs should be comparable with its peers.

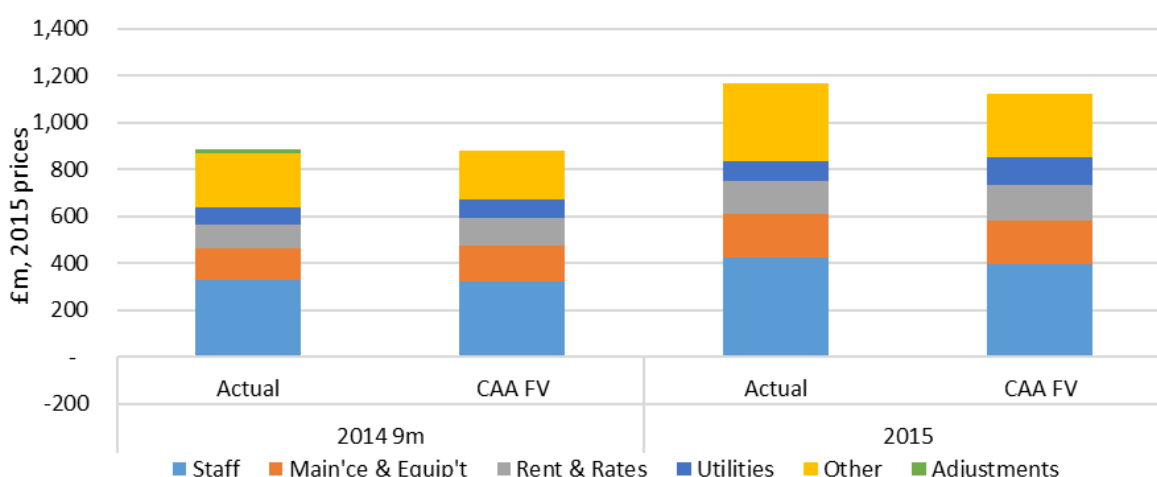
PART 1 ANALYSIS

In Part 1 we analyse HAL's actual cost performance **against the CAA's determination and against staff cost benchmarks**. The aim of Part 1 is twofold: firstly, on a standalone basis, to analyse HAL's recent performance; and secondly to provide the context for the productivity benchmarks which we assess in Part 2, in order to provide a comprehensive evidence base from which to make recommendations on the scope for HAL's future efficiencies.

HAL cost performance against determination

HAL's total opex allowance is £5.15bn over Q6 (2015 prices), as shown by category in the figure below. This includes staff costs (roundly a third), maintenance costs, utility costs, rent and rates, and other costs (roundly a quarter of opex, including intragroup costs, support functions, etc.).

Figure E.2: HAL opex allowance and actual costs by category of spend



It should be noted that HAL reclassified some of its costs in the run up to the Q6 determination and therefore, it has adjusted the CAA's cost breakdown to account for this reclassification, while preserving the total. In comparing HAL's cost against the determination, we have used HAL's reallocated version of the CAA's determination.

The total allowance of £5.15bn has a falling profile over time – the CAA set HAL the target of reducing real opex by circa 2% per year over Q6 relative to the end of Q5.¹ The main efficiency challenges are in the areas of:

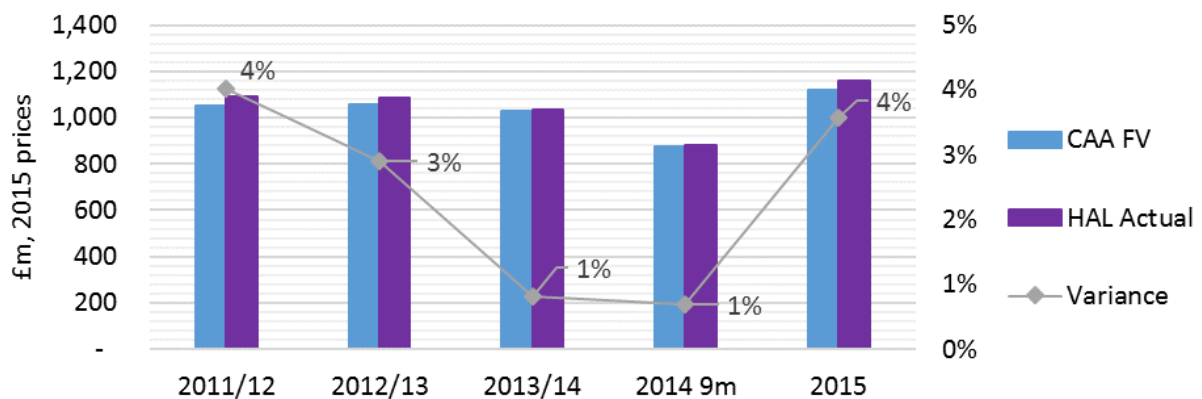
- staff costs – a 17.5% reduction in employee pay costs over Q6, and a very significant reduction in the pensions allowance over Q6, as it did not achieve determined levels in Q5;
- maintenance costs – c. 2% reduction per year; and
- ‘other’ costs – c. 3% reduction per year, with the largest savings within central support services, rail and ‘other’ costs.

In considering the scale of these percentage reductions it should be noted that the CAA set the Q6 determination by reference to HAL’s Q6 Alternative Business Plan (ABP), which contained an opex projection for the last year of Q5. HAL subsequently outperformed this Q5 projection so the percentage efficiency savings that HAL is required to make during Q6 – in order to achieve the CAA’s Q6 determination – are in reality not quite as large as those noted above.

Comparison of HAL’s operating costs to 2015 and the CAA’s determination

In the individual periods of Q6 so far, and at a total level, HAL’s actual opex has been consistently similar to – although slightly higher than – the CAA’s determination. Total cost overruns were 1% for 2014 (9 months) and 4% in 2015, or £6m and £40m respectively.

Figure E.3: HAL actual total costs versus the CAA’s determination

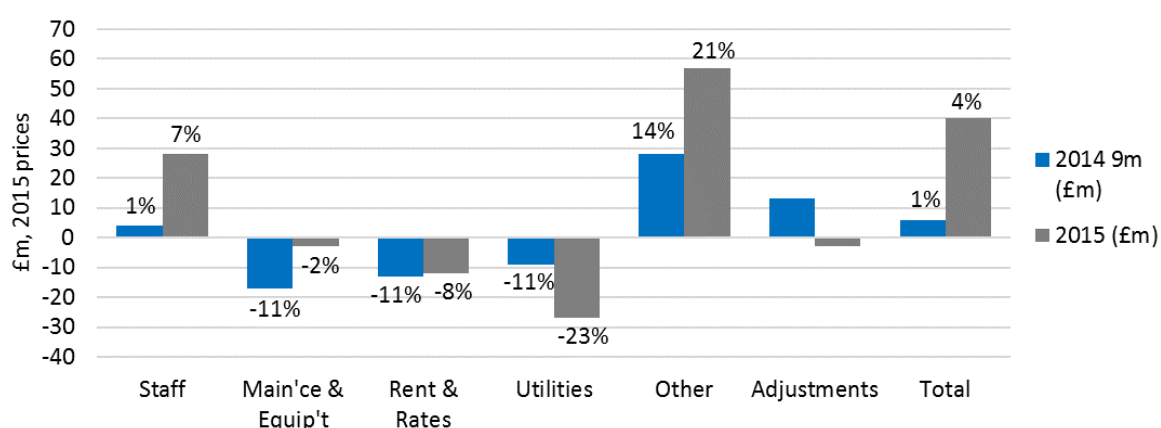


Note: Opex allowance for 2013/14 was supplied by HAL

When examined at the level of individual cost categories there have been more material variances, both positive and negative, from the costs established in the determination.

¹ The CAA’s final view p.264

Figure E.4: Difference between HAL actual costs and the CAA's determination, Q6



Notes: Variance is shown as nominal £m (column size) and as a % of the determination (column label).

The variances shown above are discussed in more detail in the table below, where we use a red-amber-green categorisation according to whether costs are in accordance with, somewhat above, or much above the determination levels.

Table E.1: Commentary on HAL's opex by category

Category	Current position	Efficiency	Notes
Staff	Costs remain above determined level.	Some recent evidence of efficiency via a reduction in security staff costs and pensions.	Targets are challenging especially for pensions where no glide path to a lower level of cost is permitted in this review period.
Maintenance	Costs currently at the level anticipated by the determination.	Some efficiency achieved to date, although possibly in part due to the Q5 baggage contract.	The efficiency challenge is back end loaded so the green status could change going forward.
Rent and Rates	Costs are currently below the determined level.	Evidence of efficiency savings e.g. early vacation of some rental property.	Determination increased cost in this category from previous period actuals. Not clear that this increase was fully justified. The CAA may wish to consider the scope for a pass-through of actual costs in future periods.
Utilities	Costs are currently below the determined level.	Evidence of efficiency savings via reduced energy consumption.	Also, likely to include some windfall benefit from lower than anticipated energy prices and milder weather.
Other	Costs are materially above the determined amount.	The 'other costs' category is large and hard to analyse, noting in particular that the sub-category within 'other' of most concern is also called 'other'. Difficult to identify realised efficiencies at this stage.	Some costs in this category may be in substitution for costs in different categories. It may also include some costs that HAL has voluntarily incurred but the CAA would not consider are necessary to running the airport.

Other issues: Capitalisation

By taking careful account of the way the regulatory process will in practice treat capitalisation, regulated companies may have an incentive to 'game' the regulatory settlement by moving costs between opex and capex in order to maximise their returns. HAL's operating costs show material capitalisation and therefore, it is an area that warrants some investigation.

A concern emerging from our review of HAL's approach to capitalisation is a lack of transparency, such that we are not in a position to determine whether or not the regulatory process is robust. We believe that capital expenditure incurred in this way may not always be subject to explicit consideration under the capex governance process that exists for airlines to have influence over the selection and cost of capital projects.

We have received a limited explanation from HAL with regards to the variation in capitalisation in different years. Although HAL has provided its capitalisation policy, and we understand that capitalised costs are audited for compliance with it, it is not clear to what extent there are regulatory safeguards in this area.

HAL staff costs against benchmarks

We also undertook a deep-dive assessment of HAL's staff costs, given that these represent the largest sub-category of operating costs. We compared HAL's staff wages costs per man-year with data from the employment survey the Annual Survey of Hours and Earnings (ASHE).

HAL's unit wage costs increased substantially over the period under review, due to a rapid increase in 2013. From discussions with HAL, this rise in costs was related to corporate restructuring in the period, when HAL divested all its airports other than Heathrow. However, costs have since fallen in real terms (whilst the ASHE benchmark has stayed fairly constant), which suggests that efficiency savings are starting to be made.

Within this trend, there are several notable observations at a more granular level as performance varies across the different staff cost sub-categories:

- Average wage costs for certain categories of staff have grown at a faster rate than their benchmarks, but the trends in some areas are starting to converge. This suggests that HAL is starting to make some efficiency gains. This is consistent with our discussion with HAL, which suggested that starting pay rates for some staff have been lowered in Q6. However, given that staff turnover in some categories of staff is relatively low, this will take time to filter through.
- For **baggage and engineering staff**, unit wage rates are currently growing at rates above their benchmarks, so there may be scope for efficiency.
- HAL's unit wage rates for **airside employees** have only grown very slightly in recent years, i.e. by less than the benchmark. This suggests that HAL is containing wages effectively in this area.

- Data for **commercial and corporate staff and other operations staff** do not seem fully reliable, e.g. there may be cost allocation issues. It may also include embedded costs related to the divestments, which is not part of the reasonable costs of operating Heathrow. We therefore recommend further analysis in this area.

Consistent with our review of actual costs to date, our staff costs benchmarking analysis shows that some cost savings are starting to be delivered. It also highlights areas where there may be potential for further efficiency.

PART 2 ANALYSIS

In Part 2 we focus on further external evidence of cost efficiency through the calculation of productivity metrics which compare HAL to airport peers and wider industry. We consider two top-down approaches to productivity, which are often used by regulators as the basis for setting efficiency targets: **Overall productivity metrics**; and **Partial productivity metrics**. These metrics provide benchmark measures of productivity growth per annum.

Before introducing the metrics, it is helpful to explain what each of them aims to measure. Specifically, it is helpful to distinguish between *Frontier Shift (FS)* and *Catch-Up (CU) efficiencies*, which economic regulators in the UK and Ireland (including the CAA) often specifically refer to when setting opex efficiency targets for the companies they regulate:

- FS efficiency implies that the efficient cost of delivering a service is falling due to a mixture of general productivity gains in the economy, and specific productivity gains in the relevant industry, which would be exhibited in a competitive industry.
- CU efficiency implies that a specific firm is operating with lower efficiency than the most efficient producers of similar services, and can therefore improve its efficiency by catching up with the efficient producers.

In terms of the metrics we analyse:

- **Overall productivity metrics.** These measure the change in the volume of outputs relative to the change in the volume of inputs. They do not take into account changes in factor input prices. Our approach is to assess HAL's performance against industry sectors that exhibit most similarity to the components of HAL's opex. *These metrics primarily relates to FS efficiency*, because the sectors included in the productivity dataset are generally in competitive operating environments, and therefore we consider that these metrics provide a lower bound for the range of improvement we would have expected to observe at HAL over time.
- **Partial productivity metrics.** These measure operating productivities over time in relation to subsets of the full range of costs. We have considered:
 - **Partial factor cost measures** calculate changes in input costs, per value of output. As with the overall productivity metrics, this is undertaken for sectors that are most similar to the components of HAL's opex. *This metric primarily*

relates to FS efficiency (similar to the overall productivity metrics above), although it also takes into account changes in input and output prices.

- **Real Unit Operating Expenditure (RUOE)** is a unit cost measure, calculated by dividing real operating expenditure by a measure of output. This measure includes all operating costs, but excludes capital costs. *This metric relates to both FS and CU efficiency.* We compare HAL's RUOE productivity against comparator airports and other industries with similar characteristics.

Overall productivity metrics

We have considered several productivity metrics based on UK-wide data across a number of years. These are:

- Total Factor Productivity (TFP): 'Residual' output growth that is not accounted for by input growth, taking into account all factors of production.
- Labour and intermediate inputs (LEMS) Productivity: 'Residual' output growth that is not accounted for by the growth of labour and intermediate inputs.
- Labour Productivity (LP): The growth of output per unit of labour input growth.

Our main estimates for productivity growth per annum in sectors undertaking similar activities to HAL are in the range 0.65% to 1.1%, across the three productivity metrics listed above. We consider that the LEMS and LP results are most relevant to HAL, as TFP includes productivities from capital inputs and so is less relevant in relation to HAL's *opex* efficiency. Our main estimates of productivity growth per year for LEMS and LP with variable capital are around 1.1%, although this would be marginally lower with constant capital assumed. **Overall, we consider that an initial benchmark for HAL's ongoing productivity gains (FS only) could be roundly 1% per annum, without taking into account any changes in input prices.**

Partial productivity metrics and partial factor cost metrics

Our partial factor cost measures are similar to the overall productivity metrics (in Section 5), in that we calculate annual changes in productivity, although for partial factor cost metrics we take into account sector-specific differences in input and output prices. Aside from this, our methodology for calculating these measures is the same as the methodology used for the overall productivity metrics, i.e. we have used the same data sources, comparator weightings, time periods and permutations (gross output and value-added, variable and constant capital). We calculate a LEMS cost measure and a Labour cost measure.

Overall, our results show that (historically) an efficient company undertaking similar activities to HAL would have – on average – been able to achieve ongoing improvements in *opex* productivity of between 0% and 1% per annum, once sector-specific costs are taken into account. **Therefore, we consider a range of 0% to 1% provides a reasonable and consistent high level benchmark for the level of ongoing productivity gains per annum (FS only) which**

HAL should be able to achieve in the near future, once sector-specific costs are taken into account. We note that further analysis and discussion would be required in order to identify the relevant FS target for HAL, and that this does not materially consider catch-up efficiencies. Our analysis and the results are set out in full in Section 6.2 of this report.

Partial productivity metric: Real Unit Operating Expenditure

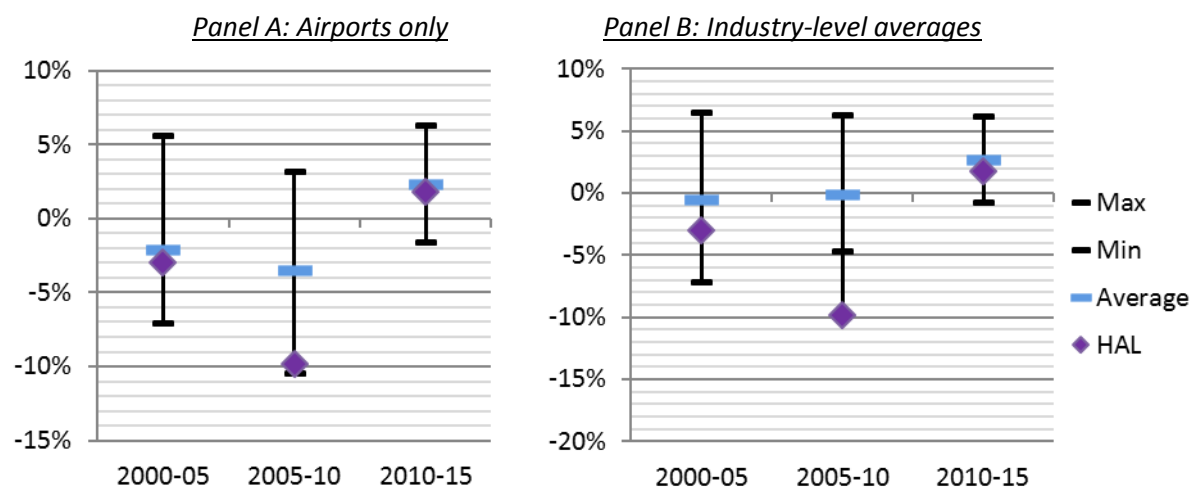
RUOE is a unit cost measure, calculated by dividing operating expenditure by a measure of output, and expressed in real prices to remove the effect of general inflation. We calculate the changes in RUOE over time, based on historical data, to provide a measure of changes in operating productivity. This 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.

In this section we show average annual productivity gains in RUOE over different time periods, by showing the reduction in RUOE as a positive number. This has been done so that productivity gains are shown as a positive numbers. We provide three sets of charts:

- Comparing HAL against other airports and other industries over 5-year time periods.
- Comparing HAL against other airports, for all years of available data.
- Comparing HAL against other regulated industries, for all years of available data

The charts below show average annual RUOE productivity gains over different 5-year time periods, for individual airports (Panel A) and comparable industries (Panel B). Panel A compares HAL against other airports – in the period 2010-2015 HAL made an average annual operating productivity gain of 2%, and other airports had a similar level of performance. Panel B compares HAL to a selection of industries with similar characteristics.

Figure E.6: Average* annual percentage reduction in RUOE, by time period (positive number = efficiency gain)

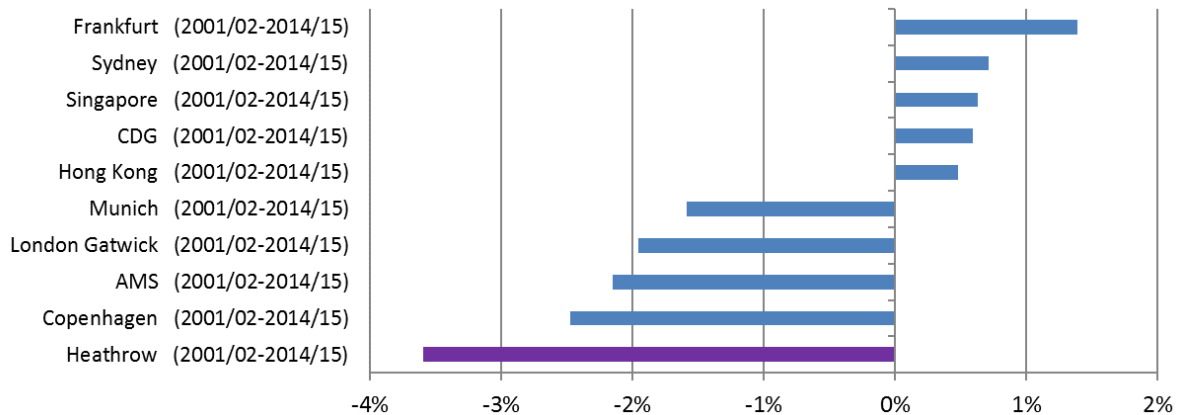


Note: In Panel A, the average of airports excludes HAL. In Panel B, the industry-level average is calculated by combining the airport average from Panel A (which excludes HAL) with the average efficiency gains from the various comparator industries.

Note (*): Geometric mean.

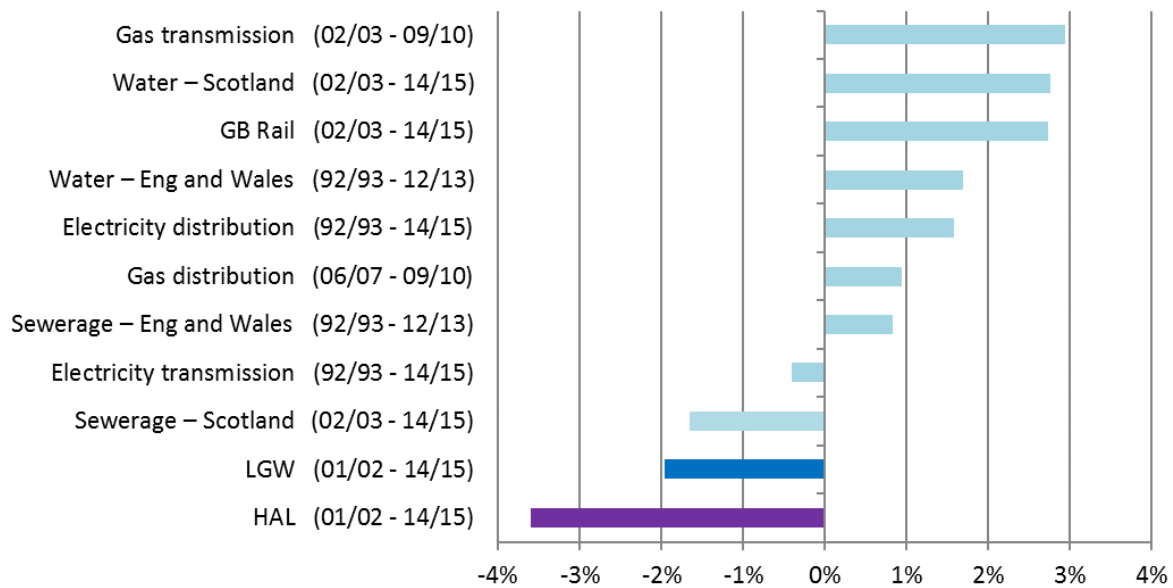
The chart below shows the average annual efficiency gains (as calculated by the inverse of percentage changes in RUOE) for airports for all years of available data.

Figure E.7: Average annual percentage reduction in RUOE for selected airports, across all years of available data (positive number = efficiency gain)



This chart above shows that the majority of comparable airports experienced a reduction (a negative number) in unit operating productivity, i.e. real unit operating costs actually increased. The average change in unit operating productivity for the comparator airports is circa -0.5% per annum. However, HAL’s unit operating productivity reduced by even more, at circa -3.5% per annum, so HAL performed relatively poorly in comparison. The chart below shows the same metric, but for industries who have been privatised for more than 10 years. Given that industries were privatised at different times, as well as data limitations for some industries, the date ranges are specific to each comparator.

Figure E.8: Average annual percentage reduction in RUOE for industries privatised for more than 10 years. Data is for the period after the industry has been privatised for 10 years to the present day



HAL has the largest reduction in unit operating productivity when compared against the selected other UK industries. It is also below the average of the comparator airports group (i.e. excluding HAL), as defined above.

Summary of RUOE analysis

Overall, the RUOE measures show that, on average, HAL’s comparator airports have experienced small reductions in efficiency for operating costs (i.e. circa -0.5%). HAL’s efficiency in opex has fallen by more (circa -3.5%) over the period of available data. Industries with similar characteristics (e.g. other regulated sectors with high fixed costs) have made efficiency gains in relation to opex, although we do observe that efficiencies fall over time post privatisation. **Overall, given that HAL’s historic performance may not have been as strong as the comparator airports (and particularly when compared with the other industries), we consider that there is likely to be scope for catch-up efficiencies.**

Regulatory precedent

We have considered recent regulatory precedent for the FS and CU opex efficiency targets set by regulators in recent price controls and these provide support for the FS and CU opportunities that we identify for HAL. Regulatory precedent suggests that FS is assessed to be relatively consistent across the regulated sector, i.e. it is often in the range 0.8% to 1.2%; figures which are consistent with our calculated range.

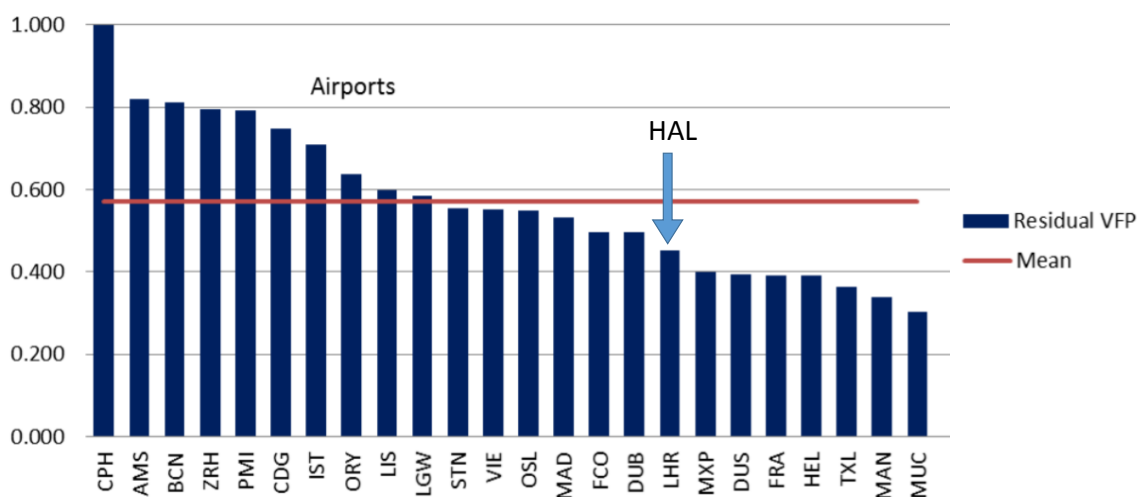
CU efficiency targets vary considerably, as would be expected given that this depends on the specific circumstances of company or industry at a given point in time. For example, Network Rail’s large catch-up efficiency target (4.4%) was influenced by the view that Network Rail was

substantially inefficient at the point in time of the determination.² However, catch-up efficiency targets are minimal if a company is deemed to be operating close to the frontier of efficient performance. Again our results fall within the range of the figures determined elsewhere.

Other precedent

The Air Transport Research Society’s (ATRS) Residual Variable Factor Productivity (VFP) metric is a measure of airport operational productivity that has been adjusted for factors ‘outside of managerial control’. The ATRS study is well-recognised within the airport industry and the Residual VFP metric takes into account a number of factors to normalize across airports, e.g. share of non-aeronautical revenue, proportion of international passengers, scale of airport, capacity constraints, etc. ATRS’s 2016 results are shown below. We note this is based on data from 2014 so any catch-up since then will not have been included.

Figure E.9: Residual VFP (index, best = 1) for large European airports, ATRS 2016 report (2014 data)



Source: ATRS report 2016, ‘Key Findings’ presentation

The chart above shows that HAL’s Residual VFP is below the average for large European airports. The majority of the most relevant comparator airports (for HAL) score *above* the average, namely Amsterdam (AMS), Charles de Gaulle (CDG), Gatwick (LGW) and Copenhagen (CPH). We have analysed previous years’ data from ATRS, which shows that HAL has consistently been below the Residual VFP average for large European airports. Although over time, we note that HAL’s score has moved closer to the average as illustrated in Annex B4.

OVERALL SUMMARY AND CONCLUSIONS

From our Part 1 analysis, our consideration of actual costs to date suggests that the determined level of cost is being achieved in some areas and that efficiencies are starting to be delivered in others – e.g. staff and pension costs. This aligns with our benchmarking of

² The 2011 McNulty Report stated that passengers and taxpayers in Great Britain were “paying at least 30% more than their counterparts in other European countries”.

staff costs against external comparators. In areas of cost overrun, we note that some may have been due to a combination of challenging targets (e.g. pension cost) and costs being outside the scope of the Q6 determination (e.g. HAL reorganisation costs and new runway planning).

Overall, there is evidence that HAL has delivered some cost efficiency in Q6, and HAL opex is close to the determination, which requires a 2% reduction in real opex per annum. If HAL achieves the determination, it will have delivered the catch-up efficiencies which were built into the determination.

However, our Part 1 analysis shows that cost reductions do not solely result from Q6 efficiencies – there may have been some efficiencies arising due to changes made during Q5 (baggage maintenance contract) and some favourable conditions (lower energy prices). There have also been cost overruns in some areas – analysis of ‘other costs’ (which are large) has been more difficult and actual costs to date materially exceed those in the CAA’s determination. Furthermore, the Q6 efficiency targets implied within the CAA’s Q6 determination are not quite as significant (at 2% per annum) if the starting point is taken to be HAL’s actual costs in 2013/14 (or the CAA’s determination for 2013/14), rather than HAL’s ABP submission for that financial year. Several areas would merit further investigation and detailed cost breakdown, e.g. capitalisation of opex. Finally, HAL will need to continue to make further efficiencies in order to meet the Q6 determination for the remainder of the regulatory period.

There is some evidence that HAL is performing less well in some areas (other costs), or has benefited from favourable conditions (energy), and there is a lack of full transparency around some aspects of cost data (capitalisation). HAL’s performance should therefore be re-considered, both in more detail and towards the end of Q6 – in order to obtain a more robust measure of its performance.

We can combine the analysis of HAL’s performance to date (in Q6) with other sources of evidence to consider the extent to which HAL should be set efficiency targets in H7. In relation to HAL’s *current* operational efficiency, several sources of evidence highlight the potential for HAL to make catch-up efficiencies from early Q6 onwards. This includes studies undertaken prior to the Q6 determination, the ATRS study, our detailed staff cost benchmarking and our RUOE analysis in Part 2. We note that a number of these sources are based on data up to and including 2015. Therefore, if HAL continues to deliver against the determination throughout Q6 some of the scope for catch-up efficiencies may have been eroded within the period.

The majority of sources suggest that HAL currently has potential to make CU efficiencies, although this should be reviewed again in future years. If efficiencies are achieved during the remainder of Q6, catch up for Q7 will be lower. In addition, further detailed analysis is required to assess the precise level of CU efficiency.

We have considered various top-down productivity measures (in Part 2) to consider the scope for HAL to make ongoing efficiency gains, as even efficient companies do over time.

Once input prices are taken into account, we consider that an efficient company undertaking similar activities to HAL could achieve ongoing improvements in opex productivity of between 0% and 1% per annum. We consider this provides a reasonable high level benchmark for future ongoing productivity gains per annum (frontier shift only) for HAL.

Finally, we have considered whether quality of service is impacting on opex efficiencies. Whilst HAL is a relatively high quality airport, it is not necessarily any higher than its peer group. In addition, whilst this may require HAL's opex per passenger to be relatively high at a given point in time, being a high-quality airport still carries the potential to make efficiency savings over time.

1. INTRODUCTION AND APPROACH

1.1. Background

Heathrow Airport Limited (HAL) is now just over halfway through the Q6 price control, which now runs from April 2014 to December 2019.³ To inform its Q6 determination process, the Civil Aviation Authority (CAA) commissioned a number of operating expenditure (opex) benchmarking studies in specific cost areas (staff costs, maintenance, central support costs, pensions, etc.), considered arguments from HAL, and undertook its own analysis to reach its *Q6 decisions*.⁴

The CAA has now started work on the H7 price control process, to which this report is an input. The objective of undertaking work now is to assess how HAL is performing against the determination and consider areas which could be assessed in more detail as part of the H7 price control process.

1.2. Objectives of this study

The CAA has commissioned CEPA to report on the efficiency of opex for HAL. This report includes detailed analyses of HAL's total and disaggregated opex, an assessment of how these expenditures compare with suitable comparators/benchmarks, assesses the potential scope for efficiency savings, and provides our suggestions for future benchmarking exercises. It is intended to form part of the evidence base that the CAA will use in preparing for the next price control process (H7).

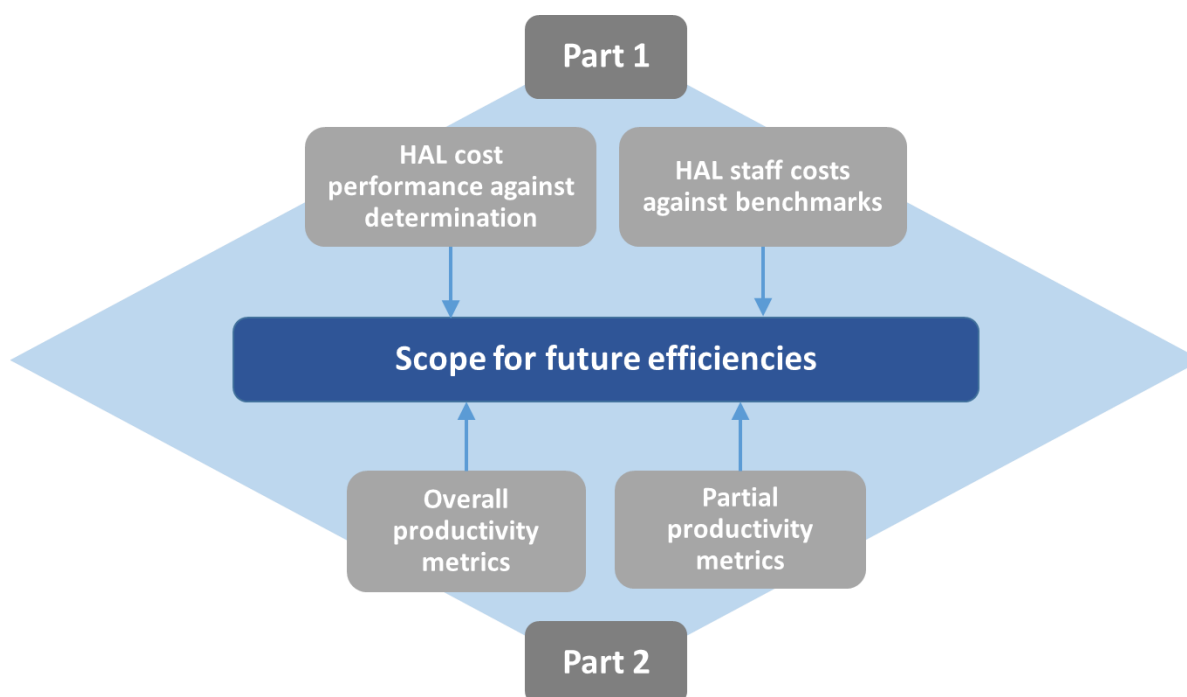
1.3. Approach

Our approach has been to undertake a range of analyses of operating costs and consider them in the round in order to make an overall assessment of HAL's performance. The components of our analysis are set out in the diagram below.

³ Following consultation with stakeholders, the CAA decided upon extending Q6 by one year. The control period therefore now ends on 31 December 2019. Further information is available at www.caa.co.uk/cap1459.

⁴ CAA, *Economic regulation at Heathrow from April 2014: Notice granting the licence*, February 2014

Figure 1.1: Analysis components



HAL’s cost performance against the determination and staff cost benchmarking form Part 1 of the analysis, which considers actual performance to date. Overall productivity metrics and partial productivity metrics form Part 2 of the analysis, as these measures are more forward-looking. Service quality is considered in Section 2 as part of the context for this work. Further technical detail on our approach to each piece of analysis is provided in ANNEX A.

Our analysis in Part 1 is predominantly backwards looking. [X]. Therefore, our assessment is based on an analysis of actuals up to, and including, 2015. We also have some data from HAL for the first 9 months of 2016, and we have used this in our analysis of HAL’s staff cost performance versus benchmarks. However, HAL’s 2016 costs are not yet available on a like-for-like basis with the CAA’s determination and so are excluded from our other analysis.

1.4. Structure of the document

- **Section 2** provides context, including a review of HAL’s quality of service, and describes our analytical approach for this study.
- **Part 1 (Sections 3 and 4)** includes our analysis of HAL’s actual costs compared to the CAA’s determination (Section 3) and a comparison of HAL’s staff costs against external benchmarks (Section 4).
- **Part 2 (Sections 5 and 6)** contains our analysis of overall productivity metrics (Section 5) and partial factor productivity metrics (Section 6) for sectors that have similar characteristics to HAL.

- **Section 7** presents our conclusions. This based on an overall assessment of our analysis in Parts 1 and 2, as well as taking into account regulatory precedent and other studies which have considered HAL's efficiency.
- **Section 8** identifies areas for further future analysis and benchmarking.

The annexes contain the details underpinning our approach and analysis, as follows:

- **Annex A** contains a detailed explanation of the approach undertaken within each of the components of our analysis.
- **Annex B** contains additional results that support the analysis discussed in the main sections.
- **Annex C** provides our initial thoughts on [✂].

2. CONTEXT

2.1. The CAA's Q5 and Q6 Determinations

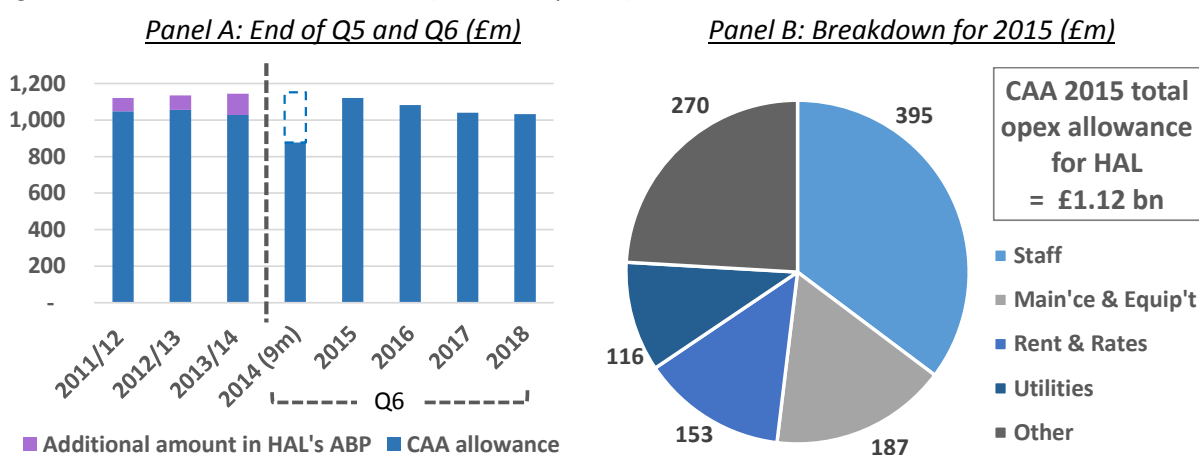
HAL is currently mid-way through its 6th price control period (Q6), running from April 2014 to December 2019. It was originally set to run for four years and nine months to December 2018, but the CAA subsequently extended it to its present expiry date. The CAA's current opex determination for this period is shown in the figure below (blue bars), both for Q6 and for the last three years of Q5 (up to 2013/14). Data for the determination is available up to the end of 2018, the original end date for Q6. We do not include analysis for 2019 in this report.

The Q5 determination was set in financial years, whereas the Q6 determination is set by calendar year⁵. As part of the transition the 2014 determination period was only 9 months, (April to December, inclusive). To maintain visibility of the total cost trend for 12 month periods, the blue dotted line shows a projection of what the 2014 determination might have been had it covered a full year using a proportionate, annualisation method.

Figure 2.1 also shows the additional opex projected in HAL's July 2013 Alternative Business Plan (ABP), submitted July 2013, relative to the determination. HAL's business plan predicted overspends against the determination in each of the Q5 years that we have considered, as illustrated by the purple blocks. These Q5 figures are relevant because the efficiencies noted in the CAA's Q6 determination are stated by reference to HAL's Q5 ABP (amounts which include the purple blocks), rather than the Q5 determination.

It is worth noting that, when the CAA decided to extend Q5 for a year to 31 March 2014, it did not publicise its view on the opex allowance for 2013/14. The 2013/14 opex allowance in Panel A below was supplied by HAL.

Figure 2.1: The CAA's determination (£m, 2015 prices)⁶



⁵ The Q6 determination was for calendar years to reflect that HAL changed its financial year from March end to December end.

⁶ Due to different price bases used across the ABP, and Q5 and Q6 determinations all figures were adjusted for inflation to 2015 prices using RPI.

HAL's total opex allowance is £5.15bn over Q6 (2015 prices). This allowance includes a falling profile over time – the CAA set HAL the target of reducing real opex by circa 2% per year over Q6, relative to the end of Q5.⁷ The main efficiency challenges are in the areas of staff costs (a 17.5% reduction in employee pay costs over Q6, and a [✂] reduction in the pensions allowance), maintenance costs (c. 2% reduction per year), and 'other' costs (c. 3% reduction per year, with the largest savings within central support services, rail and 'other' costs). However, these efficiencies were set relative to HAL's 2013/14 costs as set out in its ABP. They are not therefore, as significant when viewed from the perspective of the CAA's Q5 determination (the blue bars for 2011-12/2013/14).

Whilst HAL's allowance falls *during* Q6, there was an initial increase in opex following Q5 (2013/14), indicated by the projected total (dashed lines in the chart above) for the full year 2014. HAL's average opex allowance per year for Q6 (circa £1.08bn) is broadly 5% higher than its allowance for the last year of Q5 (£1.03bn, virtually the same as HAL's actual costs in 2013/14). The rise in costs between the end of Q5 and the beginning of Q6 is primarily driven by the opening of the new T2, where some cost areas received an increase of around 20% at the start of Q6 relative to 2013/14. The main cost areas impacted by an increased allowance were maintenance and equipment costs, rates and rent, and utility costs.

Understanding the incentives underpinning the CAA's price control framework provides important context when considering HAL's actual costs. In general, HAL is more likely to reduce its costs in areas for which it is more heavily incentivised.

The Q6 price control framework is designed by the CAA to incentivise HAL to undertake its functions efficiently, by minimising controllable costs. For the majority of cost areas HAL's revenue is set independent of its costs, i.e. there are only cost-sharing mechanisms in a few areas. This means that HAL keeps 100% of the gains from any reduction in opex during Q6, which generates strong incentives for HAL to reduce its costs, at least from a short term perspective. However, there is a longer term downside to reducing costs. If HAL reduces its costs it "reveals" to the CAA that it is able to operate more efficiently, which gives the CAA greater justification to reduce HAL's opex allowance in future price controls. Overall, there is an incentive trade-off from HAL's perspective.

2.2. The role of Service Quality

An important factor in understanding cost performance is service quality. It is well-understood that airports are not simply commoditised service providers with uniformity across locations, rather there are variations in each service offering that should be taken into account i.e. captured in the *quality* of service provided. For example, an airport seeking to attract a higher proportion of premium airlines and/or long haul international passengers may

⁷ The CAA's final view p.264

need to provide comfortable lounges, a well-maintained terminal façade, etc. This will necessitate higher operating costs (e.g. higher maintenance and cleaning costs).

As context for the analysis in this report, we have examined HAL's quality of service – including performance metric targets set by the CAA and HAL's performance over time. Brief details are provided in the sub-sections which follow.

2.2.1. HAL's Service Quality Performance

HAL releases a monthly service quality performance report, which combines individual terminal scores along with aerodrome congestion and control post queueing. These reports are part of the Service Quality Rebate (SQR) Scheme, introduced by the CAA in 2003 in order to provide clarity for airlines and passengers over the level of service they can expect in return for the charges paid. If performance falls below a predetermined level, then a proportion of the charges paid must be returned to the airlines. The CAA has set service quality targets in areas including: security wait time; passenger perception of security; cleanliness; and passenger sensitive equipment (PSE⁸) availability. A full list of the SQR metrics that Heathrow report is available in Annex B.3.

The first two security metrics were selected due to this data also being available at other airports, therefore making it possible to conduct comparisons. Cleanliness was chosen due to it being one of a number of metrics available with which the physical quality of the airport could be examined whilst, PSE availability was selected to further highlight the importance of the airport user experience. It should be noted that data for passenger perception of security and cleanliness are obtained via surveys, and are therefore subjective.

Overall HAL has, on average, exceeded the set targets for each of the performance metrics named above. Heathrow has been consistently achieving above the targeted performance level for perceived cleanliness and general PSE availability, whilst passenger security perception is yet to have a performance target set. Nevertheless, it is difficult to determine HAL's relative level of performance due to a lack of similar performance metrics being available for comparator airports.

2.2.2. Customer surveys

In addition to HAL's reporting on service performance, Skytrax publishes data for different passenger perception metrics, based upon customer reviews (score out of 5) of airports. The results show that, compared to other large international airports, HAL performs at a 'medium' level, i.e. it is below Changi and Hong Kong, above Copenhagen, Charles de Gaulle and Abu Dhabi, and level with Atlanta, Amsterdam and Munich airports.

⁸Passenger Sensitive Equipment (PSE) includes lifts, escalators, and conveyors. The availability of PSE is recorded in two measures, a priority list and a general list, to ensure key equipment is identified and monitored closely, whilst keeping the rest of the equipment maintained.

In recent years, HAL has received several awards, based on passenger satisfaction, from the most recognised award bodies:

- *Airports International Council (ACI) Airport Service Quality (ASQ) Awards*: Best Airport in Europe over 40 million passengers (2017, 2016), Best Airport (in Europe) over 25 million passengers (2015, 2013)
- *Skytrax World Airport Awards*: Best Airport in Western Europe (2016, 2015) and World's Best Airport Terminal for T5 (2016, 2015, 2014, 2013, 2012)

Heathrow has also received awards for shopping experience, environmental performance, sustainability, and for the Terminal 3 Integrated Baggage Facility suggesting that, at least in some areas, it exceeds the performance level achieved by its peers.

2.2.3. Overall assessment of service quality and its implications for this report

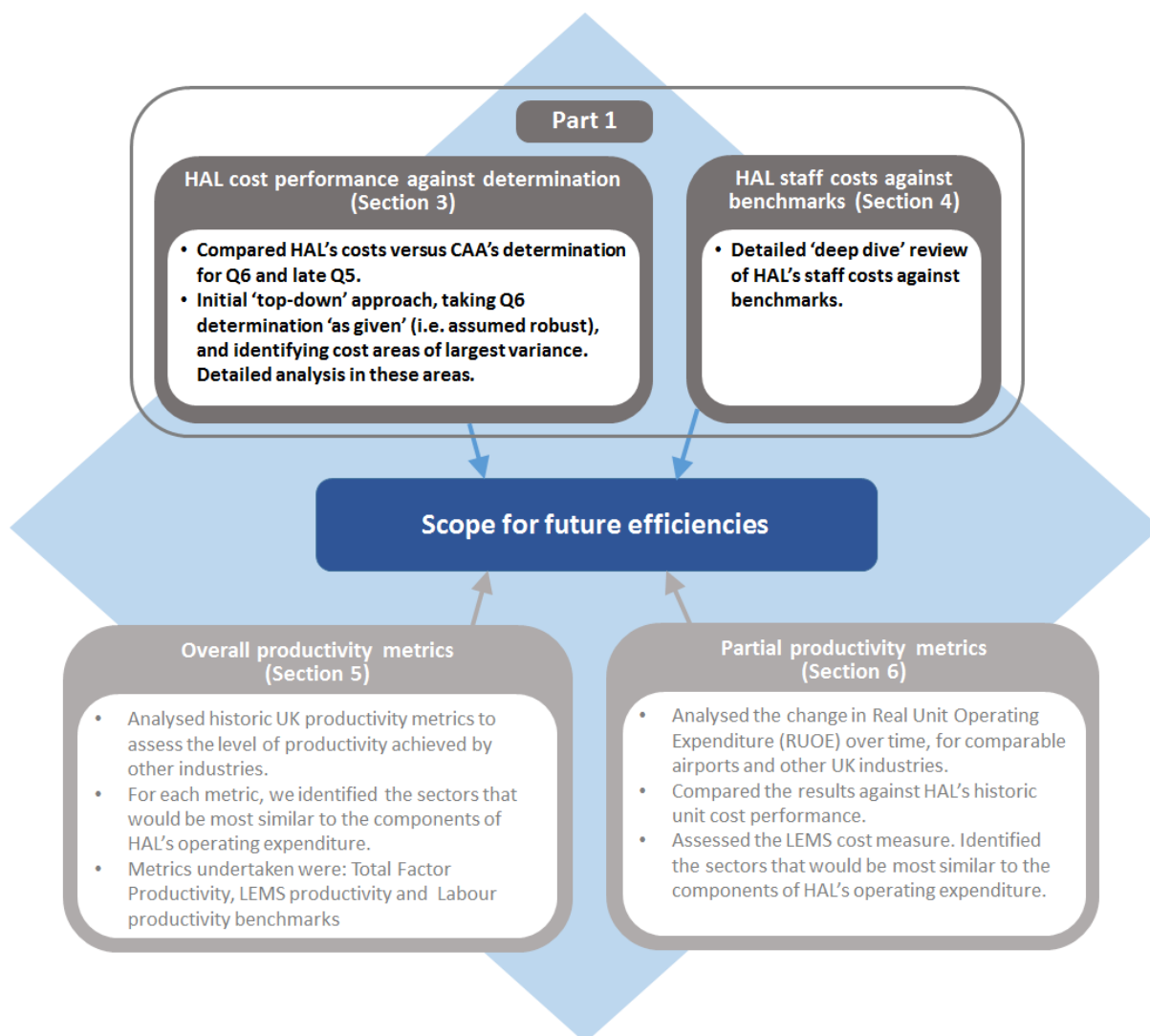
Overall, data availability is limited for quality measures and they are somewhat subjective. Therefore, some caution is required in interpreting results. Nonetheless, the available information suggests HAL is a relatively high-quality airport which sits around middle of its peer group in quality performance terms. A more detailed analysis of quality metrics at Heathrow can be found in Annex B.3.

The implication for this study is that HAL lies in a peer group of relatively high quality airports; typical of airports seeking to compete for high value international transfer passengers, as these airports do. This may indicate that HAL will tend to incur a higher level of opex than airports which aim for a different balance of market segments, where a relatively lower quality of service might be more typical. It may also mean that it is not appropriate for HAL to seek to achieve the level of efficiency of some other airports, as to do so would be damaging to its market. However, based on a quality of service arguments alone, HAL should not necessarily require a greater level of opex than other airports in its peer group.

PART 1: ANALYTICAL APPROACH AND ACTUAL PERFORMANCE AGAINST THE DETERMINATION

As noted above, we have used a range of different methods to assess HAL's opex efficiency and to consider the scope for potential future opex efficiency savings. In this Part 1, we focus on HAL's cost performance against the determination and against staff cost benchmarks, being those components of our analysis which deal with actual performance against the current determination. Those elements of our analysis relevant to this Part and a summary of our approach are highlighted in Figure P1.1 below:

Figure P1.1: Part 1 approaches used to assess HAL's opex efficiency



Cost performance and performance against staff benchmarks are considered in the subsequent 2 sections of this report.

3. HAL COST PERFORMANCE AGAINST DETERMINATION

3.1. Introduction

We have considered HAL's opex performance against the determination for the last three years of Q5 and the start of Q6. Our analysis in this section is top-down, starting from a high-level overview of HAL's performance, relative to the determination, and from this we identified areas for deeper investigation.

When reviewing HAL's Q6 performance relative to the CAA's determination, our intention was not to 'redo the determination', i.e. to say whether the CAA's determination was set at the right level, given HAL's observed costs. Our remit was to undertake a relatively 'top-down' analysis, so we analysed the Q6 performance with the view of assessing HAL's relative position, and to provide an indication of the scope for future efficiencies. Given the considerable detailed analysis undertaken within each of HAL's cost categories during the preparation for Q6, it would not have been appropriate for us to provide an assessment of whether HAL's Q6 allowance should be higher or lower.

With this in mind (i.e. taking the determination as given), we focused our attention to cost areas where HAL's actual costs varied the most from the determination, either higher or lower. Cost overruns are of interest because they highlight areas to consider whether there may be inefficiency. Cost outperformance is also of interest because it may "reveal" efficiencies that should be applied to HAL's determination in future years, e.g. H7. However, in some instances where HAL's Q6 costs were higher than the determination, HAL stated that this was because the CAA did not allow certain costs, implying that it was not feasible for HAL to undertake its operational functions within the constraints of the determination.

This section discusses:

- Cost re-categorisation post the Q6 determination and the impacts of that; and
- The time period of our analysis;

It then provides an analysis of performance under following sub-sections:

- Total operating costs;
- Costs by category;
- Capitalisation issues;

Finally, it provides an overall summary of cost performance to date compared to the Q6 determination.

3.2. Cost re-categorisation

When reading this section it should be noted that HAL reclassified some of its costs in the run-up to the Q6 determination and it therefore, also adjusted the CAA's cost breakdown to account for this reclassification, while preserving the total.

The background to this change is that in the period leading up to the first year of Q6, Heathrow Airport Holdings (HAH, the group owner of Heathrow) sold all its other airports,⁹ leaving Heathrow as the only airport in the group. The division of activities at the time of these sales was such that HAH retained a larger proportion of the group costs than had previously been allocated to it. Further, HAL chose to transfer a large number of formerly intergroup staff to the airport company. This both increased HAL's costs in total, and reallocated costs between categories, so that the costs are no longer categorised in the same way as at the Q5 determination. This is just one reason that cost categories are fungible and an analysis of total cost is more appropriate in some areas. As a result, in our Q5 analysis we can only reliably analyse opex at a granular category level where those categories are less fungible, e.g. energy costs.

In comparing HAL's cost against the determination, we have used HAL's reallocated version of the CAA's determination. This reclassification is particularly relevant to the 'Staff' and 'Other' cost categories and is discussed in more detail in those sections.

However, in some instances, the impact of this change is that it has been difficult to ascertain HAL's performance against the CAA's determination profile over Q6. There are instances where comparison of the Q5 and Q6 determinations versus Heathrow's actual costs in those years is not straightforward. To achieve a comparison, we have cross-referred to several different sources of information including regulatory accounts, the CAA's determination and HAL's business plan. Given that HAL's actual costs are provided in the regulatory accounts, we used the categorisation in the regulatory accounts as the basis for our analysis, but have made some simple assumptions to estimate how the CAA's price control determination applied to these categories.

3.3. Time period of analysis

While the focus of our analysis has been the period Q6 to date, we have also included the end of Q5, because the consultant reports commissioned by the CAA in the run up to Q6 were produced before the end of that control period. In extending the analysis back into Q5, we have had to take into account the re-categorisation that HAL has undertaken, which is discussed above.

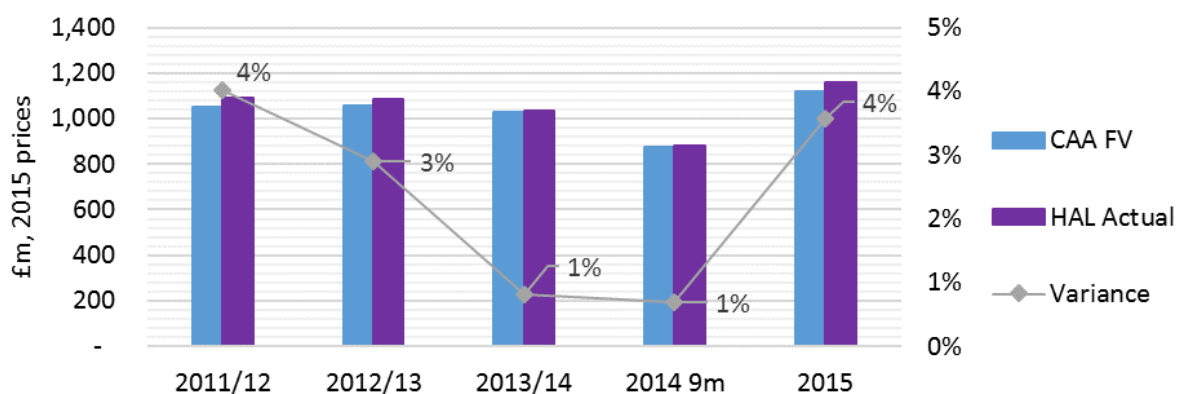
⁹ There is a substantial overlap in the major shareholders of the acquiring companies and HAH.

3.4. Total operating costs

As set out in the CAA’s Final View (p.302), the CAA set HAL an opex allowance of £4.7bn over Q6 (in 2011/12 real prices). This corresponds to a 2% per year reduction in real opex over the course of Q6, or a 1.5% per year reduction relative to 2012/13.

At a total level, HAL’s actual opex has been consistently similar to – although slightly higher than – the CAA’s determination. For Q6, total cost overruns were 1% for 2014 (9 months) and 4% for 2015, or £6m and £40m respectively.

Figure 3.1: HAL actual total costs versus the CAA’s determination



Note: opex allowance for 2013/14 was supplied by HAL

However, as shown below there are material cost differences, both positive and negative, at a more detailed cost category level. For 2014 9m (Figure 3.2) and 2015 (Figure 3.3), there was some (offsetting) variation at a category level, with cost overruns for staff and other costs (and adjustments) and outperformance in the maintenance & equipment, rent & rates, and utilities categories.

Figure 3.2: Breakdown of HAL actual costs versus the CAA’s determination in 2014 (9m)

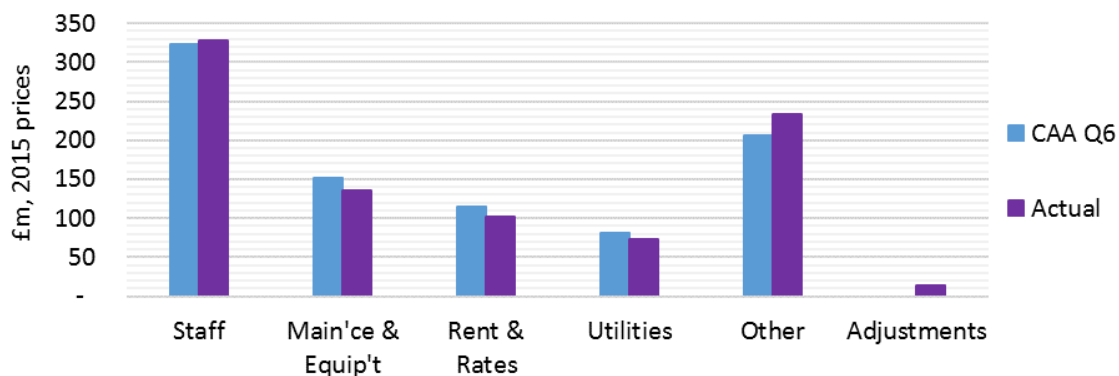


Figure 3.3: Breakdown of HAL actual costs versus the CAA's determination in 2015

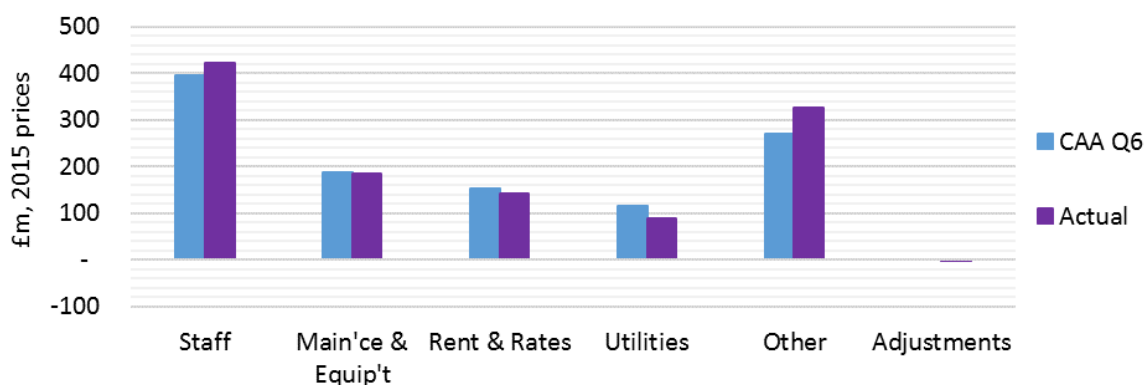
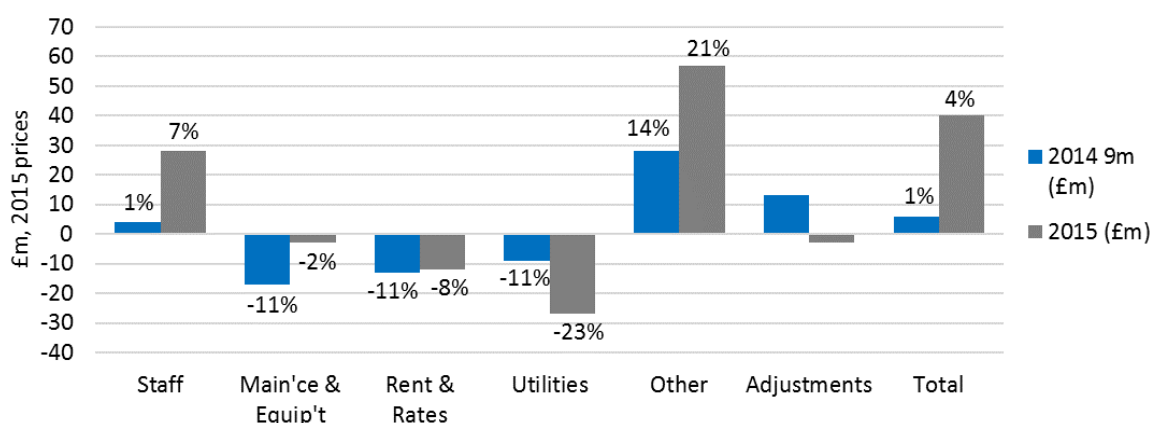


Figure 3.4 provides an analysis of costs for Q6 only (2014 and 2015) against the Q6 determination. Each cost category is discussed in more detail in the sections that follow.

Figure 3.4: Difference between HAL actual costs and the CAA's determination, Q6



Notes: Difference is shown as nominal £m (column size) and as a % of the determination (column label).

3.5. Costs by category

3.5.1. Staff costs

HAL's staff costs include only the costs of staff directly employed by HAL, and contracted personnel where the only service provided is labour working to HAL's management. Where Heathrow contracts out the provision of a service, for example the hold baggage screening, this is not accounted for as a staff cost. The main categories of staff are security, operational and non-operational. Staff pension costs are treated as a separate staff cost category.

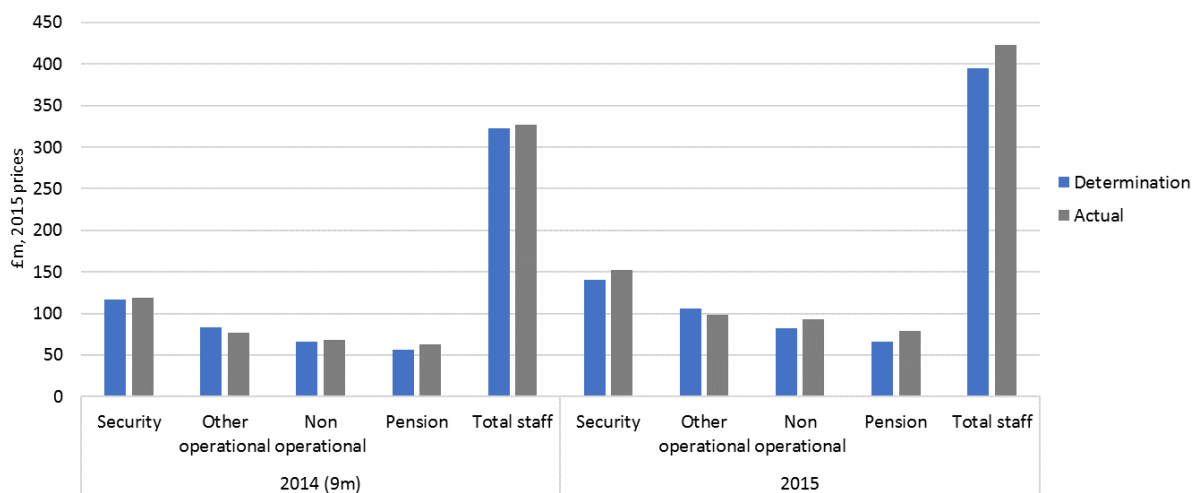
At the end of Q5 (i.e. for 2013/14), HAL's actual total staff costs were £421m. This was considerably higher than the allowance (note: opex allowance for 2013/14 was supplied by HAL), at least in part due the incorporation of Group (head office) staff into HAL following the sale of other airports. At the same time 'Other' costs were substantially reduced. This amounted to a reclassification of costs from 'Other' to 'Staff' which took place after the Q6 determination. However, the net effect was to increase total costs, since HAL absorbed some costs previously charged out to airports divested. HAL has provided us with an adjusted

version of the CAA’s breakdown of costs, to account for the cost reclassification. As noted above, we compare HAL’s actual costs against this adjusted version of the CAA’s cost breakdown.

The CAA set HAL a target of reducing employee pay by 17.5% over Q6, via a glide path. The CAA also set a significant target for pension costs reduction ([✂])¹⁰ between the end of Q5 and the end of Q6; the CAA required this sharp decrease in defined benefit contributions at the start of Q6, without any glide path. This was because this reduction was planned but not delivered in Q5, so the CAA considered it to be an inefficient cost that should not be remunerated. However, although the CAA set a reduced allowance for pensions overall, this did include a (smaller) rise in the allowance for payments made in Q6 to repair the pension deficit.

HAL’s total staff costs to date in Q6 have been above the determination, as shown in Figure 3.5

Figure 3.5: Breakdown of HAL staff costs versus the CAA’s Q6 determination



Comments from HAL

- Security costs were £11m higher (than the determination) “*primarily due to growth in passengers*”.
- Employment costs decreased due to “*new starter rates, increased productivity and lower overall headcount*”.
- Whilst a number of costs simply transferred between terminals, as they were passenger volume related (e.g. security), there were “*a number of fixed costs that remained, e.g. security fixed posts*”, which impacted on operating costs for 2015.
- HAL has noted that pension costs are “£13m higher” than the determination in 2015, which is likely due to the lack of glide path in the CAA’s determination.

¹⁰ Sourced from the CAA’s internal analysis

Assessment

HAL's actual security staff costs in Q6 have exceeded the determination. Some, although not all of this, may be explained by higher than expected passenger numbers. In addition, HAL's security staff costs (and security costs in general) fell by 10% in 2015, as a result of reduced starting salaries for new security staff. This is considerable given that security staff FTEs (and person years) have remained fairly constant, i.e. it implies a significant reduction in security staff costs per FTE. However, this does not yet meet the determination target – staff turnover at the airport is low and it will take a long time for new staff cohorts to displace higher paid established staff. Overall, however it suggests that HAL is starting to make efficiency gains.

The reduction in pension costs between 2013 and 2015 suggests that HAL is also working to reduce its costs to reach the CAA's benchmark. For example, HAL has stated that its defined benefit contribution rates have fallen [✂]. However, cost overruns to date (versus the determination) suggest that HAL continues to trail the efficiency target. We noted previously that the CAA did not provide a glide path in the determination, so we would expect some costs overruns at the start of Q6.

Although not identified by HAL, the 2015 cost overrun for non-operational staff costs may result, at least in part, from the cost of staff engaged on tasks related to the new runway, which would not be considered as costs allowed for regulatory purposes.

Section 4 discusses benchmarking of labour costs by category against external benchmarks and therefore, supplements this sub-section.

3.5.2. Maintenance and equipment

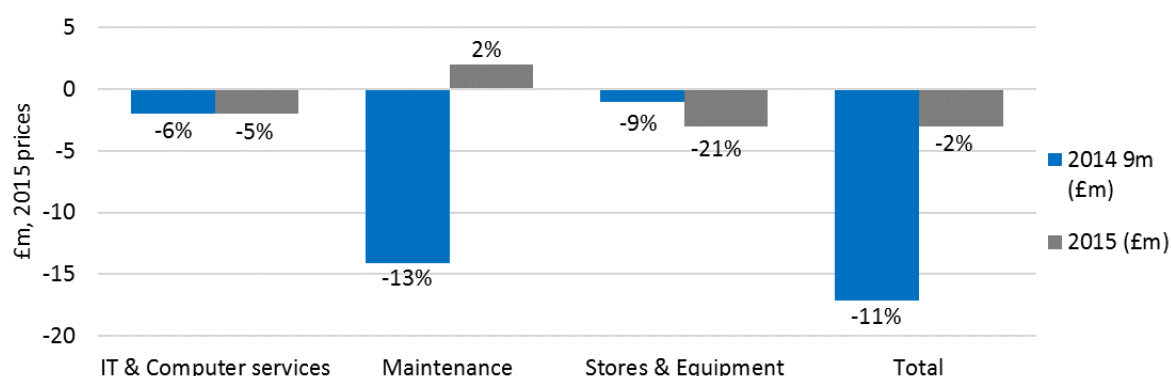
This cost category includes the maintenance of assets, operation and maintenance of baggage systems, opex associated with vehicles and IT assets, and HAL facilities maintenance expenditure. Based on HAL's actual costs in 2015, the majority (circa 70%) is maintenance costs, around 20% relates to IT and computer services, and the remainder is for stores and equipment. HAL outsources the majority of its maintenance to contractors. For Q6, 70% of maintenance, primarily planned maintenance, is contracted out, with HAL employing three main contractors.

At the end of Q5 (for 2013/14), actual maintenance and equipment costs were £165m. The CAA's allowance for Q6 is set to rise to £183m by 2018, but is comprised of an initial increase of 21% at the start of Q6, relative to 2013/14 (due to the opening of Terminal 2), and a subsequent 1.9% per annum reduction in real costs across the remainder of Q6.

Figure 3.6 (below) illustrates the variance between HAL's actual maintenance and equipment expenditure and the CAA's Q6 determination. HAL achieved outperformance in the first regulatory financial period of Q6 (2014 – the 9-month period), whilst in 2015 HAL's costs were broadly in line with the determination. The reported variance in 2014 (9m) primarily resulted from lower than anticipated maintenance costs, at £14m below the determination. HAL's

'stores and equipment' costs were 21% lower than the determination in 2015, but this category is small so the impact in £m terms is modest.

Figure 3.6: Maintenance & equipment costs: Variance of HAL actual vs. the CAA's determination, Q6



Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

Comments from HAL

- The variance in maintenance costs in 2014 was “mainly due to Maintenance (+£14m) and lower operations and maintenance costs in baggage generated by a new contract, which are offset by reduced Other Regulated Charges (ORC) income.” HAL explained that, in response to lower forecast costs (e.g. due to the new baggage contract), its income also fell, such that there was a “neutral impact on regulatory operating profit”.
- There was a “delay in go-live T3IB” (Terminal 3 Integrated Baggage system) but some “one-off T2 operational readiness spend”.
- “The baggage contract efficiency was included in the ABP, which led the CAA to apply further efficiencies based on the reduced baggage costs.”

Assessment

Based on the analysis that we have undertaken for Q6 so far, it is not clear if HAL's cost performance is the result of real efficiency savings or, a higher determination providing relatively easy scope for outperformance at the start of Q6.

In real terms, HAL's opex allowance (expressed per 12-month year) was higher at the start of Q6 than in 2013/14. This may have presented opportunities to outperform, and could partly explain the variance in maintenance costs in 2014 9m. There was also a delay in implementing the T3 Integrated Baggage project, which may have delayed operational costs, contingent upon the implementation of the new service, and may be another explanation for lower-than-expected costs in 2014 9m.

Some cost reductions could also be a continuation of the efficiency due to the new baggage contract, which was negotiated in Q5, so although this generates a variance in Q6, it is not a *genuine Q6 efficiency*. As noted above, HAL states that the projected baggage contract efficiency was included within the Q6 determination. However, if this is the case, it is not fully clear how this reconciles with another of HAL's comments (above) that the variance in

maintenance costs in 2014 was partly due to “*lower operations and maintenance costs in baggage generated by a new contract.*” We note that HAL argues that the overall impact was neutral as its income also fell.

Whatever the underlying reasons, HAL is performing well to date in relation to this aspect of opex but the more significant cost challenge within the Q6 determination starts in the later years. As we do not have access to forecasts for the remainder of the period, we cannot comment on the likelihood of efficiency savings over the course of the complete control period. The CAA may therefore, wish to reassess HAL’s cost performance later in Q6.

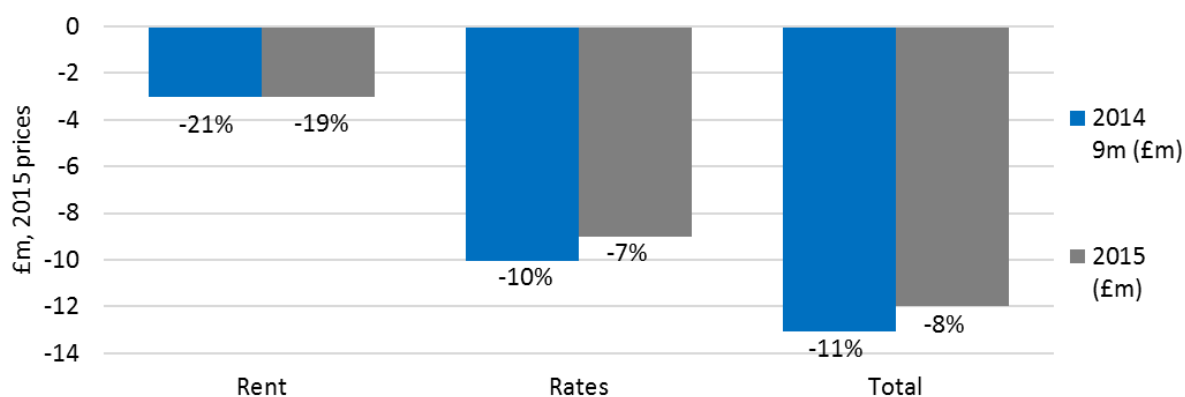
3.5.3. Rent and rates

Business rates are a tax charged on most non-domestic properties. Rates are calculated as the rateable value (RV) of properties multiplied by the rate poundage multiplier. HAL’s rent costs cover its various leases and licences for its land and accommodation.

At the end of Q5 HAL’s rent and rates costs were £125m. For Q6, the CAA allowed an initial increase of £30m (24%) in 2014 due to T2 re-opening. There is a further significant increase in the allowance in 2017 due to the upcoming rate revaluation (although with an uncertainty mechanism for this revaluation if costs are significantly higher or lower than the CAA’s forecasts). By 2018 HAL’s allowance will have risen to £193m.

In both 2014 and 2015 HAL’s actual costs for rent and rates were considerably below the determination (by £13m in 2014 and £12m in 2015), as shown in Figure 3.7. The majority of this variance arises from rates (£10m in 2014 and £9m in 2015), although rents has a larger variance in percentage terms.

Figure 3.7: Rent and rates: Variance of HAL actual costs versus the CAA’s determination, Q6



Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

Comments from HAL

- In 2014 rates costs were reduced by (£10m) as a result of a “*lower than forecast rateable value of the airport assets*”. The reduction in rents was partly due to Heathrow Point West and World Business Centre 2 premises being vacated earlier than expected.

- This cost variance (created in 2014) was continued in 2015 for the same reasons.
- HAL has further explained the reduction in rateable value of airport assets, which was “a result of renegotiation with Valuation Office Agency (VOA)”. HAL also stated that, given the potential spike in rates costs in Q6 (due to the opening of Terminal 2 and T3IB), it agreed with the Valuation Office Agency to “phase through Q6” the increase in actual rates costs, to “avoid the one-off spikes in the settlement”.

Assessment

HAL states its rates costs are lower than the determination as a result of a “lower than forecast rateable value of the airport assets”. This suggests that the CAA might consider the merits of using a pass through of actual rates costs, in place of a forecast.

Given there is a cost-sharing mechanism in place for increased rates post-2017, and given that negotiation plays a role in the rate-setting process, we note that the regulatory incentives vary over time, i.e. HAL would retain 100% of any outperformance prior to 2017, but share cost changes post 2017. This may have given HAL large incentives to negotiate lower rates costs early in Q6, but lower incentives to negotiate low rates costs post-2017. HAL states strongly that this is not the case and notes that “Heathrow worked with the VOA (Valuation Office Agency) through the revaluation period to establish valuation assumptions that were correct and reasonable”.¹¹ However further investigation would be required to understand how it was possible for HAL to outperform so significantly.

For rents, the early closure of premises (e.g. Heathrow Point West) may represent genuine efficiency savings. However, HAL’s explanation for the cost reduction does not seem fully comprehensive, e.g. the lease for Heathrow Point West was due to end in September 2014, so in theory HAL should not have budgeted costs for 2015, i.e. early vacation would not explain savings in 2015.

3.5.4. Utilities

Approximately 50% of HAL’s utility expenditure arises from electricity costs, with the remainder spent on gas (c.10%), waste and recycling (c.5%), water and sewerage (c.5%) and ‘other’ costs (c.30%).

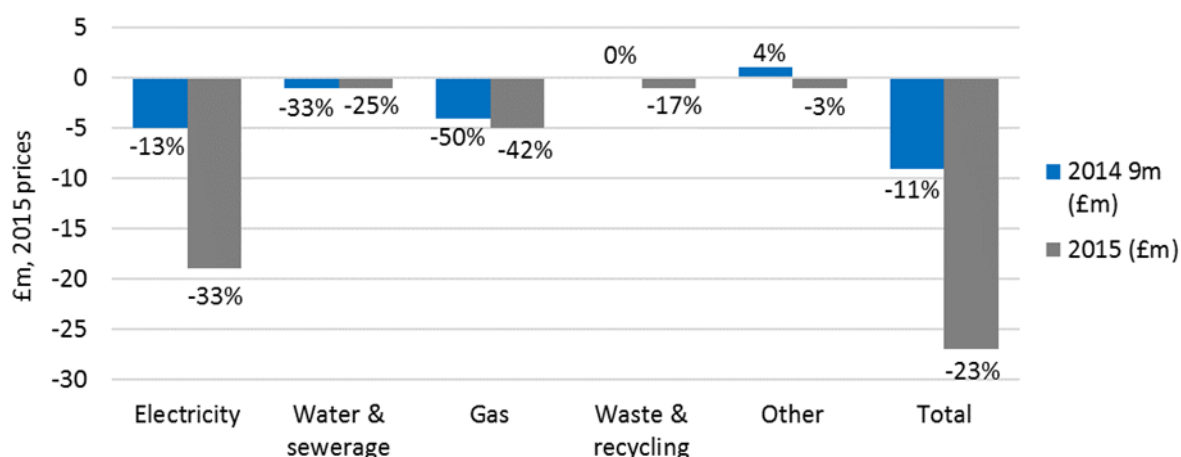
At the end of Q5 HAL’s actual utility costs were £89m. The CAA’s determination allowed for an increase in utility costs at the start of Q6 (relative to the end of Q5) of circa 20% and a further 8% increase in 2015, predominantly due to the opening of T2. HAL’s cost allowance is then stable for the remainder of Q6 (in real prices).

HAL has been able to considerably outperform the Q6 determination to date (by as much as 10%), as shown in Figure 3.8. Electricity costs create the largest variance in £m terms, whilst

¹¹ Response received from HAL, 24th April 2017

gas costs vary the most in percentage terms. HAL also outperformed in the last three years of Q5.

Figure 3.8: Utility costs: Variance of HAL actual costs versus the CAA’s determination, Q6



Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

Comments from HAL

- In 2014, the favourable variance was driven by lower-than-expected electricity costs (due to “reduced consumption aided by Energy Demand management projects and lower prices due to macroeconomic/market force factors”) and lower-than-expected gas costs (driven by reduced consumption due to “the closure of a boiler house, milder weather than average and a reduced price”).
- In 2015, the significant reduction in electricity costs was due to lower consumption (“supported by Energy Demand Management projects”) plus “lower electricity unit prices and forecast carbon reduction commitment that is no longer payable”. Gas costs were lower-than-expected due to “lower consumption in T2 than forecasted and milder weather than normal”.

Assessment

There seem to be several reasons behind the outperformance observed in Q6 to date. Firstly, genuine opex efficiencies appear to have been made through Energy Demand Management (EDM)¹² strategies, e.g. converting to electric airline tugs. This is in part about being smarter in operations, but we are also aware that HAL is investing in energy efficiency via its capital programme. It is therefore likely that, some of the outperformance arises from genuine opex efficiency savings in relation to utility costs. However, some of these opex efficiencies may have been generated via capital substitution (i.e. spending more on capex to make opex savings), in which case the *net* efficiency could be lower.

Secondly, HAL has benefited in Q6 from lower market prices for gas and electricity. The extent to which such costs are within its control are debatable. On the one hand, HAL should be

¹² The modification of consumer energy demand through the use of a variety of mechanisms such as financial incentives and behavioural changes.

seeking to optimize its purchasing strategy, e.g. hedging over different time periods. However, HAL is primarily an airport operator, rather than an energy market specialist, and so it seems fair to provide some allowance for costs varying from the determination. Nevertheless, this also implies that HAL is not fully responsible for outperformance, and any outperformance due to market movements should be viewed more like a fluctuation than a genuine efficiency saving. HAL has similarly also benefited from milder weather, which has reduced gas consumption and therefore costs. Again, this is not a controllable factor, so is a fluctuation rather than an efficiency.

In order to determine the extent of the real efficiency, it would be necessary to compare how much of the outperformance is due to EDM, as opposed to changes in market prices and the weather. It would also be relevant to consider the extent to which opex efficiencies from EDM have been offset by increased capital expenditure (capex), i.e. through capital substitution.

3.5.5. Other costs

Following reclassification a substantial part of the 'Other' cost category, described in the CAA's determination, was transferred to Staff Costs. As noted previously, we use HAL's revised allocation of staff and other costs in our analysis. In 2015, the 'Other' costs as determined by the CAA and adjusted by HAL came to £270m, or around a quarter of total opex.¹³ The CAA set HAL a target of reducing these costs by roundly 3% per annum over the course of Q6.¹⁴

Costs in this category cover operational and overhead costs, including fees to NATS for air traffic control / navigation services, insurance, marketing, communications, expenditure on consultants, expenses, etc. (accounting for roundly half of other costs). The remainder are divided between police, rail (Heathrow Express), cleaning (mainly outsourced), costs associated with Passengers with Reduced Mobility (PRM), and intragroup costs.

In terms of HAL's performance, costs exceeded the determination by 14% in 2014 (9-month period) and by 21% in 2015. A breakdown is provided in Figure 3.9 below. Within 'other costs,' cost overruns are greatest for general operational expenses, retail marketing, and other marketing and communications. HAL has clarified that this cost overrun has four main aspects:

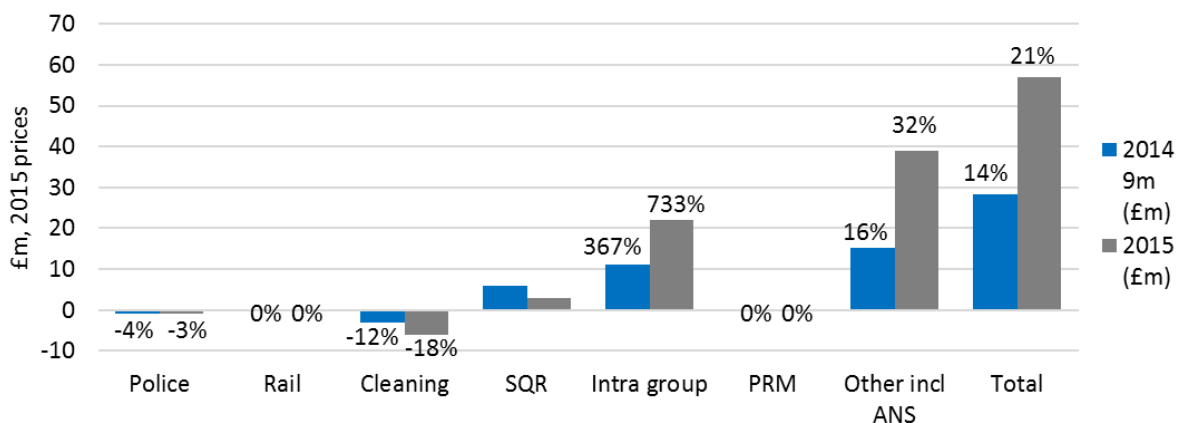
- Costs of preparing for a possible new runway,

¹³ At the time of the CAA's Q6 determination, HAL's ABP forecast that 'other' costs would be £388m in 2013/14. However, following the sale of HAL's other airports in 2013 and 2014, a large portion of costs were reallocated from intergroup to staff costs. As such, it is not a like-for-like comparison to compare the end of Q5 with the beginning of Q6, because the categorisation of costs has changed. To make this clearer, HAL restated the CAA's allowance to re-align it more closely with its actual costs, and this is how the £270m figure has been obtained.

¹⁴ The CAA's determination does refer to 'other' costs but in a slightly different way to the regulatory accounts. Based on the categories in the CAA's allowance, the average annual reduction in costs is circa 3%. However, due to the reallocation of costs away from other and towards staff costs, it may imply a somewhat different percentage cost reduction, but it is not possible to calculate what this would be.

- Intragroup costs, such as payments made from HAL to the owners and Board costs, which have increased,¹⁵
- Improving ‘airport resilience’ – expenditure on resources and equipment to prepare for bad weather, principally snow, and
- Capitalisation of ‘other costs’ was significantly lower than in the CAA’s determination (by 56%), meaning fewer costs were moved from opex to capex, thereby increasing anticipated opex.

Figure 3.9: ‘Other’ costs: Variance of HAL actual costs versus the CAA’s determination, Q6



Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

Comments from HAL

- In 2014 (9m) the variance was due to: “a reversal of SQR scheme (£6m)”; “intra group costs not allowed by the CAA / not included in the determination (£11m)”; and a rise in ‘other’ costs (£15m) due to “increased spend on airport resilience and on submissions to the Airports Commission regarding runway capacity”. In addition, “following the sale of the regional airports, around [X] of Corporate centre cost has been consolidated into Heathrow opex.” This is due to the sale of Southampton, Glasgow and Aberdeen airports in 2014.
- In 2015, the £57m variance was due to: “intra group costs disallowed by the CAA / not included within the determination (£22m)” and higher ‘other’ costs (£39m) due to “higher spend on airport operational resilience and active engagement in the debate on runway capacity in SE England, neither of which were considered in the determination”.
- T2 opened earlier than expected (June 2014), but it did so “with a restricted flight schedule, which meant that there was a requirement that T1 had to remain in

¹⁵ Even though the reorganisation moved a lot of Intragroup costs to Staff costs, the resulting Intragroup costs are still higher than shown in HAL’s adjusted version of the CAA’s determination to account for this reclassification.

operation". This created "additional marginal costs" at T2, plus HAL still needed to incur the "fixed costs" at T1, e.g. customer service staff.

- Following additional discussions with HAL, greater explanation was provided to clarify the variances in these 'other' costs:
 - HAL has clarified that [X] of intragroup costs in 2014 relate to 'Central services' (e.g. payments made from HAL to the owners, board costs, etc.).
 - In relation to resilience costs, HAL states that these additional costs were incurred in relation to expenditure on resources and equipment to prepare for "bad weather, principally snow". HAL states that it made the decision to undertake this expenditure when "the airport suffered some disruption from snow at the start of Q6". Therefore, HAL states that these costs were "not anticipated¹⁶ and not included in the Q6 settlement".

Assessment

Overall, HAL's main argument is that the CAA did not consider (or did not allow) certain 'other' costs at the time of the determination, e.g. costs relating to the runway debate, intragroup costs, and improving airport resilience.

- We agree that a large proportion of these costs are out of scope. However, the magnitude of the cost variance (+£39m) across runway preparation costs and airport resilience costs for a single year (2015) does appear high.
- We note that HAL has been allowed up to £10m per year for runway planning permission costs going forward,¹⁷ now that Heathrow is the government's preferred provider of a new runway, but this does not retrospectively allow its previous costs of preparing or lobbying for this status.
- HAL also noted some double-running costs from T2 opening earlier than expected. In considering whether this additional expenditure is justified from a customer perspective, key issues are whether it was solely HAL's decision to open T2 early, whether they communicated (and obtained approval) for increased costs, and the extent to which these costs were controllable.
- Some of the additional costs are due to intergroup payments (to the owners, Board costs, etc.), and we agree with HAL that such costs are outside of the regulatory settlement.
- HAL will likely wish to make a case that the additional resilience costs for bad weather it did not previously anticipate are justified, e.g. on safety grounds and reducing disruption. It would require detailed analysis to consider the extent that these

¹⁶ We interpret this as meaning that although the requirement for resilience was clear at the time HAL costed Q6, HAL did not at the time fully anticipate what it would intend to spend on it.

¹⁷ <http://publicapps.caa.co.uk/docs/33/CAP%201470%20NOV16.pdf>

additional costs are justified, e.g. whether HAL has received allowances in previous price control periods to cover resilience.

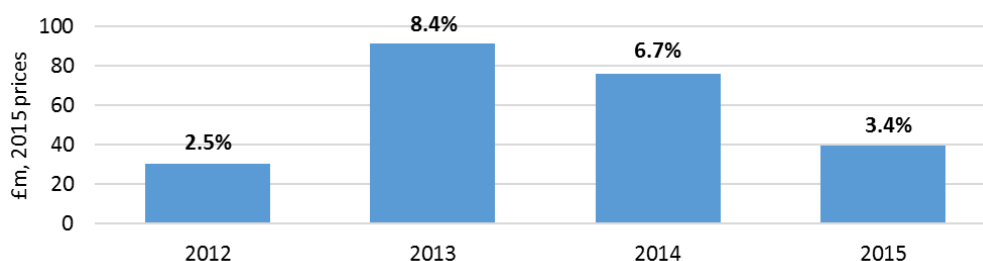
- More generally, it is important to note that the 'other' cost category is the least transparent: it contains a number of different categories, including some 'new' cost items (e.g. costs preparing for a potential new runway, as noted by HAL), and is therefore difficult to benchmark / assess for efficiency. It may be desirable therefore to revise and standardise the cost categories within the scope of 'other costs' to facilitate future comparisons.

Overall HAL has offered reasonable explanations for why it has recorded these cost overruns, albeit at a relatively high level. It has however, incurred some costs which the CAA may consider were not essential to the purpose of running the airport to the standard it desires. The CAA may wish to identify such costs more precisely, so as to consider them individually, and decide how to treat them going forward.

3.6. Issue of concern: capitalisation of costs

By taking careful account of the way the regulatory process will in practice treat capitalisation, regulated companies may have an incentive to 'game' the regulatory settlement by moving costs between opex and capex in order to maximise their returns. HAL's operating costs show material capitalisation (see chart below) and therefore, it is an area that warrants some investigation.

Figure 3.10: Capitalisation of opex, 2012 to 2015



Notes: Capitalisation is shown as £m (column size) and as a % of total opex (column label).

We note that the proportion of capitalised costs varies significantly from one year to the next. Capex tends to be lumpy, so we would expect the value of capitalised costs to vary over time and therefore potentially, the proportion of opex that is capitalised will vary.

However, a concern emerging from HAL's capitalisation data is a lack of transparency from a regulatory perspective, such that we are not in a position to determine the extent to which the process is robust. We believe that capital expenditure incurred in this way may not always be subject to explicit consideration, as part of the capital governance process that exist for airlines to have influence over the selection and cost of capital projects. We have asked for, but only received, a limited explanation from HAL of the variation in capitalisation in different years (shown in the chart above), and the low level of capitalisation in 2015. HAL has provided its capitalisation policy and we understand that HAL's capitalised costs are externally audited

for compliance with that policy. However, it is not clear to what extent there are *regulatory* safeguards in this area, for example to ensure that opex capitalised offers value for money.

Overall, it is not possible for us to assess (based on the data provided) to what extent HAL's capitalisation approach is appropriate in regulatory terms and therefore, this may merit further investigation and / or monitoring by the CAA.

3.7. Summary

HAL's total costs for the end of Q5 and the start of Q6 are broadly in line with, although marginally higher than, the CAA's determination. Our analysis of the drivers of this performance provides a mixed picture. Cost reductions appear to result from:

- Some genuine Q6 efficiency savings in utility costs (EDM), staff costs (e.g. lower starting salaries), and rents (early vacation of premises).
- The baggage maintenance contract, agreed in Q5, has produced efficiencies which have contributed to allowing HAL to outperform the Q6 determination.
- Lower costs due to favourable conditions, which have reduced uncontrollable aspects of energy costs (lower market prices and milder weather).
- Factors which are currently not fully explained i.e. lower rates and rent costs.

Cost overruns appear to be due to a combination of:

- The determination requiring sharp cost reductions, sometimes such that cost overruns at the start of Q6 are inevitable, i.e. pension costs.
- The addition of costs which are out of scope of the regulatory determination, i.e. costs involved in preparing for a potential new runway and payments to owners.
- Costs arising from new requirements which HAL now considers it did not fully anticipate in the settlement e.g. costs of resilience.

Whilst HAL's costs have been close to the determination to date, the lack of transparency around the capitalisation of opex, [✂], means that it is difficult to provide a confident view about the efficiency trajectory of HAL's opex relative to the determination. While HAL's opex appears to be falling in line with (or at least close to) the expectations of the determination, we recommend that trends continue to be monitored as further audited data becomes available.

We consider that it would be worth investigating a number of areas further:

- The reasonable level of intergroup costs following HAL's divestment of other airports, taking into account both costs still accounted for as intergroup costs and costs that have been reallocated to staff costs;
- The transparency of the 'other cost' category, to devise more stable and useful categories of cost;

- Capitalisation of opex, to ensure that there is explicit oversight and assessment of the value for money of this form of capital expenditure; and
- Identifying the costs of activities that the CAA would not consider part of the core business of running the airport to its desired standard.

4. HAL'S STAFF COSTS AGAINST AVAILABLE EXTERNAL STAFF BENCHMARKS

4.1. Introduction

This section provides an analysis of staff costs against available external benchmarks, using HAL data and now limited available external comparator data¹⁸, for the purpose of assessing how HAL is performing to date against the current determination.

4.2. HAL staff costs against benchmarks

There have been several previous studies benchmarking wages at Heathrow, in some cases alongside the other London airports previously in common ownership with Heathrow. These studies have highlighted that an inherent difficulty with such benchmarking is that a substantive proportion of airport labour roles are distinctive from comparable roles elsewhere in the economy. There are clearly other airports, but the best sources of wage data do not distinguish specific airport labour roles. Moreover, within the airport sector, Heathrow forms such a large fraction of the airport activity in the economy, and is also so distinctive in its location, that even using airport-specific roles for benchmarking is difficult.

These difficulties are clearly illustrated by the largest component of the labour Heathrow employs, security staff. The airport security role is quite distinctive from other security roles, requiring a higher level of training and customer-facing skill than the generality of other such roles. It is also substantially better paid.

As a result of these issues, we benchmark trends in labour costs rather than levels of labour costs, and benchmark against non-airport roles. However a potential difficulty in benchmarking against non-airport roles is that, it is possible that airport wages are somewhat less responsive to trends in the labour market as a whole than most other roles. In Thomson-IDS's previous detailed labour benchmarking report on Heathrow, it notes the labour turnover of airport staff is much lower than the general labour market.¹⁹ To us, this indicates that airport employment is sought after, and that airport employment perhaps provides higher benefits to employees than the generality of similar roles the employees might be qualified for.

Labour cost trends also vary regionally, and an interesting question is what region is best for comparing Heathrow. Clearly geographically it lies in the London region but, London wages as a whole are substantially affected by central London wages, which may be different from outer London wages. Heathrow lies right on the edge of London and may therefore, have similarity with South East regional wages.

¹⁸ We rely on the Annual Survey of Hours and Earnings (ASHE). HAL has suggested using another external comparator – Xpert HR – which carried out a transport salary survey in 2016. However, only 1 data point from this source is currently available, and therefore we have decided to use ASHE.

¹⁹ See Section 10.2 of *Benchmarking employment costs, A research report for the CAA, Heathrow*, Thomson-IDS, 2013

4.2.1. HAL data

To facilitate our analysis, HAL has provided us with data on person-years of labour and wage costs, split in a number of ways for the years 2012 to 2015 inclusive and part year 2016. The data provided is shown in the following tables. Following discussion with HAL, our understanding is that these categories comprehensively cover all of HAL's staff, without overlaps. We also note that corporate restructurings occurred between 2012 and 2013 as all airports, other than Heathrow itself, were sold to other companies. Therefore, HAL's staff FTEs and associated costs increased between 2012 and 2013.

In the tables below, contracted labour is included where that labour is directly contracted (e.g., an agency is contracted to provide a person to work under HAL management's direction). But it excludes staff where they are part of the delivery of an outsourced service, (e.g., the hold baggage screening outsourced service): those are included elsewhere in opex.

Table 4.1: FTE data provided by HAL

[✂]

Table 4.2: Staff cost data provided by HAL

[✂]

4.2.2. Approach

We have compared this data to the Annual Survey of Hours and Earnings (ASHE), produced and published by the Office for National Statistics. ASHE currently provides the only useful and practical time series of benchmarking data that we have been able to locate. It has a number of shortcomings e.g. numerous wage categories, but no airport specific categories. There are some specific air transport labour categories in the data, but these are for airline employment, not airport employment, and there is no reason to suppose that wages for airline job roles relate to likely wages for airport job roles. First, these roles are quite different in nature, and second, airlines often have a choice of country to source a substantial part of their staff from, giving an international element of wage pressure much less present for airport job roles. However, despite these shortcomings, ASHE provides the best available source of benchmarking data presently available.

4.2.3. Choice of ASHE benchmarks

In the following table, we discuss how we have selected benchmarking categories for the region and for the categories of labour for which Heathrow has supplied data, including also which ASHE Region to use. In selecting benchmarks for the different categories, we used our best judgement based on the information received from HAL on the roles of the staff within each category.

Table 4.3: Benchmarking Categories

HAL staff category	Discussion	Chosen ASHE benchmark
Region	Heathrow Airport lies on the periphery of London. Since the London wage region is substantially affected by the distinctive labour market in central London, and conditions in the periphery of London bear some similarity to the South-East region, we propose to use a 50:50 average of London and South East region wages. It is noticeable that the recessionary dip in wages in the SE came a year later, so far as can be told in this annual data series, than in London.	50:50 average of London Region and South East Region
Security	The <i>Security guards and related occupations</i> category (SOC category 9421) has generally been used for this purpose and we see no reason to vary from the practice. Albeit that airport security work is distinctive from the generality of security work, we are not aware of another category that would better match the labour role. Often SOC 4-figure category data are based on a small sample that would imply a lack of statistical robustness in the reported average. But this 4-figure category is based on a sufficiently large sample to have good statistical robustness.	<i>Security guards and related occupations</i> (SOC 9421)
Engineering	We propose to use the <i>Science, engineering and technology associate professional's</i> category (SOC category 31). This is a mixed category, including a variety of trades. We feel that no 3-digit category is sufficiently broad nor is there an easy aggregation of 3-digit categories. Another problem is that some of the 3-digit categories likely to be relevant are not large enough for the data to be stable. Whilst there will likely be a senior level of professional engineers (a separate category in SOC) within this group, it seems likely that it is dominated by technical trades in the sense of this broad category.	<i>Science, engineering and technology associate professionals</i> (SOC 31)
Baggage	We propose SOC category 3, <i>Associate professional and technical occupations</i> . The largest category of baggage labour – hold baggage sorting – is contracted out and thus not included in this labour cost. Also, the actual loading and retrieval of baggage into the baggage system that Heathrow provides is carried out by Ground Handling operators contracted to airlines. The other trades in HAL's baggage category include the higher-level operation of the baggage systems, and we understand that it also includes some driving trades. Thus, we propose to benchmark it with a broad category of technical operations that include all of these.	<i>Associate professional and technical occupations</i> (SOC 3)
Airside	We propose SOC category 3, <i>Associate professional and technical occupations</i> . The largest categories of airside labour – ground handling and air traffic control – are not carried out by the Airport. Rather we understand that the trades in this category substantially include the fire service, and a variety of other, mainly technical jobs. Thus, we propose to benchmark it with a broad category of technical operations that include all of these.	<i>Associate professional and technical occupations</i> (SOC 3)

HAL staff category	Discussion	Chosen ASHE benchmark
Commercial	We propose SOC category 72, <i>Customer service occupations</i> . We understand from comments on previous benchmarking studies that the commercial function largely encompasses a customer service role, and hence we propose to benchmark it with that.	<i>Customer service occupations</i> (SOC 72)
Other Operations	We propose SOC category 3, <i>Associate professional and technical occupations</i> . Again, this is a mix of technical roles, and we propose this broad category to address it.	<i>Associate professional and technical occupations</i> (SOC 3)
Corporate	We propose SOC category 11, <i>Corporate managers and directors</i> . We expect that this role will also incorporate some more functional roles, but the cost is likely to be dominated by the managerial roles which will be concentrated in head office.	<i>Corporate managers and directors</i> (SOC 11)
Heathrow Express	We propose SOC category 356, <i>Public services and other associate professionals</i> . In principle, SOC category 8234, <i>Rail transport operatives</i> , would appear to be more suitable. But it is clear from examination of the data on category 8234 in the London and South East regions that it has been substantially distorted by the industrial disputes that have become more common in the later years under study. The effect is also large enough to affect the national figures. We therefore select 356, because transport operation has some similarity in terms of its labour market for to public sector technical trades.	<i>Public services and other associate professionals</i> (SOC 356)

4.2.4. Results and analysis

The charts below show HAL's average wage costs (per person year, including redundancy payments and other one-off staff payments), in real terms with a base year of 2015, over time. An inflation correction, which uses RPI to match the regulatory regime, was used. Figure 4.1 below shows that HAL's wage costs in most categories have risen slightly over time, as would be expected, e.g. due to inflation. At an overall level (the orange dotted line), average wages rose in 2013 but, have since been stable in nominal terms and are therefore slightly falling in real terms, which is consistent with the challenge set by the CAA.

Figure 4.1: Breakdown of Heathrow's average wage cost per person year over time (£, 2015 prices), selected categories

[✂]

Note: 2016 is based on data from the first 9 months of 2016, and has been pro-rated up to a full year figure.

Figure 4.2 below shows the two sub-categories [✂] where there appear to be some data quality issues. Specifically, average wages for [✂] have fluctuated considerably, with very high implied wages for [✂] (over [✂] in 2016, although it was previously higher). These large movements would tend to suggest that the staff populations they are being averaged over are changing substantially, which makes it difficult to benchmark them. Other difficulties may include high levels of redundancy costs at times, and possibly also varying populations of

contractor and permanent staff. Some of these issues arise from the divestment of HAL’s other airports, following which a substantial number of former holding company staff became part of HAL’s staff; redundancies also followed.

Figure 4.2: Heathrow’s average wage cost per person year over time (£, 2015 prices), selected categories where there appear to be data problems

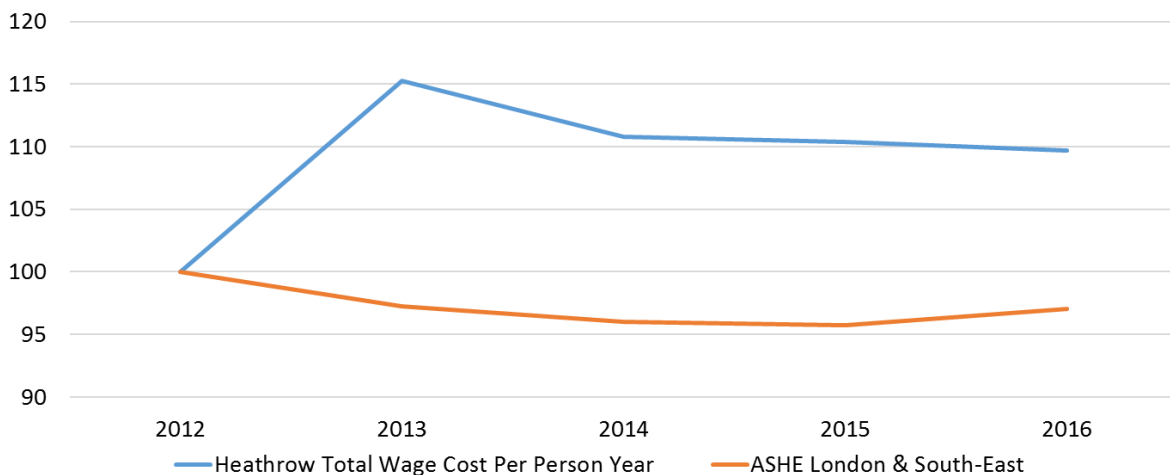
[✂]

*2016 is based on data from the first 9 months of 2016, and has been pro-rated up to a full year figure.

4.2.5. Comparison against benchmarks

In the graphs below we compare HAL’s staff wage costs per person-year (total wage costs divided by total person-years in all categories) with the relevant benchmarks. All graphs are in real terms, with a base year of 2015, so the trends are comparable, and 2012 is set as the base year for the index (2012=100). In practice, the 2012 and 2013 years are financial years, beginning in April of the stated year. We have data only for 9 months of 2016, so it is pro-rated to a full year figure, as is the 2014 9-month period. The ASHE data for 2016 is provisional.

Figure 4.3: Heathrow’s Overall Average Unit Wage Costs (Index, based on 2015 prices)



Note: Between 2012 and 2013, HAL experienced an increase in costs and man years associated with corporate staff. Therefore 2012 data is based on a lower number (and slightly different mix) of staff.

Overall, HAL’s unit wage costs appear to have increased substantially over the period under review, due to the rapid increase in 2013, as illustrated in Figure 4.3 above. From discussions with HAL, this rise in costs was related to corporate restructurings in the period as all airports, other than Heathrow itself, were sold to other companies. However, they have stayed relatively constant in nominal terms since 2013, and thus falling in real terms, whilst the benchmark has been fairly stable in real terms. This suggests that wage efficiency savings are starting to be made. From discussions with HAL, a practical example of this is that starter salaries for security staff have fallen in recent years.

Within this trend, there are several interesting observations at a more granular level – detailed results are provided in Annex B. Performance varies across the different staff categories:

- Average wage costs for [X] and the [X] have grown at a faster rate than their benchmarks, but the trends are starting to converge. This suggests that HAL is starting to make some efficiency gains. This is consistent with our discussion with HAL, which suggested that starting pay rates for [X] have been lowered in Q6. Given that [X] turnover is relatively low, this will take time to filter through.
- For [X], unit wage rates are currently growing at rates above their benchmarks, so there may be scope for efficiency.
- HAL's unit wage rates for [X] employees have only grown very slightly in recent years, i.e. by less than the benchmark. This suggests that HAL is containing wages effectively in this area.
- As noted above, data for [X] does not seem fully reliable, e.g. there may be cost allocation issues. We would therefore, recommend further detailed analysis in this area to understand what is happening. As noted elsewhere, the CAA is unlikely to view the restructuring costs from HAL's divestments to be part of the reasonable costs of operating the airport, and this may be an area where some of these costs have landed, at least temporarily.

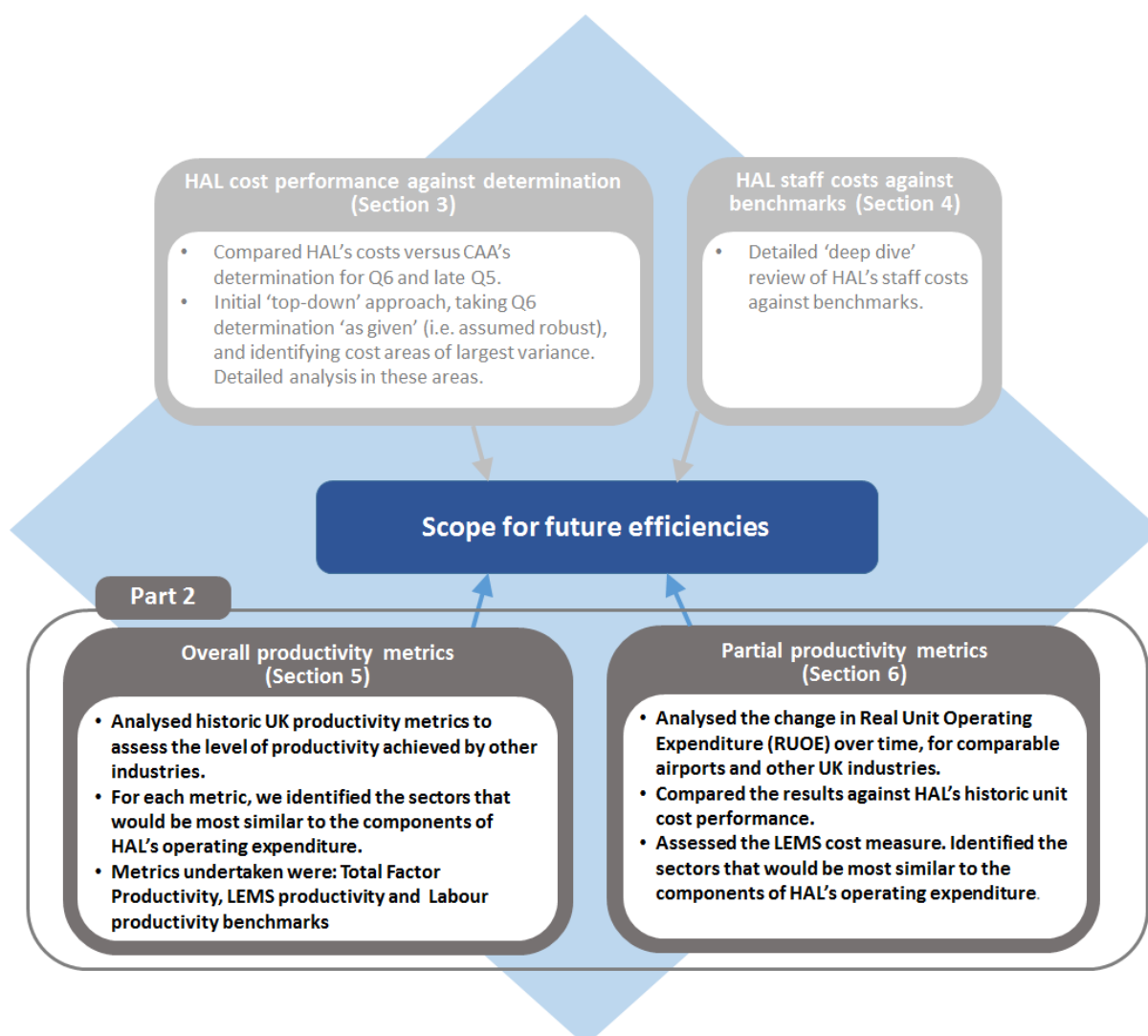
4.2.6. Assessment

Our analysis suggests that overall, HAL's costs have grown at a faster rate than relevant benchmarks, which tends to imply some ongoing scope for efficiency savings. However, HAL's unit staff costs, in nominal terms, have been relatively constant since 2013. The CAA's determination set the challenge of considerably reducing staff costs during Q6 noting that, with a nominal wage freeze, this would likely be achievable, and there is already some evidence that HAL is responding to this challenge, e.g. [X]. This finding is consistent with our analysis of costs which also suggests that some staff cost efficiencies are starting to be delivered.

PART 2: ANALYSIS OF PRODUCTIVITY METRICS

In Part 2 we focus on further external evidence of cost efficiency through the calculation of productivity metrics which compare HAL to airport peers and the wider industry. We consider two top-down approaches to productivity, which are often used by regulators as the basis for setting efficiency targets. Those elements of our analysis relevant to this Part, and a summary of our approach, are highlighted in Figure P2.1 below:

Figure P2.1: Part 2 approaches used to assess HAL's opex efficiency



Types of efficiency

Economic regulators in the UK and Ireland, including the CAA, tend to divide the opex efficiency targets for the companies they regulate between Frontier Shift (FS) and Catch-Up (CU) efficiencies.

- FS efficiency implies that the efficient cost of delivering a service is falling due to a mixture of general productivity gains in the economy, which tend to affect all producers, and also specific productivity gains in an industry, which are specifically related to the production processes in that industry. FS efficiency is what would tend

to be exhibited in a competitive industry, and a firm operating at the frontier would be market leading in terms of efficiency.

- CU efficiency implies that a firm is operating with lower efficiency than the most efficient producers of similar services, and can therefore improve its efficiency by catching up to the efficient producers. Typically, it takes time for a regulated company to improve or modify its management, operational practices, and stock of capital assets, so CU may be spread over an extended period. CU efficiency is a feature of firms which have been, or still are, protected from competition.

Different productivity metrics assess efficiency in different ways, some cover both CS and FS, others focus on one aspect. In our subsequent analysis we specify whether each metric we consider primarily refers to FS and/or to CU efficiency, and our conclusions refer to the level of CS and FS that our analysis suggests HAL should be able to deliver.

Different productivity metrics assessed in Part 2

Our analysis utilises two sets of top-down metrics:

- **Overall productivity metrics (Section 5).** These measure the change in the volume of outputs relative to the change in the volume of inputs. *This metric primarily relates to FS efficiency.* Our approach is to assess HAL's performance against industry sectors that exhibit most similarity to the components of HAL's opex.
- **Partial productivity metrics (Section 6).** These measure operating productivities over time in relation to subsets of the full range of costs. We have considered two specific metrics:
 - Partial factor cost measures (Section 6.1) calculate changes in input costs, per value of output. As with the overall productivity metrics, this is undertaken for sectors that are most similar to the components of HAL's opex. *This metric primarily relates to FS efficiency.*
 - Real Unit Operating Expenditure (RUOE) (Section 6.2). This measure includes all operating costs, but excludes capital costs. *This metric relates to both FS and CU efficiency.* We compare HAL's RUOE productivity against comparator airports and other industries with similar characteristics.

Use of historical data

For both the overall productivity and partial productivity metrics that follow, we have calculated historical trends over different time periods. The aim is, by comparing *historical* performance for HAL and other airports/sectors, 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 CU.

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 (and industries) 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 acute.

Although we consider that these top-down metrics provide an informative comparison, albeit at a high level, they use simple output measures, without adjustment for quality changes or changes in the scope of output delivered. The results should therefore, be treated as indicative of HAL's relative efficiency.

5. OVERALL PRODUCTIVITY METRICS

5.1. Introduction

We have studied three productivity metrics based on UK-wide data across a number of years in order to provide measures of annual historical productivity growth. Data is sourced from the EU KLEMS database, which was developed with support from the European Commission (EC), and which contains various measures (economic growth, productivity, employment creation, capital formation and technological change) at the industry level for all European Union member states from 1970 onwards. The data on which these are based is mainly from competitive industries. Therefore, as noted further above, the measures derived from this data can be argued to relate mainly to FS efficiency, although some cover both.

5.2. Productivity metrics

We have calculated the following three measures:

- **Total Factor Productivity (TFP):** ‘Residual’ output growth that is not accounted for by input growth, taking into account all factors of production. TFP is calculated using either the gross output or value added measure – the former includes the contribution from intermediate inputs, whereas these are excluded from the latter.
- **Labour and intermediate inputs (LEMS) Productivity (LEMSP):** The abbreviation LEMS refers to Labour Energy Materials Services. LEMSP is ‘Residual’ output growth that is not accounted for by the growth of labour and intermediate inputs. This is calculated under both flexible and constant capital assumptions.
- **Labour Productivity (LP):** The growth of output per unit of labour input growth. Or, consistent with the explanations above, ‘residual’ output growth that is not accounted for by the growth of labour inputs.

5.3. Variants of the productivity metrics

We calculate each productivity metric in a number of variants. These are summarised in the table at the end of this sub-section. The variants arise from three distinctions we make when calculating them, as follows:

- **The measure of output** – either gross output or value added. Under the gross output measures of productivity, intermediate inputs are assumed to contribute to productivity growth, whereas their impact is removed in the value-added measure. These measures generally give similar results, as shown further below.
- **Capital variability** – either variable capital or constant capital. Capital is an important factor of production however, the effect of capital growth is sometimes distortionary. To mitigate that, the measures can be calculated using a constant capital assumption.

For the purposes of setting productivity benchmarks for HAL’s opex in this report we consider both are relevant:

- On one hand, the CAA uses different processes to set HAL’s allowances for opex and capex, so it is relevant to develop an opex productivity benchmark for HAL that holds capital constant.
- On the other hand, the CAA is likely to consider growth of the capex budget to some extent when setting opex targets. For example, if HAL has received an allowance from the CAA to invest in energy efficient lightbulbs, this will reduce opex in the future, and therefore this provides an opportunity for opex productivity gains. Therefore, there is an argument for assessing productivity benchmarks that allow for capital to vary.
- **The period of coverage of the averages** – either all available years (denoted 1) or selected years (denoted 2). The variant 1 is a fixed period. However for variant 2, there are a number of options available, and these are used as sensitivities.

The following table summarises all the variants of the overall productivity metrics we calculated.

Table 5.1: An overview of the variants of productivity metrics calculated

Metric	Factors of production included	Output measure	Capital variability	Period averaging	Acronym
Total factor productivity (TFP)	Total (Capital, Labour and intermediate inputs)	Gross output	Variable capital	All available years	TFP GO
				Selected years	TFP VA 2
		Value-added		All available years	TFP VA 1
LEMS productivity (LEMSP)	Partial (Labour and intermediate inputs)	Gross output	Variable capital	All available years	LEMSP var K 1
				Selected years	LEMSP var K 2
		Value-added	Constant capital	All available years	LEMSP con K 1
				Selected years	LEMSP con K 2
Labour productivity (LP)	Partial (Labour only)	Gross output	Variable capital	All available years	LP var K 1
				Selected years	LP var K 2
		Value-added	Constant capital	All available years	LP con K 1
				Selected years	LP con K 2

Further technical details (e.g. in relation to the years selected) are contained in Annex A.

5.4. Approach

KLEMS provides data on productivity by sector of the economy. We are therefore able to choose a weighted basket by sector, through the development of a composite index that is specific to HAL i.e. that is matched to HAL’s activities. We did this as follows:

- We reviewed HAL’s costs, and calculated the percentage within each cost area.
- For each cost area we selected the most appropriate comparator sector, or multiple comparator sectors, if appropriate. As **sensitivities**, we selected various alternative weightings of the comparator sectors.
- For each of these relevant sectors, we calculated initial (unweighted) productivity metrics based on the EU KLEMS database.
- We used the percentages in the first step to weight the selected sector productivity metrics and calculate a weighted composite index for HAL.
- We calculated each of the variants to the metrics described in the previous section.
- We carried out **sensitivity analysis** as follows. For each metric, we calculated a number of sensitivities based on comparator sector weights. These are set out in Annex A.5. For some of the Variant “2” metrics, we calculates sensitivities based on the number of business cycles covered. This produced a **range** of results. Within that range, we report the **Maximum, Minimum, Average**, and our **Base Case** (described above).

These methodological issues are also discussed in more detail in Annex A.

5.5. Results

In the chart below, we present the average annual changes in the various productivity indices and their variants. As noted above, we calculated a number of sensitivities and show the range and average for those sensitivities, and also our selected base case. A key is provided below the chart to identify the measures and the variants shown there, which matches the tables above.

Figure 5.1: Average annual change in productivity (positive number = efficiency gain)

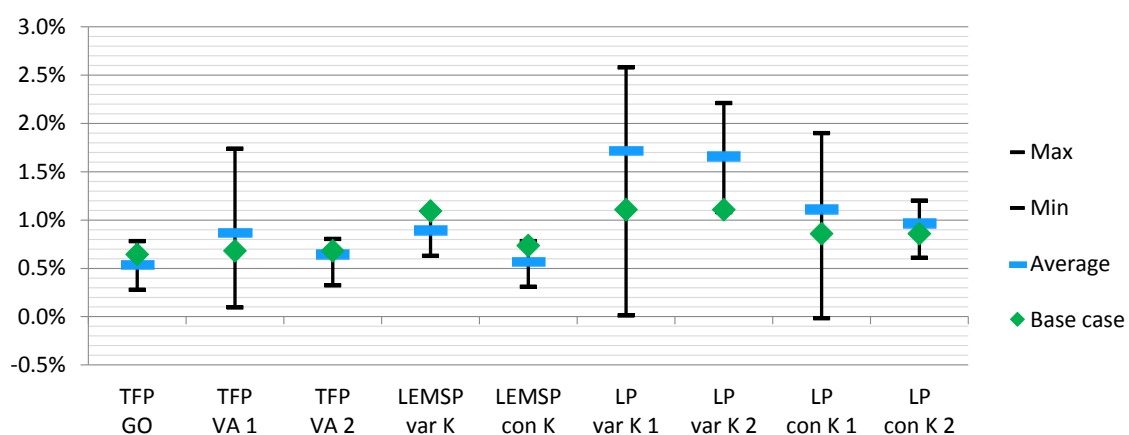


Table abbreviations: GO = Gross Output, VA = Value-added; LEMSP = LEMS Productivity, LP = Labour Productivity; var K = variable capital, con K = constant capital. 1 and 2 refer to coverage period variants.

We make the following observations on the results.

- The base case for TFP is almost exactly 0.65% per annum for the TFP measures.

- The base case for LEMS productivity is between 0.7% per annum (at constant capital) and 1.1% (with variable capital). Similarly, the base case for LEMS productivity (or LP) is between 0.8% per annum (at constant capital) and 1.1% per annum (with variable capital).
- The difference between the TFP results and the LP results with variable capital indicate that capital inputs have grown at a faster rate than LEMS (or labour) inputs.
- The LEMS (and labour) productivity metrics are slightly lower under the (hypothetical) constant capital assumption, because in most cases capital inputs appear to be driving output growth. Therefore, when we control for capital changes we exclude the output growth associated with capital inputs, and so output growth is lower; hence LEMS productivity and LP are also lower.

5.6. Assessment

All of our base case results for productivity growth are in the range 0.65% to 1.1% per annum, which is *predominantly related to Frontier Shift efficiency*. There is then a question about which measure is most appropriate as a comparator for the productivity growth that might be expected in relation to HAL's opex, mainly in relation to:

- TFP, by nature, measures productivity for all factors of production. However, as we are considering HAL's opex, TFP could be seen as less appropriate than the LEMS or LP metrics.
- The difference between LEMS productivity and LP is the efficiency gain made due to intermediate inputs (energy, materials and services). Whilst some intermediate inputs are included within HAL's operating cost base (i.e. energy and operational services), the remainder are likely to sit within HAL's capex base (i.e. materials and capex-related services such as construction). Therefore, we consider that both LEMS productivity and labour productivity should be taken into account when reaching a final estimate for the scope of efficiency.
- Finally, there is a choice between LEMS (or labour) productivity at either constant capital, or with variable capital. The optimal choice depends on whether the CAA is setting HAL's opex allowance in isolation, or whether it is taking into account changes in capex. For the former, it is more appropriate to use a constant capital assumption. For the latter, the CAA needs to calculate opex productivity *in light of* complimentary or substitutable capex. The CAA is likely to consider the capex budget *to some extent* (which favours using variable capital), but the opex and capex budget are set via different processes (which favours using constant capital). Therefore, we take both results into account.

Our base case results for LEMS and labour productivity growth, with variable capital, are approximately 1.1%, and are our preferred results. As noted above, *this primarily relates to*

Frontier Shift efficiency. We also take into account the base case results under the assumption of constant capital, which are 0.7% for LEMS productivity and 0.8% for labour productivity.

5.7. Implications

The implications of the analysis in this chapter are as follows:

- Historically, an efficient company undertaking similar activities to HAL would have – on average – been able to achieve ongoing improvements in opex productivity of broadly 1% per annum. For example, each year, for the same inputs, outputs would have increased by circa 1%.
- Given that this historical analysis is based on medium-term averages over complete business cycles, we consider this provides a reasonable benchmark for the level of ongoing productivity gains per annum (frontier shift only) which HAL should be able to achieve in the near future.
- This benchmark of 1% per annum primarily relates to *frontier shift*, i.e. it is what HAL should achieve in order to match the annual productivity gains made by an efficient company over time. Therefore, this benchmark does not materially consider the extent to which HAL's *current* productivity can be considered efficient, and therefore does not take into account whether any additional catch-up efficiencies might be justified. Catch-up efficiencies are discussed in the following chapter.

6. PARTIAL PRODUCTIVITY METRICS

Partial productivity metrics provide measures of productivity growth per annum in relation to a partial selection of cost inputs. We study two types of metric:

- Partial factor cost measures (Section 6.1) calculate changes in selected input costs, per value of output. This is calculated by taking the overall productivity metrics (in Section 5) and adjusting for input and output prices. As with the productivity metrics, this is undertaken for sectors that are most similar to the components of HAL's opex. *This metric primarily relates to frontier shift efficiency.*
- Real Unit Operating Expenditure (RUOE) (Section 6.2). Unlike the productivity measures, RUOE uses a physical measure of output rather than valuing it in monetary terms. We compare HAL's RUOE performance against comparator airports and other industries with similar characteristics. *This metric relates to both frontier shift and catch-up efficiency.*

6.1. Partial factor cost measures

Partial factor cost measures calculate the percentage annual changes in operating costs. They are based on the overall productivity metrics, adjusted for variations in input and output prices to provide a measure of *cost efficiency*. Like RUOE (see Section 6.2 below), they take into account changes in productivity and input/output prices. Given that we are considering HAL's opex efficiency, we focus on measures that include changes in labour and intermediate inputs, but exclude capital inputs.

These cost measures are conceptually similar to the RUOE measure, albeit that the measure of output is monetised rather than physical, and there are some differences of detail:

- Many of the comparator industries in the RUOE analysis are regulated industries operating within a monopoly environment, or at least having significant market power. Therefore, they are likely to have greater potential for catch-up efficiency. In contrast, these partial factor cost measures are derived by considering productivity across a much wider range of sectors in the UK economy, many of which are more competitive than the industries in the RUOE analysis, so on average efficiencies are likely to be predominantly frontier shift (with less potential for catch-up). Therefore, on average we might expect these cost measures to exhibit lower efficiencies than our RUOE results.
- RUOE does not make any adjustment for capital substitution, i.e. all the benefits from capital substitution appear to represent opex efficiency gains. This is likely to result in RUOE showing greater efficiency gains in comparison to the partial factor productivity measures under the constant capital assumption, i.e. where the impact of capital inputs on outputs is controlled for.

6.1.1. Methodology

Our methodology for calculating these partial factor cost measures is the same as the methodology used for the overall productivity metrics in Section 5, i.e. we have used the same data sources, comparator weightings, time periods, permutations (gross output and value-added, variable and constant capital).

- The LEMS cost measure is based on gross output productivity data. Therefore, our base case (main estimate) is based on the 2009 data release, and the most recent business cycle (1997-2006) within this dataset.
- The Labour cost measure is based on value-added productivity data. Therefore, our base case (main estimate) uses the 2016 data release, and is based on data for the period 1998-2014, i.e. the two most recent business cycles.

The key difference between these partial factor cost measures and the overall productivity metrics (in Section 5) is that the former is based on changes in the real value of inputs and outputs, so it takes into account sector-specific differences in input prices.

6.1.2. Results

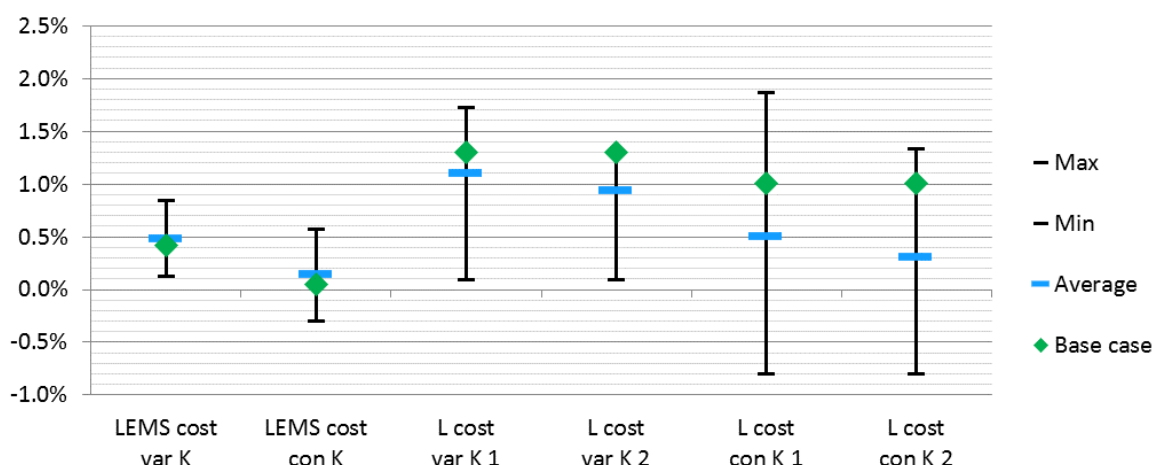
As in Section 5, we show cost efficiency gains as positive numbers, i.e. a higher number implies greater cost efficiency.

Below, we present our results for the LEMS cost and Labour cost metrics. Acronyms are provided below the chart. For the labour cost metric, we have included two ranges:

- Based on all data: The number “1” is used in the acronym.
- Based on the most relevant data, having removed (in our judgement) the least relevant data points (i.e. the results from the 2009 data release, given it is the oldest data; and the 2006-2014 result, given was a highly unusual period). Here, the number “2” is used in the acronym. This does not affect our base case assumption.

Taking all results together, in the following chart we present our base case, the range, and the average (based on the different time periods and sensitivities discussed above).

Figure 6.1: Average annual change in factor productivity



Acronyms: LEMS cost = LEMS cost measure; L cost = Labour cost measure; var K = variable capital; con K = constant capital

- The base case across all measures is in the range 0.0% - 1.3%.
- The LEMS cost measures are lower (implying lower cost efficiencies), with our base case in the range 0.0% - 0.5%. The L cost measures are higher, with a range of 1.0% - 1.3%.
- The LEMS (and labour) cost measures are slightly lower under the (hypothetical) constant capital assumption. This means that some of the cost efficiencies under the *variable capital* scenarios are due to capital growth.

6.1.3. Assessment

Our base case results are in the range 0.0% to 1.3%. As we have noted in relation to the overall productivity metrics, the CAA is likely to consider the capex budget to some extent when setting HAL's opex determination, but HAL's opex and capex budgets are set via different processes. Therefore, we do not see a strong rationale to exclude any of the points from this range.

As noted in relation to overall efficiency metrics, productivity metrics calculated from the EU KLEMS database tend to be predominantly attributed to frontier shift efficiency, with the (smaller) remainder due to catch-up. Applying this to the cost measures derived from the EU KLEMS database, our results imply ongoing (FS) cost efficiencies of between 0% and 1%.

6.1.4. Implications

The implications of the analysis in Section 6.1 are as follows:

- Historically, an efficient company undertaking similar activities to HAL would have – on average – been able to achieve ongoing improvements in opex productivity of between 0% and 1% per annum, once sector-specific costs are taken into account. For

example, each year, for the same expenditure on inputs, outputs would have increased by between 0% and 1%.

- As per our analysis in Section 5, we consider this analysis provides a reasonable and consistent high level benchmark for the level of ongoing productivity gains per annum (FS only) which HAL should be able to achieve in the near future, once sector-specific costs are taken into account.
- As per our analysis in Section 5, this range of ‘between 0% and 1% per annum’ primarily relates to *frontier shift*, so does not materially consider catch-up efficiencies.
- The overall measures in section 5 relate primarily to frontier shift and the results from these partial measures are in the range 0-1%. Further analysis and discussion would be required in order to identify the relevant FS target for HAL.

6.2. RUOE

6.2.1. Introduction

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 prices. If RUOE has fallen over time, this could imply an increase in operating efficiency.

Our analysis seeks to focus on other airports – as well as other industries – where the companies have a degree of market power in their particular sector, and many of our comparators are regulated companies. Regulators often seek to distinguish between companies that are operating at the efficient frontier of performance, and those that are not. With the latter, they often set more challenging efficiency targets to induce them to ‘catch up’ to the efficiency frontier. As such, the productivity improvements exhibited by the companies in our RUOE analysis tend to include elements of *both frontier shift and catch-up efficiency*.

Productivity gains are presented as positive numbers, in order to align with the presentation of our overall productivity metrics. An efficiency gain is achieved by a reduction in RUOE. So, if the change in RUOE is -3% per annum on average, in the subsequent charts we show this as a positive productivity gain of +3% per annum.

RUOE changes are calculated for both for HAL and for a selection of comparators – airports and industries that exhibit similarities to HAL (see Annex A.6.4. for comparator selection) – to compare how HAL’s operating productivity has changed over time. 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 and industries have some specific characteristics. For example, in comparison with other industries, the evolution of airport security standards is a cost pressure specific to airports. However, there are enough similarities to make this observation relevant at a high level, e.g. all regulated sectors face pressures to improve quality.

We provide below an overview of our approach to assessing changes in efficiency using the RUOE metric, and a summary of the results. Further explanation of the approach and further detailed results are presented in Annex A.6 and Annex B.5 respectively.

6.2.2. Approach

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

- We collected comparator data, building on the dataset that we developed previously, CEPA (2013)²⁰. We refined the existing data, added new comparator sectors and collected new data.
- We undertook the calculations of average annual changes in RUOE.
- We assessed the results and considered the potential for HAL to make efficiency savings in the future.

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, and Frankfurt. The remainder of our comparators are selected from UK industries. These are: air traffic control, rail network, electricity distribution and transmission, gas distribution and transmission, water and sewerage, road networks, hospitals and retail estate management.

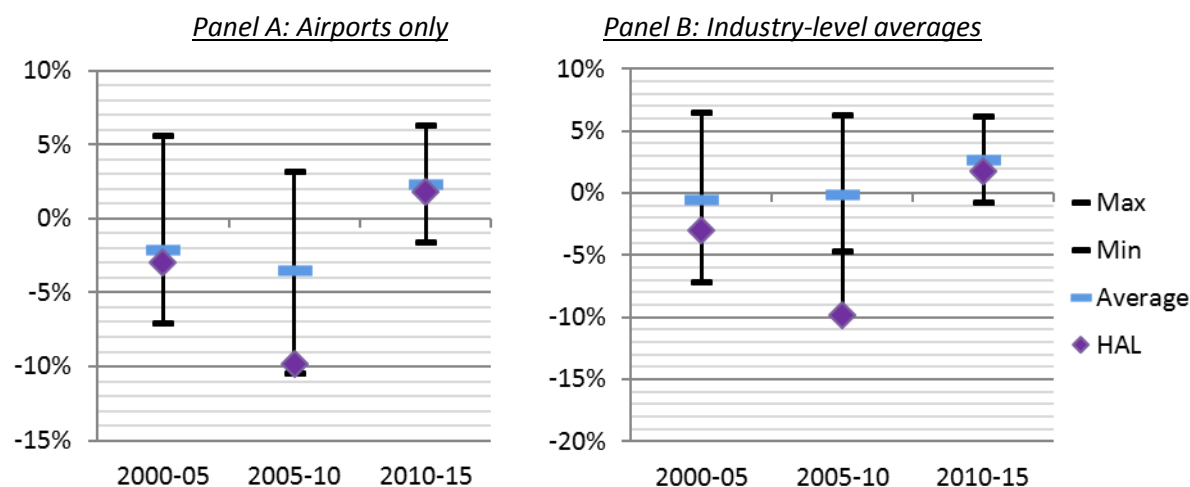
6.2.3. Results

The charts below show average annual RUOE productivity gains over different time periods for individual airports (Panel A) and comparable industries (Panel B). Panel A compares HAL against other airports – in the period 2010-2015 HAL made an average annual operating

²⁰ Scope for Efficiency Gains at Heathrow, Gatwick and Stansted Airports, Report for the CAA, April 2013

productivity gain of 2%, and other airports had a similar level of performance. Panel B compares HAL to a selection of industries with similar characteristics.

Figure 6.2: Average* annual percentage reduction in RUOE, by time period (positive number = efficiency gain)



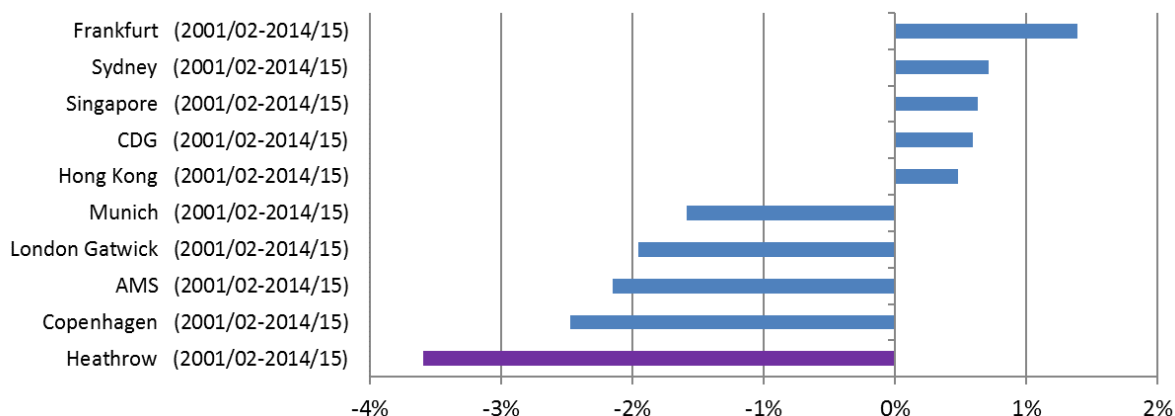
Note: In Panel A, the average of airports excludes HAL. In Panel B, the industry-level average is calculated by combining the airport average from Panel A (which excludes HAL) with the average efficiency gains from the various comparator industries.

Note (*): Geometric mean.

Panel A above shows that HAL's annual operating productivity gains (as measured by a reduction in RUOE) have been at or below the airport average in each of the five-year time periods reviewed. Compared to other industries (Panel B), HAL has again performed similarly or worse in terms of making efficiency gains over time. 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.

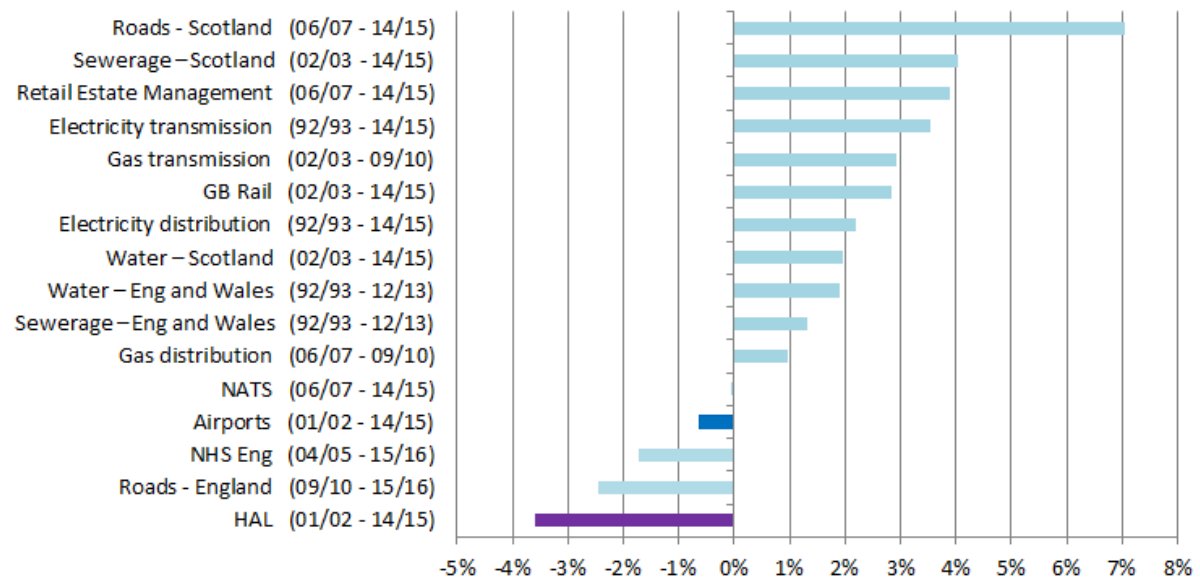
The chart below shows the average annual efficiency gains (as calculated by the inverse of percentage changes in RUOE) for airports for all years of available data.

Figure 6.3: Average annual percentage reduction in RUOE for selected airports, across all years of available data (positive number = efficiency gain)



This chart above shows that the majority of comparable airports experienced a reduction in unit operating productivity (a negative number), i.e. real unit operating costs actually increased. HAL’s unit operating productivity reduced by -3.5% per annum, so HAL performed relatively poorly in comparison to most of the other airports. The chart below shows the same metric, but at an industry level.

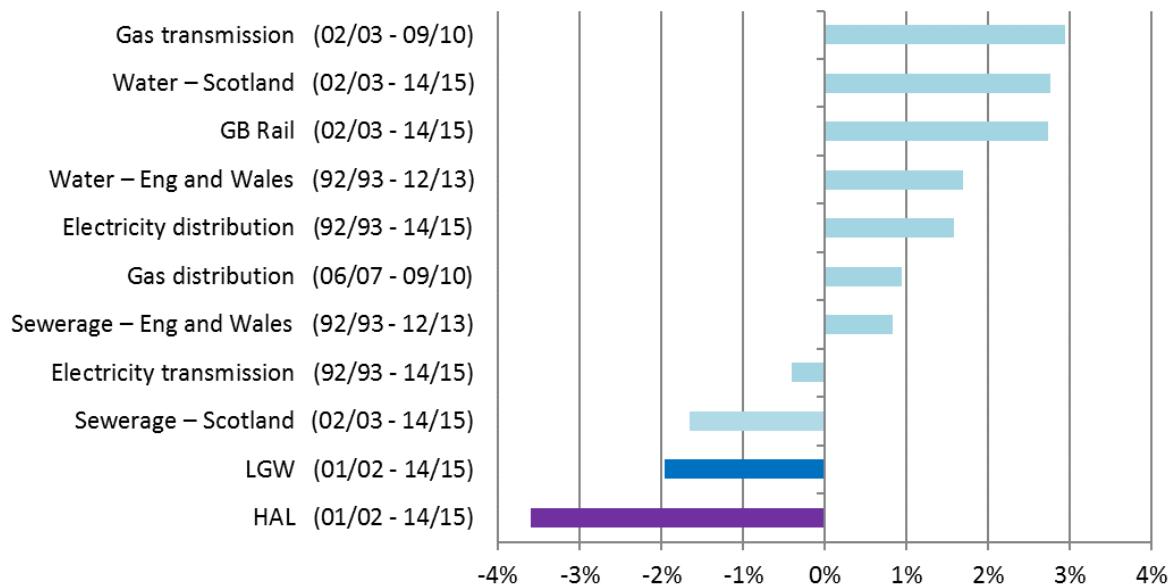
Figure 6.4: Average annual percentage reduction in RUOE for HAL, selected UK industries, and selected comparator airports across all years of available data



HAL has the largest reduction in unit operating productivity when compared against the selected other UK industries. It is also below the average of the comparator airports group (i.e. excluding HAL).

The chart below shows the average annual operating productivity changes for regulated industries that have been privatised for more than 10 years. Results are based on data for the period *after* the industry has been privatised for 10 years. This is relevant because opportunities for opex efficiencies tend to decline over time within regulated industries, as easy efficiencies ('low hanging fruit') are realised first (support for this hypothesis is provided in Annex B.5.1). This chart is consistent with the previous results.

Figure 6.5: Average annual percentage reduction in RUOE for industries privatised for more than 10 years. Data is for the period after the industry has been privatised for 10 years to the present day



Due to limitations on data availability, it has not been possible to have the same years in all comparator cases.²¹ For reference, comparable time periods are assessed in Figure 6.1 above.

6.2.4. Assessment

In all our RUOE comparisons, HAL has experienced the least gain in operating productivity, including during an extended period of reducing operating productivity. In particular, we found that HAL’s operating productivity trend has been close to or below the productivity trend of airport comparators in each of the 5-year time periods. Whilst individual airports and industries have some specific characteristics (e.g. change in airport security requirements), we consider that there are enough similarities to make this observation relevant at a high level. For example, all sectors face pressures to improve quality. HAL has experienced cost pressures in some areas (e.g. new terminals), although some other airports have undergone similar transformations without the same cost increases, e.g. the Hong Kong International Airport (HKG).

6.2.5. Implications

The implications of the analysis in Section 6.2 are as follows:

- Historically, HAL has experienced a reduction in the efficiency of operating costs (i.e. an increase in real unit operating costs), of roughly 3.5% per annum over the period for which we have data.

²¹ The different time period for the comparator industries could make it difficult to draw direct conclusions from the results.

- Over the same time period as for HAL, other airports have also experienced a fall in efficiency for operating costs, although by circa 0.5% per annum on average. Therefore HAL's performance, based on the RUOE measure, is of lower performance than other airports in our sample group.
- Given that HAL has experienced higher rises in real unit operating costs than other airports, there may be scope for HAL to make catch-up efficiencies in the future.
- The RUOE analysis is relatively high level and does not take into account all differences between airports. However, we have chosen airports of a similar scale and nature to HAL (e.g. hub airports). In addition, the significant difference in RUOE performance between HAL and the 'airport average' suggests that there might be scope for catch-up. Therefore, this observation should be considered alongside other pieces of evidence, and further analysis could be undertaken in this area at a more granular level.
- We note that the implied catch-up efficiencies would be even greater if we were to take into account other (non-aviation) industries.

6.3. Summary

The partial factor cost metrics (Figure 6.1) show that, on average, small operating cost efficiencies (i.e. roughly between 0% and 1%) have been made historically for the sectors included within our composite index. Given the nature of industries within the dataset for these cost metrics (i.e. competitive to some degree), cost efficiencies of this approximate magnitude are likely to be achievable over time even by companies operating at the frontier of efficient performance, i.e. *this primarily relates to FS*.

The RUOE measures (Section 6.2) show that, on average, HAL's comparator airports have experienced small reductions in efficiency for operating costs (i.e. circa -0.5%). HAL's efficiency in opex has fallen by more (circa -3.5%) over the period of available data. Industries with similar characteristics (e.g. other regulated sectors with high fixed costs) have made efficiency *gains* in relation to opex, although we do observe that efficiencies fall over time post privatisation. Overall, given HAL's *historical* performance may not have been as strong as the comparator airports (and particularly when compared with the other industries), we *consider that there is likely to be scope for future catch-up efficiencies*.

7. OVERALL ASSESSMENT AND CONCLUSIONS

7.1. Summary of Part 1 analysis

HAL cost performance (total opex) against determination

HAL's total opex to date in Q6 are almost in line with the CAA's Q6 determination. Cost reductions seem to have been achieved via a combination of genuine Q6 efficiencies (staff and pension costs), some efficiencies from changes made in Q5 (baggage maintenance contract) and some favourable conditions (lower energy prices). Cost overruns in some areas are due to a combination of some challenging targets (e.g. pension cost), some costs incurred which are outside scope (e.g. HAL reorganisation costs and new runway planning) and some costs which HAL failed to anticipate at the Q6 determination (e.g. resilience costs). Our findings are summarised in the following table.

Table 7.1: Commentary on HAL's opex by category

Category	Current position	Efficiency	Notes
Staff	Costs remain above determined level.	Some recent evidence of efficiency via a reduction in security staff costs and pensions.	Targets are challenging especially for pensions where no glide path to a lower level of cost is permitted in this review period.
Maintenance	Costs currently at the level anticipated by the determination.	Some efficiency achieved to date, although possibly in part due to the Q5 baggage contract.	The efficiency challenge is back end loaded so the green status could change going forward.
Rent and Rates	Costs are currently below the determined level.	Evidence of efficiency savings e.g. early vacation of some rental property.	Determination increased cost in this category from previous period actuals. Not clear that this increase was fully justified. The CAA may wish to consider the scope for a pass-through of actual costs in future periods.
Utilities	Costs are currently below the determined level.	Evidence of efficiency savings via reduced energy consumption.	Also, likely to include some windfall benefit from lower than anticipated energy prices and milder weather.
Other	Costs are materially above the determined amount.	The 'other costs' category is large and hard to analyse, noting in particular that the sub-category within 'other' of most concern is also called 'other'. Difficult to identify realised efficiencies at this stage.	Some costs in this category may be in substitution for costs in different categories. It may also include some costs that HAL has voluntarily incurred but the CAA would not consider are necessary to running the airport.

HAL staff costs against benchmarks

Since 2012, HAL's staff costs have increased by more than the benchmarks (although this may be due in part to changes in cost categorisation), but have been stable since 2013. HAL is starting to implement staff efficiencies, with real wages falling after 2013.

7.2. Summary of Part 2 analysis

The table below summarises the results of the various components of our analysis.

Table 7.2: Summary of analysis

Component of analysis	Scope	Results and conclusions	Discussion
Overall productivity metrics	Total opex	<u>Overall productivity metrics</u> : HAL benchmark is a gain of circa 1% per annum , before adjustments for input prices. This primarily relates to FS.	Variable factor productivity growth per annum is in the range 0.7%-1.1% under our base case assumptions. This does not contain adjustments for input prices.
Partial productivity metrics	Total opex	<u>Partial factor costs</u> : Benchmark for HAL is gain of 0-1% per annum , taking into account input and output prices. This metric predominantly relates to FS. <u>RUOE</u> : Productivity performance of HAL is below similar airports and other relevant comparators. So there may be scope for catch-up efficiencies.	<u>Partial factor costs</u> : Cost benchmarks imply FS of between 0% and 1% under base case assumptions. Takes into account changes in input and output prices. <u>RUOE</u> : On average HAL has performed below comparator airports and industries. Precise scope for catch-up efficiencies is not certain and should be considered alongside other evidence.

* Notes: FS = Frontier shift efficiency target; CU = Catch-up efficiency target.

Overall, our analysis of productivity measures suggests that:

- FS for HAL might be in the region of 0% to 1%, once input prices have been taken into account.
- There may be scope for HAL to make further catch-up efficiencies. On a standalone basis, our RUOE analysis suggests that there is *likely* to be scope for catch-up.

7.3. Regulatory precedent

The table below presents recent regulatory precedent for the FS and CU opex efficiency targets set by regulators in recent price controls and provides support for the FS and CU opportunities that we identify for HAL:

Table 7.3: Recent regulatory precedent for opex efficiency targets (to 1 decimal place)

Regulator	Country	Sector	Price control	Costs	FS	CU
CAA	GB	Heathrow Airport	2014 – 2018	Opex	1.0%	1.0% ¹

Regulator	Country	Sector	Price control	Costs	FS	CU
CAA	GB	Gatwick Airport	2014/15 – 18/19	Opex	0.9-1.0%	0.7% ¹
CAR	Ireland	Airports	2015 – 2019	Opex	0.8% ²	
ORR	GB	Rail	2015 – 2019	Opex	0.3%	4.4%
Ofwat	Eng & Wal	Water and Sewerage	2010 – 2015 ³	Opex	0.2-0.4%	2.2-2.9%
WICS	Scotland	Water and Sewerage	2015/16 – 20/21	Opex	1.9% ²	
Ofgem	GB	Transmission	2013 – 2021	Opex	1.0%	n/a
Ofgem	GB	Electricity Distribution	2016 – 2023	Totex	0.8-1.1%	Various
Ofgem	GB	Gas distribution ⁴	2013 – 2021	Opex	1.0%	n/a
				Totex	0.8%	1.6%
Range					0.2-1.2%	Up to 4.4%

Notes ¹ HAL/LGW: CU is the residual cost reduction after netting off FS, so not the same as CU.

² CAR and WICS: Breakdown not available between FS and CU.

³ Ofwat: Not possible to obtain FS and CU figures for the latest price control (2015-2020).

⁴ Gas distribution: Totex is included as it shows the CU target (not available for opex).

The regulatory precedent cited in the table above suggests that FS is assessed to be relatively consistent across the regulated sector, i.e. it is often in the range 0.8% to 1.2%; figures which are consistent with our calculated range. However, FS is occasionally lower at circa 0.3% (e.g. ORR's Network Rail determination and Ofwat's determination for England and Wales water and sewerage companies). There are likely to be detailed reasons why these specific cases depart from the norm.

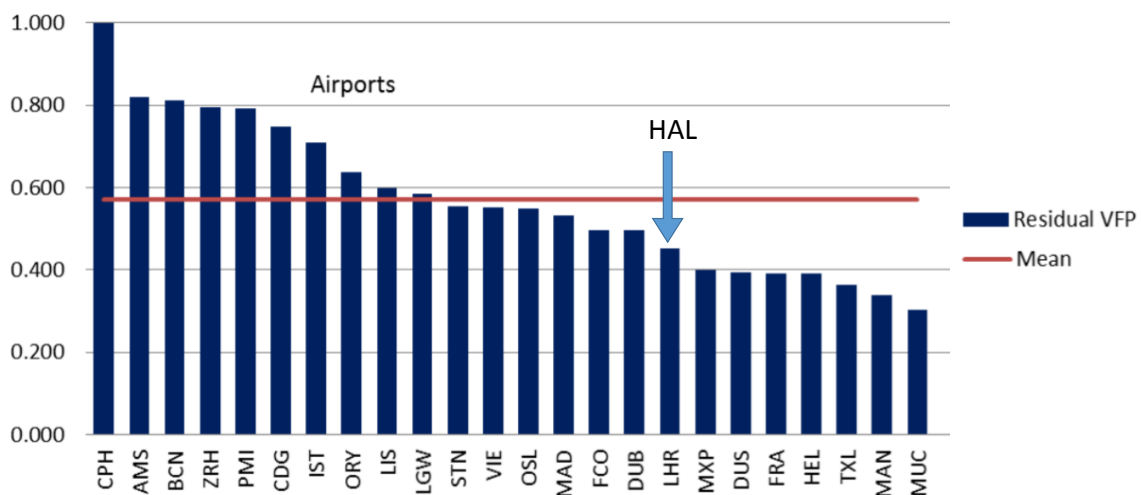
CU efficiency targets vary considerably, as would be expected given that this depends on the specific circumstances of company or industry at a given point in time. For example, Network Rail's large catch-up efficiency target (4.4%) was influenced by the view that Network Rail was substantially inefficient at the point in time of the determination.²² Again our results falls within the range of the figures determined elsewhere.

7.4. Other precedent

The Air Transport Research Society's (ATRS) Residual Variable Factor Productivity (VFP) metric is a measure of airport operational productivity that has been adjusted for factors 'outside of managerial control'. The ATRS study is well-recognised within the airport industry and Residual VFP takes into account a number of factors to normalize across airports, e.g. share of non-aeronautical revenue, proportion of international passengers, scale of airport, capacity constraints, etc. ATRS's 2016 results are shown below. We note this is based on data from 2014 so any catch-up since then will not have been included.

²² The 2011 McNulty Report stated that passengers and taxpayers in Great Britain were "paying at least 30% more than their counterparts in other European countries".

Figure 7.1: Residual VFP (index, best = 1) for large European airports, ATRS 2016 report (2014 data)



Source: ATRS report 2016, 'Key Findings' presentation

The chart above shows that HAL's Residual VFP is below the average for large European airports. The majority of the most relevant comparator airports (for HAL) score *above* the average, namely Amsterdam (AMS), Charles de Gaulle (CDG), Gatwick (LGW) and Copenhagen (CPH). We have analysed previous years' data from ATRS, which shows that HAL has consistently been below the Residual VFP average for large European airports. Although over time, we note that HAL's score has moved closer to the average as illustrated in Annex B.4.

7.5. Conclusions

From our Part 1 analysis, our consideration of actual costs to date suggests that the determined level of cost is being achieved in some areas and that efficiencies are starting to be delivered in others – e.g. staff and pension costs. This aligns with our benchmarking of staff costs against external comparators. In areas of cost overruns, we note that some may have been due to a combination of challenging targets (e.g. pension cost) and costs being outside the scope of the Q6 determination (e.g. HAL reorganisation costs and new runway planning).

Overall, there is evidence that HAL has delivered some cost efficiency in Q6, and HAL opex is close to the determination, which requires a 2% reduction in real opex per annum. If HAL achieves the determination, it will have delivered the catch-up efficiencies which were built into the determination.

However, our Part 1 analysis shows that cost reductions do not solely seem to have been achieved by genuine Q6 efficiencies – there may have been some efficiencies arising due to changes made during Q5 (baggage maintenance contract) and some favourable conditions (lower energy prices). There have also been cost overruns in some areas – analysis of 'other costs' (which are large) has been more difficult and actual costs to date materially exceed those in the CAA's determination. Furthermore, the Q6 efficiency targets implied within the

CAA's Q6 determination are not quite as significant (at 2% per annum) if the starting point is taken to be HAL's actual costs in 2013/14 (or the CAA's determination for 2013/14), rather than HAL's ABP submission for that financial year. Several areas would merit further investigation and a detailed cost breakdown, e.g. capitalisation of opex. Finally, HAL will need to continue to make further efficiencies in order to meet the Q6 determination for the remainder of the regulatory period.

There is some evidence that HAL is performing less well in some areas (other costs), or has benefited from favourable conditions (energy), and there is a lack of full transparency around some aspects of cost data (capitalisation). HAL's performance should therefore be re-considered, both in more detail and towards the end of Q6 – in order to obtain a more robust measure of its performance.

We can combine the analysis of HAL's performance to date (in Q6) with other sources of evidence to consider the extent to which HAL should be set efficiency targets in H7. In relation to HAL's *current* operational efficiency, several sources of evidence highlight the potential for HAL to make catch-up efficiencies from early Q6 onwards. This includes studies undertaken prior to the Q6 determination, the ATRS study, our detailed staff cost benchmarking and our RUOE analysis in Part 2. We note that a number of these sources are based on data up to and including 2015. Therefore, if HAL continues to deliver against the determination throughout Q6 some of the scope for catch-up efficiencies may have been eroded within the period.

The majority of sources suggest that HAL currently has potential to make CU efficiencies, although this should be reviewed later in future years. If efficiencies are achieved during the remainder of Q6, catch up for Q7 will be lower. In addition, further detailed analysis is required to assess the precise level of CU efficiency.

We have considered various top-down productivity measures (in Part 2) to consider the scope for HAL to make ongoing efficiency gains, as even efficient companies do over time.

Once input prices are taken into account, we consider that an efficient company undertaking similar activities to HAL could achieve ongoing improvements in opex productivity of between 0% and 1% per annum. We consider this provides a reasonable high level benchmark for future ongoing productivity gains per annum (frontier shift only) for HAL.

Finally, we have considered whether quality of service is impacting on opex efficiencies. Whilst HAL is a relatively high quality airport, it is not necessarily any higher than its peer group. In addition, whilst this may require HAL's opex per passenger to be relatively high at a given point in time, being a high-quality airport still carries the potential to make efficiency savings over time.

8. ISSUES FOR FURTHER CONSIDERATION

This study has been commissioned as relatively ‘top down’ piece of analysis, with the intention that it will highlight areas where a more granular analysis is justified in the future. We discuss our findings below. We have also identified a number of more general issues where we feel that further discussion and analysis could be beneficial to the development of the price control.

8.1. Data Issues

Key issues in our analysis have been data consistency and comparability. To understand HAL’s opex we have reviewed its business plans, CAA’s determination, regulatory accounts and in some cases adjusted versions of the same produced subsequent to the determination. The data sources all break down operating costs in a different way and it has been necessary to reconcile, and in some cases adjust, data or make assumptions. In the next control period we think it would be beneficial for all parties to adopt a standard form of data breakdown structure perhaps based on the current regulatory accounts to maintain the existing data series wherever practicable, but noting that HAL may not always hold data used for its own purposes in that structure.

Related to this we would suggest that CAA and HAL develop a more transparent breakdown of other costs, which after staff cost is currently the largest category of operating expenditure, and which we have found difficult to analyse.

Additionally HAL has incurred higher ‘other’ costs in Q6, for example spending money to argue for a new runway, and reorganisation costs arising from divestments. The CAA might consider how such costs should be treated and recorded in future. Some transactions are with connected companies, and the CAA may also wish to consider guidance in this area.

8.2. Regulatory approach

A particular consideration for the CAA is the starting point for its assessment of operating expenditure. In this report we note that the business plan projected higher costs at the end of the Q5 control period which HAL subsequently outperformed. As a consequence the efficiency targets set by the CAA look different if they are viewed from the perspective of actual costs rather than the plan; they are less stretching. We note however that the new T2 opened at the beginning of the control period and necessitated some increase in operating costs.

As noted elsewhere in the report we have been unable to fully understand the capitalisation of opex which occurs on a relatively material scale. We suggest that the CAA considers whether the regulatory regime is currently adequate for managing and monitoring such movements because HAL has the opportunity to make opex savings by increasing capex, e.g. new equipment should incur lower maintenance costs. This is known as capital substitution.

In HAL's case a capex governance process attempts to verify the value for money of capital expenditure, but in practice some capex may escape this check, and this may be the case for some opex which is capitalised. Cross-checks should therefore be made between the capex and opex allowances for several reasons:

- To ensure that opex savings are genuine efficiencies, rather than reclassified as capital without any proper scrutiny.
- If there are capex proposals which are justified by HAL in terms of future opex efficiencies, these should be passed through to the opex determination according to a timing and method set out in advance, at least for the typical case.
- To look more generally at nature and impact of HAL's capitalisation policy, as this has the potential to be an area of low transparency.

Another issue that the CAA might consider as it refines its approach for the next control period is whether truly uncontrollable cost (e.g. rates) should be subject to pass through or if negotiable (e.g. rents) some form of sharing mechanism. HAL has achieved some benefits in this period which will not be subject to the current claw back mechanism.

We also received feedback from KPMG/HAL that there is a lack of consistency over time in terms of the framework applied by the CAA for the opex price control process. For example, the CAA does not provide the same sort of price control strategy / framework documents that exist in other UK regulated sectors, e.g. water and energy. We agree that regulatory transparency and stability is important, and so the CAA might wish to consider developing / publishing a strategy for future periods. Such frameworks should not be too detailed, as an excessively prescriptive or predictable process can be possible to 'game'. But equally it should not be too high level, as this provides too much freedom and reduces the likelihood of a consistent approach being applied.

8.3. Actual cost analysis

We would suggest that the cost analysis that we have undertaken be updated by the CAA later in the control period. The lack of access to projections has meant that our analysis is backward looking. Although some efficiency improvement is apparent even at this stage it is not yet possible to predict whether HAL will meet the requirements of the determination in full. We note in this context that some of the required savings are back end loaded e.g. maintenance or especially challenging e.g. pensions.

8.4. Benchmarking

It is no longer possible to undertake such detailed staff cost benchmarking work as has been done in the past, because several of the data sources have closed. HAL has pointed us to a new source of data Xpert HR for which there is currently only one data point. The CAA may wish to secure access to this data as it develops as an alternative source to ASHE which we

have relied upon but which has some shortcomings that we discuss in the benchmarking section of this report

Our analyses have also highlighted some unusual movements in some categories of staff costs. Some of this may be due to HAL's reorganisations which are not associated with running Heathrow airport. Some detailed examination of the staff numbers, roles and remuneration would be required to understand what has been happening, and what costs should reasonably be considered allowable costs. Given the scale of these costs, the CAA may wish to look further at this issue in preparation for H7.

[✂]

ANNEX A DETAILED EXPLANATION OF APPROACH

A.1. HAL performance versus determination

In some instances where HAL's Q6 costs were higher than the determination, HAL stated that this was because the CAA did not allow certain costs, with the implication that it was not feasible for HAL to undertake its operational functions within the constraints of the determination. However, when reviewing HAL's Q6 performance relative to the CAA's determination, our intention was not to 'redo the determination', i.e. to say whether the CAA's determination was set at the right level, given HAL's observed costs. Rather, we analysed the Q6 performance with the view of assessing HAL's relative position, and to provide an indication of the scope for future efficiencies.

A further reason for this approach is that our remit was to undertake a relatively 'top-down' analysis. Given the considerable detailed analysis undertaken within each of HAL's cost categories during the preparation for Q6, it would not have been appropriate for us to provide an assessment of whether HAL's Q6 allowance should be higher or lower.

With this in mind (i.e. taking the determination as given), we focused our attention to cost areas where HAL's actual costs varied the most from the determination, either higher or lower. Cost overruns are of interest because they highlight areas to consider whether there may be inefficiency. Cost outperformance is also of interest because it may "reveal" efficiencies that should be applied to HAL's determination in future years, e.g. H7.

Incentives for under/over performance

Understanding the incentives underpinning the CAA's price control framework provides important context when considering HAL's actual costs. In general, HAL is more likely to reduce its costs in areas for which it is more heavily incentivised.

The Q6 price control framework is designed by the CAA to incentivise HAL to undertake its functions efficiently, by minimising controllable costs. For the majority of cost areas HAL's revenue is set independent of its costs, i.e. there are only cost-sharing mechanisms in a few areas. This means that HAL keeps 100% of the gains from any reduction in opex during Q6, which generates strong incentives for HAL to reduce its costs, at least from a short-term perspective. However, there is a longer-term downside to reducing costs. If HAL reduces its costs it "reveals" to the CAA that it is able to operate more efficiently, which gives the CAA greater justification to reduce HAL's opex allowance in future price controls. Overall, there is an incentive trade-off from HAL's perspective.

The price control framework contains specific incentive mechanisms in cost areas which the CAA deems to be not fully controllable.²³ These have the potential to change HAL's incentives for under/over performance, so are areas for further analysis:

²³ CAA, *Economic regulation at Heathrow from April 2014: Notice granting the licence*, Part C.1

- **Security costs.** There is a security revenue adjustment mechanism - the 'S-factor' in the price control condition. It allows HAL to pass through 90% of cost overruns above/below a certain level (versus the determination) to airport users where there is new security legislation which generates a genuine change in security standards. As HAL need to demonstrate that changes in security costs are driven by changes in security standards if it wants to increase/decrease cost recovery through the S-factor, there is not much scope for HAL to game the system.
- **Rates.** The revaluation of properties' *rateable values* will come into effect from 2017, and accordingly the CAA has provided HAL a higher rates allowance for 2017 and 2018. For any variation between the actual rateable value and the cost allowance, HAL can pass through 80% of the difference to airport charges. However, prior to 2017, HAL is unable to share any rates cost variations, i.e. 0% cost pass through.
- **Some utility costs.** For utility services provided by HAL to other parties (e.g. airlines), HAL will recover the actual costs through other regulated charges, i.e. any underspends or overspends would be passed on to users. However, if HAL underspends (or outperforms) on its own utility costs, HAL is able to keep the difference, which gives HAL high incentives to reduce its own utility costs.

HAL's airport charge allowance also contains a correction term (k) to adjust for historical over/under recovery of costs, due to reasons such as actual passenger numbers being higher or lower than forecast.

A.2. HAL performance versus benchmarks

Sources of benchmarking data

Previous benchmarking studies of airport wages for the CAA have made use of several sources of data, however not all of these are remain available. Presently ASHE provides the only useful and practical source of benchmarking data we have been able to locate. It has numerous wage categories, but none are airport specific. It has a few air transport categories, but these apply to airlines, not airports. There is no reason to suppose that wages for airline job roles tell us anything useful about likely wages for airport job roles. First, these roles are largely quite different, and second, airlines often have a choice of country to source a substantial part of their staff, giving an international element of wage pressure much less present for airport job roles.

A.3. Other studies

We have assessed two important external sources of benchmarking analysis which provide useful context to our study.

- We considered results from the Air Transport Research Society (ATRS) Global Airport Benchmarking Report over several years. We assess HAL's performance under ATRS's main opex productivity metric (*Residual Variable Factor Productivity, or Residual VFP*) – a highly regarded operational efficiency measure.
- [✂]

ATRS report

ATRS publishes an annual benchmarking report which measures and compares the performance of several aspects of airport operation: productivity and efficiency, unit costs and cost competitiveness, financial results and airport charges.

ATRS's most relevant opex productivity measure is Residual Variable Factor Productivity (Residual VFP), which it states is "*considered as the most important and comprehensive measure of operating efficiency for airports*".²⁴ This is developed by calculating variable factor productivity initially, and then removing the effects of the variables 'beyond managerial control' (based on regression analysis) to derive a more robust measure known as Residual Variable Factor Productivity. These measures are discussed below.

Variable Factor Productivity (VFP)

Variable Factor Productivity (VFP) is computed by aggregating labour productivity and soft cost input productivity using variable cost shares as the weights. VFP measures how efficiently an airport utilizes variable inputs for a given level of capital infrastructure and facilities. ATRS's decision to provide the VFP metric is driven by a lack of consistent data on capital inputs comparable across airports in different countries. Therefore, ATRS consider only two categories of non-capital inputs: labour and soft cost input.

In terms of its robustness as a measure of productivity, ATRS states that it is appropriate in the short to medium term, given that airports make managerial and operational decisions within the given state of their capital infrastructure and facilities, i.e. including all non-capital or variable inputs. However, for the longer term, ATRS states that variable factor productivity is not a good indicator for comparing overall efficiency of operations across airports, because it does not take into account changes in capital.

To quantify outputs, ATRS considered a number of different measures, including passengers and aircraft movements. ATRS also developed an 'aggregate output index' for airport services by aggregating all types of outputs and services including passenger traffic volume, aircraft landings and take-off movements, and non-aeronautical services such as concessions, rentals

²⁴ ATRS report 2013, Part I, p.26.

and development activities, etc. This output index represents a single aggregate measure of all outputs each airport produces and services.

Residual Variable Factor Productivity (Residual VFP)

ATRS states that a robust productivity measure should be adjusted for factors that are beyond managerial control, e.g. an airport with a higher proportion of international travellers may require more staff in passport control, and will therefore incur higher operating costs. ATRS developed the Residual VFP in order to adjust for such factors.

Residual VFP is adjusted for the effects of: percentage of international passengers; percentage of connecting passengers; share of non-aeronautical revenue; capacity constraint indicator (proxy for service quality to airlines and other users); and average aircraft size proportion of air cargo in total traffic handled. (ATRS found that airports with a higher share of non-aeronautical revenue tended to achieve higher VFP, e.g. airports proactively developing commercial opportunities appear more efficient than airports relying on aeronautical revenue.) ATRS also found that airport scale is a significant variable that is beyond the scope of managerial control, and so it splits its analysis between large airports and medium/small airports.

Unit variable cost

ATRS does not consider that unit cost comparisons across different airports will necessarily reflect true comparative cost competitiveness, as different airports “*operate under different operating and regulatory environments*”.²⁵ As such, we have focused on ATRS’s main productivity metric (Residual VFP).

²⁵ ATRS 2013, Part I page 2

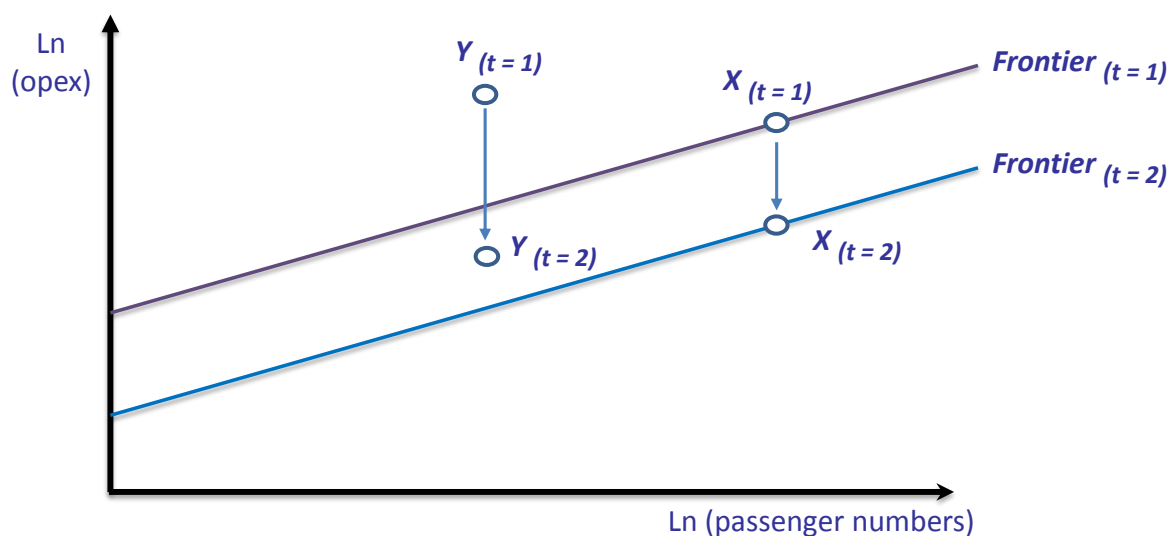
A.4. Frontier Shift efficiency and Catch-Up efficiency

An operational cost efficiency describes the scenario when a company is able to produce the same outputs by spending less on inputs (or producing more outputs with the same inputs). Even the most efficient companies can be expected to make efficiency improvements over time – for example, by employing new technologies or working processes. Typically, regulators assume that a company is able to achieve a degree of ongoing efficiency (or frontier shift) over time, and this is incorporated within the price control allowance. For Q6, the CAA set HAL a 1.0% ongoing efficiency challenge, which was applied on top of the efficiencies proposed by HAL within its final business plan.

However, at any one time, some companies will be efficient (i.e. at the frontier of efficient performance), whereas others will be lagging behind. For the latter group of companies, they will need to catch up to the other companies if they themselves wish to be considered as efficient. This is referred to as catch-up efficiency. It is defined as efficiency improvements which are made by adopting current technology or efficient working practices, in order to catch-up to current best practice.

The chart below illustrates the difference between ongoing and catch-up efficiency improvements. In general, an efficiency is achieved by a movement downwards, i.e. generating the same level of output (e.g. passenger numbers) for lower costs. At $t=1$, Company X is at the efficient frontier, whereas Company Y is inefficient. At $t=2$, Company X is still at the efficient frontier – this change between $t=1$ and $t=2$ is *frontier shift* efficiency. At $t=2$, Company Y is closer to the (new) efficient frontier (compared with where it was relative to the frontier in $t=1$), therefore it has achieved both (i) the ongoing efficiency improvements in line with the shift in the frontier, and (ii) a degree of *catch-up* efficiency, i.e. getting closer to the frontier level of performance.

Figure A.1: Distinction between ongoing and catch-up efficiency



However, whilst a relatively clear distinction can be made in theory, in practical terms it is often not possible directly to observe or distinguish between frontier shift and catch-up efficiency. There is debate around what assumptions – if any – are appropriate for identifying each component. However, there are academic studies from which simplifying assumptions can be obtained for the purposes of undertaking top-down benchmarking. In particular, academic studies²⁶ have suggested that the majority of total factor productivity growth is frontier shift, with the (smaller) remainder due to catch-up efficiency.

This also applies to our analysis of partial factor cost measures, which are also based on the EU KLEMS database. Therefore, any cost efficiency gains observed within these cost measures are likely to be predominantly related to frontier shift.

²⁶ For example, Fäire et al. (1994), *Productivity Growth, Technical Progress, and Efficiency Change in Industrialized Countries*, The American Economic Review.

A.5. Overall productivity metrics

We analysed historical UK productivity metrics over different time periods to assess the level of productivity achieved by other industries over time. The aim was to calculate high level productivity metrics for sectors that have similarities with Heathrow's opex.

We considered several metrics based on UK-wide data across a number of years. For each of these metrics we identified the sectors that would be most similar to the components of HAL's opex. We considered a number of different permutations, including the type of measure, the choice of relevant comparator sectors, the time period of analysis, etc. These issues are discussed here.

Data source. The EU KLEMS, a database containing productivity data for EU members from 1970 onwards, provided data on variables that were used to develop the productivity metrics. For each country in the database the data is at a sector (or industry) level, e.g. transport and storage.

The EU KLEMS database provides an extended coverage of years, and there are also several releases of the data which do not provide the same information each time.

Data releases. There have been three data releases: In 2009 (updated in 2011, using the NACE 1.1 classification system), in 2012 and in 2016 (both using the NACE 2 classification system). The 2009 release has data for both *Gross output* and *Value-added* metrics (explained below), whilst the 2012 and 2016 releases only provide data on a *Value-added* basis.

Within each data release, the data covers different time periods. The 2009 release is the largest dataset and contains data between 1970 and 2007. Given that productivity can be pro-cyclical, we believe it is appropriate to calculate changes in productivity based on complete business cycles, and thus there is an argument for selecting the period of the average rather than simply using all of the available data.

NACE is a statistical classification system for economic activities occurring within the European Union. The sectors under NACE 1.1 are similar – although slightly different – to the sectors under NACE 2.

Gross output and value-added TFP. There are two different types of TFP statistics: gross output TFP and value-added TFP. Under the gross output measures of productivity, intermediate inputs are assumed to contribute to productivity growth, whereas their impact is removed in the value-added measure. Generally, gross output measures of TFP growth are the preferred concept for industry specific studies because the role of intermediates is acknowledged, and so the measure better reflects the business decisions taken by companies. However, the value-added measure has the advantage that it is not impacted by changes in the vertical structure of an industry. We have calculated both in our analysis, where data has been available, i.e. Gross output measures could be calculated using the 2009 data, but not using the 2012 or 2016 data.

Selection of data. For completeness, our approach has been to calculate productivity benchmarks firstly using all of the available data (variant “1”), and secondly using our view of the most relevant data (variant “2”), but in a number of sensitivities.

- For the value-added measures, all three data releases provide useful information. In general, we consider the latest data releases to be the most accurate. However, because the 2016 release also contains the period 2006-2014, which was unusual from an economic perspective due to the global recession, we do not think it is appropriate to focus solely on the 2016 data release. Therefore, in our variant “2” metrics we have used both the 2012 and 2016 data releases, but have not included the single most recent business cycle on its own (2006-2014). For the same reason, our “**base case**” (main estimate) for value-added measures (VA), within the period options for variant “2”, is the period 1998-2014. This base case uses the most up-to-date 2016 dataset, but calculates an average across the *two* most recent business cycles.
- For the gross output measures, only the 2009 data release provides useful information, because the 2012 and 2016 releases only have value-added data. Our “**base case**” (main estimate) for gross output measures (GO), within the period options for variant “2”, is therefore the most recent business cycle available in the 2009 release, which is 1997-2006.

We summarise this in the following table.

Table 8.1: Data sources and periods used in different productivity metrics

Gross output or value added	Metrics included	Data releases used	Business cycles covered by the data release
Gross output	TFP GO LEMSP var K LEMSP con K	2009 data release	*1997-2006 (1 business cycle) 1986-2006 (2 cycles) 1978-2006 (3 cycles) 1972-2006 (4 cycles)
Value-added	TFP VA (1 and 2) LP var K (1 and 2) LP con K (1 and 2)	2016 data release	2006-2014 (1 business cycle) * 1998-2014 (2 cycles)
		2012 data release:	1997-2006 (1 business cycle) 1986-2006 (2 cycles)
		2009 data release	1997-2006 (1 business cycle) 1986-2006 (2 cycles) 1978-2006 (3 cycles) 1972-2006 (4 cycles)

Notes: * An asterisk indicates our main estimate or **base case** assumption
Bold text indicates where data has been included within a variant labelled “2”, e.g. LP VA 2.

Partial productivity measures. Given that we are assessing the efficiency of HAL’s operating costs, it is not necessarily appropriate to assess TFP, because TFP is a total factor productivity measure, i.e. it includes capital, as well as labour and intermediate inputs. For the purposes

of this study, it is preferable to consider partial productivity measures such as labour productivity and LEMS productivity (which considers labour and intermediate inputs).

Variable or constant capital assumption. Partial productivity measures have the potential to create misleading results if substitution between inputs occurs. For example, capital substitution (automation) could result in measured gains in a labour productivity. Therefore, we calculate these partial productivity measures under the assumptions of both variable and constant capital.

Methodology for calculating productivity measures. For each measure (noted above), we calculated a *composite productivity index* for HAL using several steps:

1. We reviewed HAL’s costs, and calculated the percentage within each cost area.
2. For each cost area, we selected the most appropriate comparator sector (or multiple comparator sectors, if appropriate).
3. For these relevant sectors, we calculated initial (unweighted) productivity metrics based on data in the EU KLEMS database.
4. We used the percentages in step 1 to weight the selected sector productivity metrics and calculate a weighted composite index for HAL.

Selection of comparators. The EU KLEMS website provides documents which contain a very detailed explanation of the types of activities contained within each of the sectors. We reviewed this information in detail to determine the likely best comparator sector for each component of HAL’s opex. In some cases this was relatively straightforward, e.g. under NACE 2, there is a sector entitled Professional, scientific, technical, administrative and support service activities, which is a good proxy for HAL’s central support / administrative costs.

Choosing comparator sectors is not an exact science, and so judgement was required in some cases. For example, the ‘real estate services’ sector include facilities management which might be relevant to the estate management activities of an airport. However, the broad high level sector includes a lot of other non-FM activities, including owner-occupied housing, and the EU KLEMS methodology document notes the risks with using this metric (“productivity comparisons of this industry, and aggregates including this industry, should be interpreted with caution”). Therefore, in line with our 2013 report for the CAA, we have used this category in developing our composite indices.

Table A.1: Comparator selection and weightings under base case, for 2016 data release

EU comparator used	KLEMS	Weight	Rationale
Transport and storage		38%	Includes ‘air transport’, so likely to be a good proxy for a number of HAL’s activities. Proxy sector for <i>Operational staff costs</i> . Includes ‘legal, accounting, recruitment, office admin and business support’, etc. so proxy for <i>central support services, consultants & marketing, general expenses and intercompany</i> .

EU KLEMS comparator used	Weight	Rationale
		Includes 'renting of accommodation or office containers', so proxy for <i>rent and rates</i> . EU KLEMS stated that Real estate activities is a potentially unreliable category.
Professional, scientific, technical, administrative and support service activities	29%	Includes 'security activities' so proxy for <i>security staff costs</i> . Includes industrial cleaning' so proxy for <i>Facilities Management staff</i> . Includes 'business management, recruitment, legal, accounting, head office activities, advertising, employment activities, office admin, business support, and market research' so proxy for <i>central support services, general expenses, and intercompany</i> . Includes 'renting of accommodation or office containers' so proxy for <i>rent and rates</i> . Real estate activities are not a good category. Includes 'market research, advertising, business management' so proxy for <i>consultants and marketing</i> .
Other manufacturing; repair and installation of machinery and equipment	18%	Includes 'repairs and maintenance', although this is closer to heavy maintenance, so proxy for <i>maintenance</i> .
Electricity, gas and water supply	7%	Includes 'generation, transmission, distribution and supply' so proxy for <i>electricity, water and sewerage, gas, waste and recycling, capitalisation and LES distribution fee</i> .
Financial and insurance activities	5%	Includes 'pension funding' so proxy for <i>pension service costs</i> .
Other service activities	3%	Includes 'repair of office, accounting and computing machinery' so proxy for <i>maintenance</i> .

Given judgement was necessary, we also undertook some sensitivities:

- In sensitivity 1, we did not include sectors or costs that are, in our view, the least controllable among HAL's cost categories. For example, we consider rates to be difficult for HAL to control (consistent with the CAA's cost-sharing mechanism from 2017). Therefore, we did not select a sector for this cost category. Overall, we did not apply sectors for security staff costs, utilities and rates.
- In sensitivity 2, we started with the base case and made two changes: (1) we considered that the 'Accommodation and Food Service Activities' sector could be a robust alternative comparator to use for HAL's rates and rent costs; and (2) we considered that HAL's other operational activities might be closer to retail activities than transport infrastructure activities. So instead of the 'transport and storage' sector, we used the 'Retail trade, except of motor vehicles and motorcycles' sector as the comparator.

The impact of these sensitivities on the weightings is shown below. The table shows weightings for the Base Case (BC), Sensitivity 1 (S1), and Sensitivity 2 (S2).

Table A.2: Sector weightings

Sector	Weightings		
	BC	S1	S2
Transportation and storage	38%	48%	21%
Professional, scientific, technical, administrative and support service activities	29%	24%	24%
Other manufacturing; repair and installation of machinery and equipment	18%	16%	29%
Electricity, gas and water supply	7%	0%	7%
Financial and insurance activities	5%	8%	5%
Other service activities	3%	4%	3%
Accommodation and food service activities	0%	0%	12%

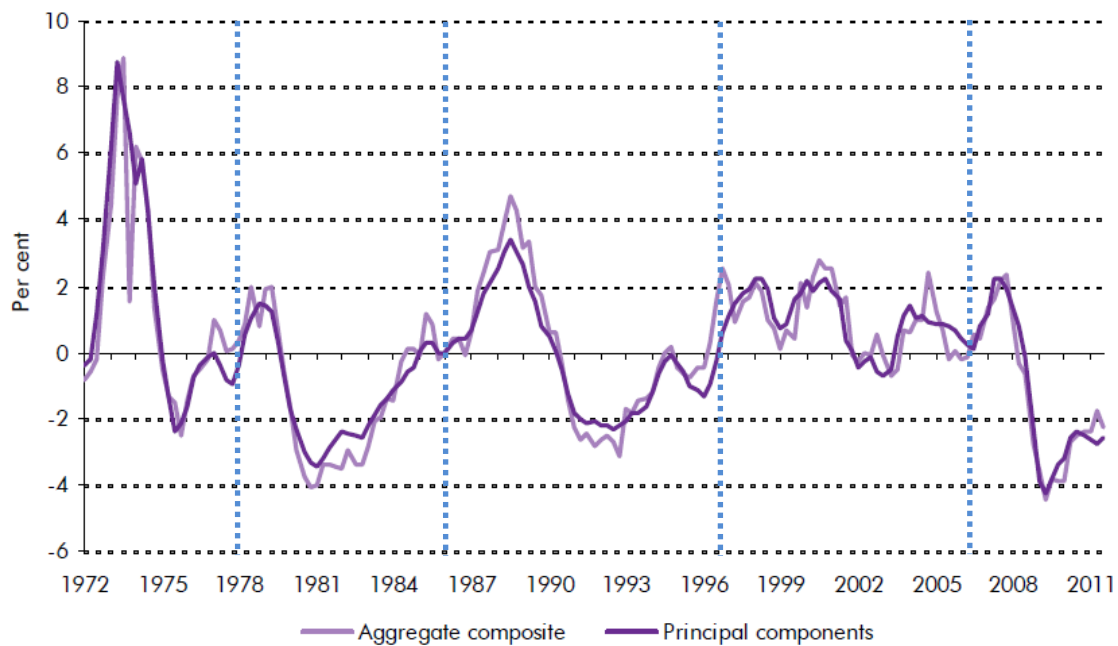
We note that the sectors used for the 2012 and 2009 data releases were virtually the same, although with some minor variations, e.g. certain sectors were not available.

Time period of analysis. Productivity is a highly cyclical variable which shows marked variation over the business/economic cycle. In general it is pro-cyclical, as productivity growth tends to accelerate during periods of economic expansion and decelerate during periods of recession.²⁷ Hence it is standard practice to consider TFP growth over complete economic cycles. Consistent with our 2013 report for the CAA, we consider the following to be complete business cycles (i.e. from a point of zero output gap to another point of zero output gap, including both a peak and a trough): 1972 – 1978; 1978 – 1986; 1986 – 1997; and 1997 – 2006. This is based on the Office for Budgetary Responsibility's (OBR) data on the output gap²⁸, shown in the chart below.

²⁷ OECD (2001), Measurement of aggregate and industry level productivity growth, p.119

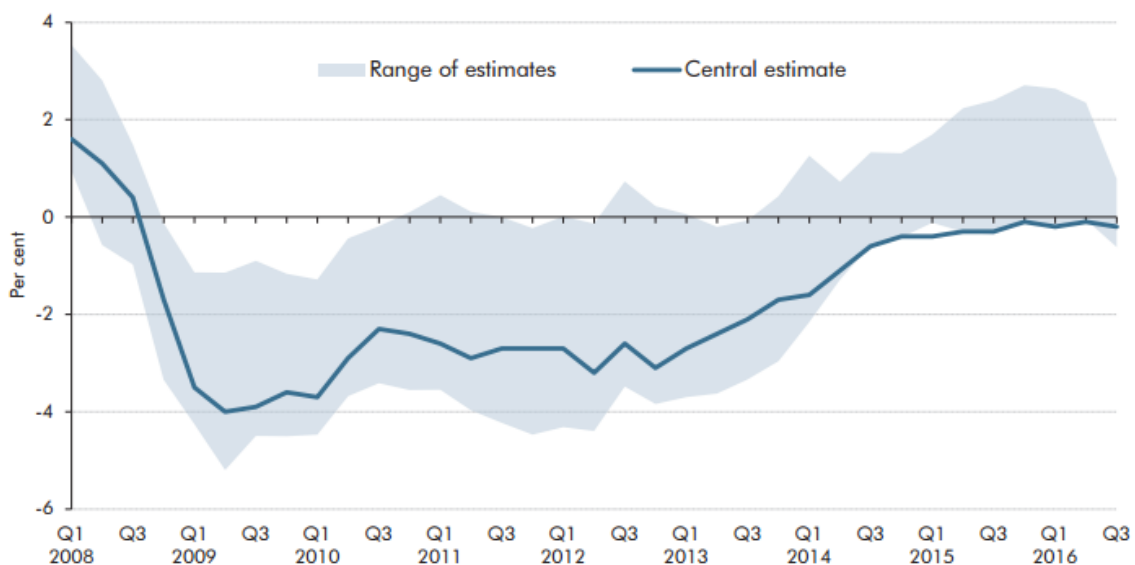
²⁸ Source: OBR, Estimating the UK's historical output gap, Working paper 1, Nov 2011.

Figure A.2: UK Output Gap (%) and identification of complete business cycles



Given that the 2016 EU KLEMS data release includes data up to 2014, we considered whether it would be appropriate to include this latest data. We used OBR’s latest data to review estimates of the output gap in recent years. As shown by the chart below, the output gap was slightly below (although close to) zero in 2014. Therefore, when using the 2016 EU KLEMS data, we also include the period 2006 – 2014 as the most recent business cycle in our analysis. However, given that it may not precisely be a full business cycle, and because this was a period of highly unusual economic conditions, the estimate for this period may not be as precise as for other periods in our analysis.

Figure A.3: UK Output Gap (%) and identification of complete business cycles



Source: OBR, *Economic and Fiscal Outlook*, November 2016, p.46

We used the following time periods:

- 2016 data release: 2006-2014 (1 business cycle); and 1998-2014 (2 business cycles).
- 2012 data release: 1997-2006 (1 business cycle); and 1986-2006 (2 business cycles).
- 2009 data release: 1997-2006 (1 business cycle); 1986-2006 (2 business cycles).
- 1978-2006 (3 business cycles); and 1972-2006 (4 business cycles).

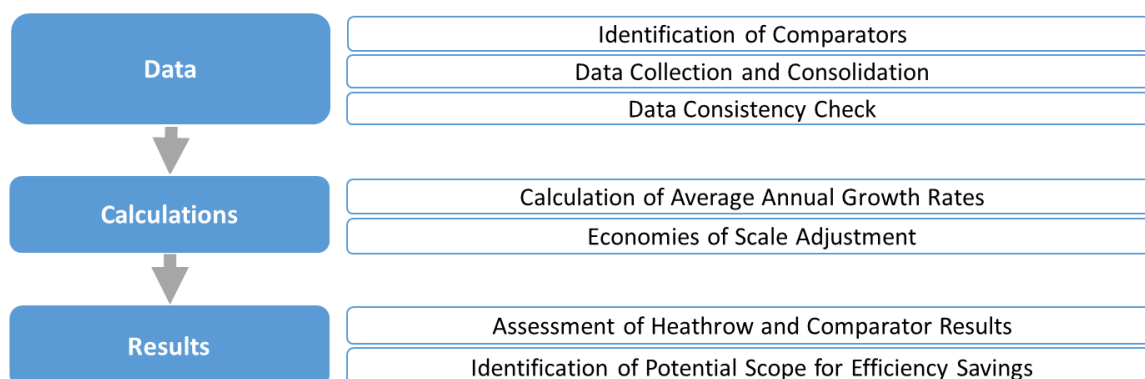
Our **base case** is 1998-2014 (2 business cycles) using the 2016 data, as it uses the most recent data, and does not focus solely on the period 2006-2014 which was unusual from an economic perspective, i.e. due to the global recession.

A.6. Partial productivity metrics: RUOE

A.6.1. Introduction

Our methodology for estimating RUOE metrics is summarised in the figure below.

Figure A.4: RUOE Approach



In the following sub-sections, we provide further explanation for the different stages of our approach.

A.6.2. Data Collection

Building on our dataset that we had developed from previous reports (e.g. from our 2013 opex project for the CAA), we refined the existing data, added new comparator sectors and collected new data. The table below sets out the new data that was collected within this project, including both new comparator industries, as well as industries from our previous work where existing data has been brought up to date.

Table A.3: Source of collected data

Comparator	Years	Input Type	Source
Airports (All)	2000/01 – 2014/15	All	[✂] Dataset
Network Rail	2011/12 – 2015/16	Output Measures	NRT Data Portal, ORR Website
	2006/07 – 2013/14	Controllable Opex	Network Rail Regulatory Accounts
	2014/15	Total Opex	Network Rail Regulatory Accounts
Highways England	2006/07 – 2014/15	Output Measure	Department for Transport Website
	2009/10 – 2015/16	Total Opex	Received directly from Highways England
Transport Scotland	1993/94 – 2012/13	Output Measure	Scottish Transport Statistics
	2006/07 – 2015/16	Total Opex	Transport Scotland Annual Report

Comparator	Years	Input Type	Source
Water and Sewerage (England and Wales)	2011/12 – 2012/13	All	Ofwat Website
Water and Sewerage (Scotland)	2010/11 – 2015/16	All	Regulatory Accounts, WICS Website
Electricity Transmission	2011/12 – 2014/15	Output Measure	DECC Energy Trends
	2002/03 – 2015/16	Total Opex	NGET Regulatory Accounts
Electricity Distribution	2010/11 – 2014/15	All	DPCR5 Performance Report, Ofgem Website
Gas Distribution	2007/08 – 2015/16	Output Measure	Received directly from Frontier Economics
	2013/14 – 2015/16	Total Opex	RIIO DD1 Model, Ofgem Website
Retail Estate Management	2006/07 – 2014/15	All	Intu Annual Accounts
NHS England	2001/02 – 2015/16	All	Individual Trusts Annual Accounts
NATS	2006/07 – 2015/16	All	Annual Report and Accounts

Exchange rate adjustments were first made. First, we converted foreign currency figures into pounds using the 2015 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 sectors, 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. There were several comparators whom we had to exclude some years from our analysis due to unresolvable issues, which are explained in the table below.

Table A.4: Data Exclusions

Comparator Sector	Region	Excluded Year/s	Reason
Airports	Germany	2002	Frankfurt: There is a substantial decrease in opex for which we cannot find an explanation, despite having undertaken further research.
Electricity Distribution	GB	2000/01	There appears to be an abnormally large reduction in real unit operating costs in this year, which affects a large number of companies.
		2010/11	There appears to be an abnormally large reduction in real unit operating costs in this year as a result of a reporting change.

Comparator Sector	Region	Excluded Year/s	Reason
Electricity Transmission	GB	2000/01	A change in reporting requirements means that NGC started to include the whole of Great Britain in their reported electricity volumes (in line with Oxera 2008).
		2008/09	There is a substantial jump in NGET's "other expenditure (by c. 30%) for which we cannot find an explanation, despite having undertaken further research.
Water and Sewerage	England & Wales	2005/06	"... reported operating expenditure no longer includes cost for recovering pension deficit... at the same time, companies are dealing with volatile energy costs - which have risen overall since price limits were set...' Ofwat, 2006: 'Water and sewerage services unit costs and relative efficiency', December, p.3.

A.6.3. 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.5: 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.

Airport	Opex Component	Years	Comment
Amsterdam Schiphol	Other subcontracted	2008	Cleaning and security costs recorded separately to other subcontracted costs from 2008 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	2009/10	No data available until 2009/10.

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 it was received.

A.6.4. Selection of comparators

Operating productivity analysis, as measured by the change in RUOE, involves comparing the operating productivity of a number of sectors over time, with the aim of using them as high-level comparators to HAL's own possible future efficiency development. This section details how and why comparator industries were selected for productivity analysis.

Selection Criteria

We set out here and explain the main criteria that were considered when comparator selection was undertaken for HAL with regards to operating costs/efficiencies.

- **Similar activities:** Heathrow's main operational activities are broadly, asset management and maintenance, terminal operations, and customer service. Good comparators should undertake reasonably similar activities.
- **Similar assets:** The assets of Heathrow are of a large scale, in the sense that its financing charges are relatively large in comparison to its operating costs, and include terminal buildings, runways, baggage and freight handling, security systems,

commercial estate, car parks and internal transport systems. Suitable comparators should hold an asset base of a similar scale and composition.

- **Similar technology:** Recent technological improvements at Heathrow include security scanners and automated baggage systems. However, due to the importance of security and safety, there is a limit on the role technological progress has played, or is expected to play, as some staff operation is often still required, and there is no fundamental change in methods. Appropriate comparators therefore, will hold some scope for technological progress, but potentially also a limit as to the impact this holds over their operational activities.
- **Similar level of competition:** Whilst Heathrow experiences competition from other airports for both terminating traffic (e.g. City, Gatwick) and interlining traffic, (e.g. Amsterdam, Paris CDG), and also some from other modes of transport on shorter journeys, the CAA has identified that Heathrow has substantial market power. Thus, the ideal comparator would also have some limited degree of competition also, but monopoly firms are closer comparators than those in highly competitive industries.
- **Similar policy environment:** Heathrow and Gatwick are the only UK airports assessed to have substantial market power and to require economic regulation of their charges. They currently find themselves in middle of their 6th price control period. Thus, the closest comparators are those that lie within economically regulated industries.
- **Data availability/consistency:** The analysis that can be undertaken is constrained by data availability, and its consistency over time, regardless of a comparators suitability.

Assessment Method and Results

We used a four-level qualitative assessment metric as follows, with our results summarized in the table below.

- Meets the criterion well = ✓✓✓
- Mostly meets the criterion = ✓✓
- Meets the criterion to some extent = ✓
- Does not meet the criterion = ✗

Table A.6: Assessment of potential comparator sectors against criteria

Sector	Activities	Assets	Technology	Competition	Policy	Data
Other airports	✓✓✓	✓✓✓	✓✓✓	✓✓✓*	✓✓✓*	✓
Air Traffic Control	✓	✓	✓✓	✓✓	✓✓✓	✓✓✓
Rail Networks	✓✓	✓✓✓	✓✓	✓✓	✓✓✓	✓✓✓
Energy Networks	✓	✓✓	✓✓	✓✓	✓✓✓	✓✓✓
Water & Sewerage Networks	✓✓	✓✓	✓✓	✓✓	✓✓✓	✓✓✓
Telecoms Networks	✓	✓✓	✗	✓✓	✓✓	✓✓
Road networks	✓✓	✓✓	✓✓	✓✓	✓	✓✓✓
Hospitals	✓	✓✓	✓	✓✓	✓	✓✓✓
Retail Estate Management	✓✓	✓✓	✓✓	✓	✗	✓✓
Manufacturers	✗	✓✓	✗	✓	✗	✓

* Subject to selecting appropriate comparator airports

The results of the assessment show that other airports, air traffic control, Network Rail, the energy networks, and water and sewerage networks are all well placed comparators. On the other hand, telecoms and manufacturing are not whilst in between, lie some cases which are not quite perfect – retail estate management, hospitals and road networks.

The final list of Heathrow comparators to be used is therefore:

- Other Airports
- Air Traffic Control
- Network Rail
- Energy Networks
- Water and Sewerage Networks
- Road Networks
- Hospitals
- Retail Estate Management

A.6.5. 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.

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

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

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, specific to each industry, to the RUOE calculations. These cost elasticities represent the percentage change in costs that would arise from a one percent increase in output. The table below sets out the cost elasticity value used for each sector within our analysis. For consistency, most of these are the same as the figures used in our previous CAA opex work (in 2013), whilst we have added values for industries / sectors added since that work.

Table A.7: Cost Elasticities

Sector	Elasticity	Source
Roads	0.84	Krause (1981)
Retail Estate Management	0.5	Keh and Chu (2003)
Air Traffic Control	0.95	Pels, et al (2002)
Healthcare	0.76	Marini and Miraldo (2009)
Airports	0.5	SDG (2012) and regulatory precedent
Electricity Transmission	0.721	Burns and Weyman-Jones (1994)
Electricity Distribution	0.721	Burns and Weyman-Jones (1994)
Gas Transmission	0.9	Oxera 2008 assumption: TFP elasticity figure
Gas Distribution	0.9	Oxera 2008 assumption: TFP elasticity figure
Rail	0.2	CEPA assumption from various sources
Water and Sewerage	0.96	CC (2000)

A.7. Partial productivity metrics: Partial factor cost metrics

Introduction

Our partial factor cost metrics – the LEMS and labour cost measures – calculate changes in input costs (per unit of output) for the UK sectors deemed most similar to HAL. The LEMS cost measure includes both labour and intermediate inputs, whilst the labour cost measure only includes labour. As per our top-down productivity measures (discussed earlier), we identified the sectors that would be most similar to the components of HAL’s opex. These partial factor cost measures calculate the percentage annual changes in operating costs over time (rather than the level at a point in time). They combine our top-down productivity metrics (see earlier), with sector-specific variations in input and output prices, to provide a measure of cost efficiency. Therefore it takes into account changes in productivity and in factor input prices.

Methodology

Given that these cost measures are based on the top-down productivity metrics (see formulas in Annex A.5), our approach was consistent with these productivity metrics, in relation to: the data source (EU KLEMS); the data releases used (2009, 2012 and 2016); the application of either variable or constant capital assumption; the selection of comparators and their weightings (including sensitivities); the time period of analysis; and our choice of base case.

These cost measures are conceptually similar to the RUOE measure (above), although there are a few differences:

- Like the top-down productivity measures, these costs measures derived from data in the EU KLEMS database, which is comprised of industries across the whole economy, and therefore will include sectors which are relatively competitive. In contrast, our selected RUOE comparators feature mostly regulated industries where companies have a degree of market power. Companies in both sectors will have potential for *frontier-shift efficiency*, but there is likely to be an additional *catch-up efficiency* component for regulated companies. Therefore, on average, we might expect these cost measures to exhibit lower efficiencies than RUOE.
- RUOE does not make any adjustment for capital substitution. For industries where capital growth has been significant (relative to growth of labour and intermediate inputs), the cost efficiencies implied by RUOE will therefore be higher. In these costs measures, we control for this by showing the results both with variable capital, and under a constant capital assumption.

Frontier shift and catch-up efficiency

Whilst we are not required in this study to provide a specific estimate for frontier shift and catch-up efficiency, this distinction is relative to the extent that we need to interpret the results of the RUOE analysis and the partial factor cost measures. Following our discussion in Annex A.4, we assume that the majority of any reductions in unit costs within the partial

factor cost measures are mainly due to frontier shift, and only a small amount of catch-up, because the industries tend to be relatively competitive. In contrast, our RUOE analysis contains a number of regulated industries where we would expect higher potential for catch-up, due to the lower competitive pressures.

Presentation of results

We show reductions in unit costs (i.e. efficiency *gains*) as *positive* numbers. Whilst this may appear slightly counterintuitive, it has been done to achieve consistency with the top-down productivity metrics, where a positive number represents a productivity *gain*.

A.8. Formulas

A.8.1. Overall productivity metrics

For overall productivity metrics: **TFP** is total factor productivity, **LEMS** represents intermediate inputs (Labour, Energy, Materials and Services), **LEMSP** is LEMS productivity, **LP** is labour productivity, **var K** stands for variable capital, **con K** stands for constant capital, **TFP_{GO}** is gross output TFP, **TFP_{VA}** is value-added TFP, output volume is denoted **Y**, labour volume is denoted **L**, capital volume is denoted **K**, volume of intermediate inputs is denoted **M**, **GO** is the value of gross output, **LAB** is expenditure on labour, **CAP** is expenditure on capital, **II** is expenditure in intermediate inputs, and s_L , s_K and s_M are labour, capital and intermediate input's share of value respectively.

TFP GO

$$TFP_{GO} = Y_{GO} / (L^{s_L} \times K^{s_K} \times M^{s_M})$$

TFP VA

$$TFP_{VA} = Y_{VA} / (L^{s_L} \times K^{s_K})$$

Where: $\Delta Y_{VA} = \Delta Y_{GO} - II$. i.e. the value of output produced in a sector minus expenditure on intermediate inputs used in their production.

LEMSP var K

$$\Delta LEMSP_{varK} = \Delta Y_{GO} - s_{L2} \cdot \Delta L - s_{M2} \cdot \Delta M$$

$$\text{Where: } s_{L2} = \frac{LAB}{(LAB+II)} \text{ and } s_{M2} = \frac{II}{(LAB+II)}$$

LEMSP con K

$$\Delta LEMSP_{conK} = \Delta TFP_{GO} / (1 - \frac{K}{GO})$$

LP var K

$$\Delta LP_{varK} = \Delta Y_{VA} - \Delta L$$

LP con K

$$\Delta LP_{conK} = \Delta TFP_{VA} / (1 - \frac{K}{GO})$$

A.8.2. Partial productivity metrics

In the following formulas for partial productivity measures:²⁹

RUOE is Real Unit Operating Expenditure;

²⁹ The basic theory of the LEMS and labour cost measures is, like the RUOE measure, the change in real unit operating costs is equal to the changes in factor input prices minus changes in productivity growth. More detail is available at Reckon, *Report for Ofwat: PRO9 Scope for efficiency studies*, October 2008, p.185.

ROE is Real Operating Expenditure;

O is the chosen output measure (e.g. passenger numbers);

Corrected RUOE is RUOE adjusted for economies of scale;

LEMS represents intermediate inputs (Labour, Energy, Materials and Services);

LEMS cost is the LEMS cost measure;

L cost is the labour cost measure;

var K stands for variable capital;

con K stands for constant capital;

GO is the value of gross output;

LAB is expenditure on labour;

CAP is expenditure on capital;

II is expenditure in intermediate inputs.

RUOE

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

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

LEMS cost var K and LEMS cost con K

$$\Delta LEMS_{cost_{varK}} = \Delta P_{LEMS} - \Delta LEMS_{P_{varK}}$$

$$\Delta LEMS_{cost_{conK}} = \Delta P_{LEMS} - \Delta LEMS_{P_{conK}}$$

$$\text{Where: } \Delta P_{LEMS} = s_{L2} \cdot (\Delta LAB - \Delta L) + s_{II2} \cdot (\Delta II - \Delta M)$$

$$\text{And where: } s_{L2} = \frac{LAB}{(LAB+II)} \text{ and } s_{II2} = \frac{INT}{(LAB+II)}$$

L cost var K and L cost con K

$$\Delta L_{cost_{varK}} = \Delta P_L - \Delta LP_{varK}$$

$$\Delta L_{cost_{conK}} = \Delta P_L - \Delta LP_{conK}$$

$$\text{Where: } \Delta P_L = \Delta LAB - \Delta L$$

ANNEX B DETAILED ANALYSIS

B.1. HAL performance versus determination

The CAA's determination was stated in 2011/12 prices, whilst HAL's actual costs were recorded in nominal prices. To ensure a like-for-like comparison, we have used RPI (as per the CAA's approach in its Q6 determination) to convert all figures into 2015 real prices. HAL's opex allowance for Q6 is shown below.

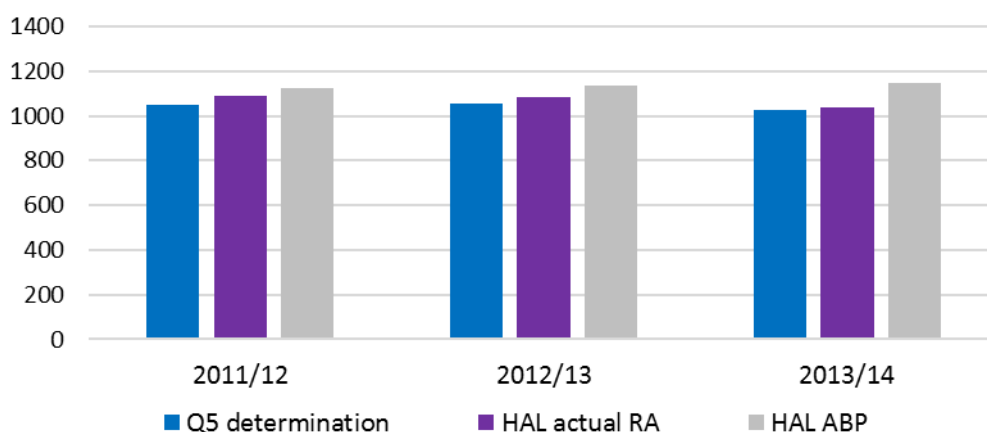
In the run-up to the Q6 determination, HAL made a large reclassification of its costs between 'Staff' and 'Other' costs. This resulted from the fact that HAL divested all its other airports, and many of the staff at group level were moved into HAL. Thus, charges which had previously been intergroup costs with 'Other' cost became staff costs. They also changed in total, but this is a separate issue. To enable a useful comparison between the CAA's determination and HAL's costs as they are currently classified, HAL has provided an adjusted version of the CAA's determined costs that mirrors this reclassification, while maintaining the total that the CAA determined. In the following, when we refer to the CAA's determined costs for Q6, as broken down into categories, it refers in fact to this version as adjusted by HAL to enable future comparability.

Table B.1: Total annual opex allowance over Q6 (2015 prices)

Year	Q6 Allowance (£m)
2014 (9 months)	877
2015	1121
2016	1082
2017	1040
2018	1033
Total	5153

It is interesting to observe HAL's actual performance at the end of Q5, both relative to the Q5 determination and relative to its forecasts (as shown in its Q6 Alternative Business Plan). This is shown below. The chart shows that HAL's Q6 ABP was higher than both the determination and its actuals, particular for 2013/14.

Figure B.1: Total annual opex allowance over Q6 (2015 prices)



Note: opex allowance for 2013/14 was supplied by HAL

Interestingly, the efficiencies set out in the CAA's determination are set relative to the HAL's 2013/14 ABP figure. Therefore, the efficiencies stated in the CAA's determination are larger than if viewed in relation to the Q5 determination or HAL's actual costs.

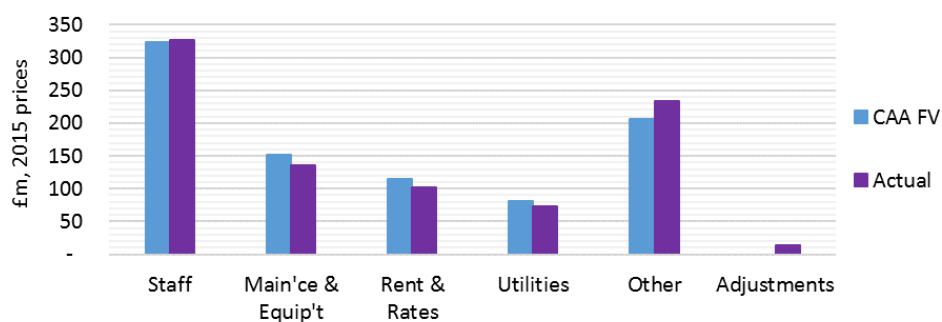
B.1.1. Total costs

The CAA's determination

As set out in the CAA's Final View (p.302), the CAA set HAL an opex allowance of £4.7bn over Q6 (in 2011/12 real prices). This corresponds to a 2% per year reduction in real opex over the course of Q6, or a 1.5% per year reduction relative to 2012/13.

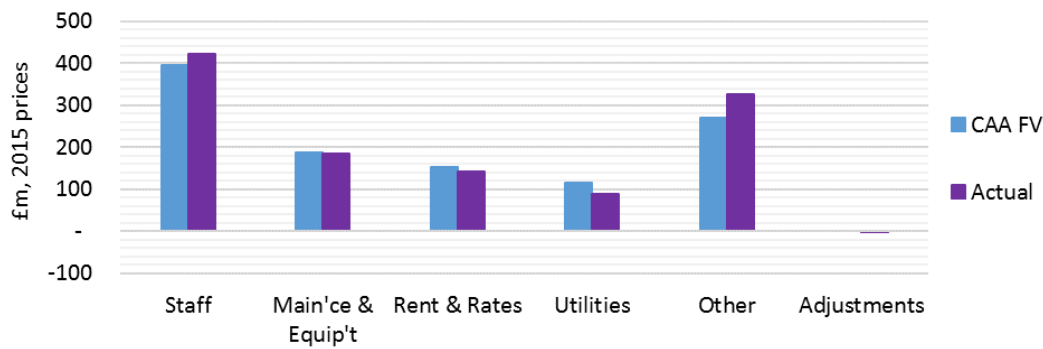
Results and analysis

Figure B.2: Breakdown of HAL actual costs versus the CAA's determination in 2014 (9m)



For 2014 9m (chart above) and 2015 (chart below), there was some (offsetting) variation at a category level, with cost overruns for staff and other costs (and adjustments). There was outperformance in the maintenance & equipment, rent & rates, and utilities categories.

Figure B.3: Breakdown of HAL actual costs versus the CAA's determination in 2015



B.1.2. All staff costs

The CAA's determination

The CAA set HAL a target over reducing employee pay by 17.5% over the course of Q6,³⁰ via a glide path.³¹ This was based on its conclusion that HAL's staff costs were 15-20% too high at the time of the Q6 review,³² as informed by IDS's staff cost benchmarking report and an assumption that real earning growth would be negative over the course of Q6. In its Q6 business plan, HAL had already included staff cost efficiency savings based on its 'Workforce Initiative', but the CAA's determination required an *additional* £97m (real 2011/12 prices) in wage cost efficiency savings.

For pension costs, the CAA's determination was based on consultant reports from IDS and GAD. In 2013, HAL's average contribution rate was 33%. (IDS p.18). IDS suggested an appropriate benchmark was below 20%. GAD's report on defined benefit scheme contributions was more measured, considering 23-24% to be a fair weighted average contribution rate for HAL. The CAA went with GAD's target, judging IDS's efficiency target to be overly aggressive. The CAA did not allow a glide path for HAL, stating that rates should have been reduced in Q5 (see the CAA's final view p.266-269). Therefore, the determination requires HAL to sharply reduce its pension costs from the start of Q6, given that HAL's pension contribution rate was 33% in 2013, and the Q6 allowance is 23-24%. For HAL's defined contribution pension scheme, CAA allowed a contribution rate of 9%, in line with HAL's business plan proposal.³³

³⁰ Economic regulation at Heathrow from April 2014: notice of the proposed licence, p.265

³¹ Economic regulation at Heathrow from April 2014: notice of the proposed licence, p.266

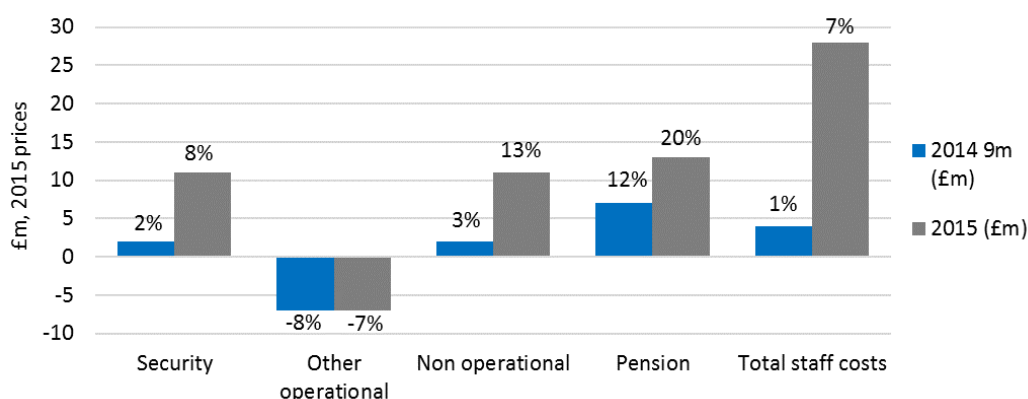
³² Economic regulation at Heathrow from April 2014: notice of the proposed licence, p.264

³³ Economic regulation at Heathrow from April 2014: notice of the proposed licence, p.267

Results

Total staff costs (including pensions)

Figure B.4: Variance of HAL's actual staff costs versus the CAA's determination, Q6

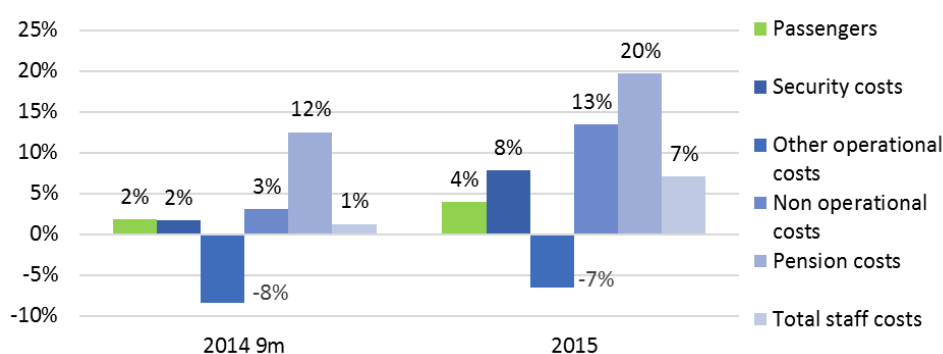


Notes: Variance is shown as €m (column size) and as a % of the determination (column label).

- Staff costs are considerably higher than the determination. This is due to security, non-operational and pension costs.
- Due to the incentive mechanism for security costs, any overspend or underspend of security costs can be passed through to airport charges, up to a limit. Therefore, we consider these in more detail.
- Pension costs are the most above the determination in percentage terms so we focus on them in more detail.

We have investigated whether rising passenger numbers explain the rise in staff costs. This is shown below.

Figure B.5: For pax and staff costs: % difference between HAL actuals and the CAA's determination



Passenger numbers were 2% above the determination in 2014 9m, and 4% above in 2015. Therefore, whilst rising passenger numbers will have no doubt contributed to higher staff costs, this does not explain the whole variance in 2015 where the staff cost variance was 7%. In addition, we would not expect all staff costs to be variable with passenger numbers.

Security staff costs

Focusing in detail on security staff costs, we compare security costs (both staff costs and total security costs) with security staffing levels (both FTEs and person years). This analysis is based on statutory accounting information, as regulatory accounting information on security costs is not available for Q5.

Figure B.6: Indices of security costs and security staff FTEs / person years

[✂]

- Security *staff* costs rose in 2013 and 2014, but fell considerably in 2015. Total security costs have been lower, also falling in 2014. However, security staff FTEs and person years have remained fairly constant. [✂]
- We note that the reduction in opex between 2014 and 2015 based on statutory data (over 9%, shown above), is greater than the reduction in opex for the same period based on regulatory accounting data (which we estimate at just over 4%).
- Passenger numbers rose steadily during the period (2012 – 2015).
- Overall it suggests that HAL is starting to make efficiencies in security costs, both for staff costs and total costs. However, given that actual security *staff* costs have been above the determination (as shown in Figure B.4), it suggests that HAL still has a way to go to reach an efficient level of costs.
- HAL has stated that it has reduced its starting salaries for security staff, but this seems unlikely to explain the full reduction in costs over Q6, particularly given that HAL's security staff turnover is relatively low.

Pension costs

HAL's actual costs are considerably above its allowance for Q6 (by 12% for 2014 9m and 20% for 2015). This is shown above in Figure B.4.

Using statutory cost data, we compare pension costs with staffing levels (both FTEs and person years). This analysis is based on statutory accounting information, as regulatory accounting information on pension costs is not available for Q5.

Figure B.7: Indices of pension costs and staff FTEs / person years

[✂]

Pension costs rose significantly in 2013 but have fallen since then. Given that staffing levels have been relatively constant (both FTEs and person years), pension costs per staff FTE (or person year) have been falling since 2013. Focusing on the trend 2013 to 2015, it suggests that HAL is making efficiencies in pension costs.

HAL has provided an initial explanation for the rise in costs in 2013, which seems to make some (but not complete) sense. In 2012 and before, corporate pensions were charged under 'intercompany' costs, whereas they were included within HAL staff the salary lines from 2013

onwards. This seems to align with the sale of Stansted Airport, although HAL still owned several other airports until 2014 (Southampton, Glasgow and Aberdeen), so it is not clear why the spike occurred in 2013. [X]

HAL states that its defined benefit scheme contribution rates have dropped to “[X]”, which is even better than the CAA’s Q6 target (of 23-24%).

We note that the reduction in costs between 2014 and 2015 based on statutory data (circa 10%, shown above), is slightly greater than the reduction in opex for the same period based on regulatory accounting data (which we estimate at 7%).

Overall, the data is slightly inconclusive. On one hand HAL states that its contribution rate is even better than (i.e. below) the CAA’s target for Q6. However, HAL’s actual pensions costs have been above the determination for Q6 to date (as shown in Figure B.4), which suggests that HAL still has a way to go to reach an efficient level of costs. In addition, the explanation provided for the changes in HAL’s pension costs over time is still slightly unclear, so there remains a degree of uncertainty.

B.1.3. Maintenance and equipment costs

The CAA’s determination

The CAA’s Q6 determination for maintenance costs was informed by HAL’s strategy and analysis by SDG,³⁴ with a number of targets set to increase efficiency during Q6.

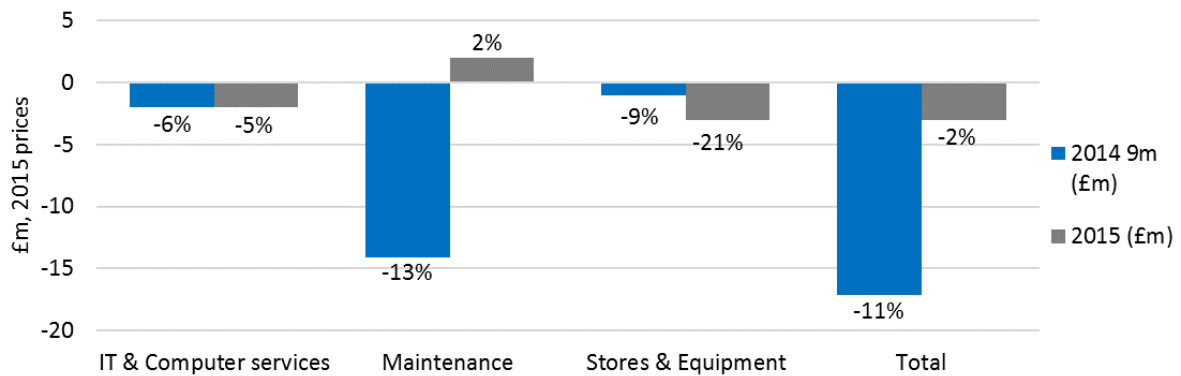
- HAL planned to reduce out-sourcing for building and hard services (where multiple contracts were creating inefficiencies through contractual complexity) by moving to a new procurement framework arrangement in 2014. HAL aimed to increase in-house delivery and improve staff utilisation, and also assumed a reduction in engineering / baggage maintenance staff numbers.
- SDG identified that HAL could achieve efficiencies by improving procurement processes (reducing contractual complexity), supported by an observed 25% efficiency saving made by HAL on its baggage operations and maintenance contracts. Greater out-sourcing of reactive maintenance and mid-tier complexity activities could also generate efficiencies. SDG recommended that HAL’s maintenance costs (per sq m) should remain at their current level during Q6.

After the CAA applied £16m (2011/12 prices) of efficiencies to HAL’s proposal, the CAA set a target of a 1.9% per year reduction in real costs over Q6 (which included an initial increase in at the start of Q6 relative to 2013/14). No glide path was required. As noted above, the reduction was based on HAL moving to a new procurement framework arrangement (and reducing contractual complexity), increasing in-house delivery and staff utilisation, and a reduction in engineering / baggage maintenance staff numbers.

³⁴ SDG, *Assessment of maintenance and renewals costs at Heathrow Airport*, March 2013, p.19

Results and analysis

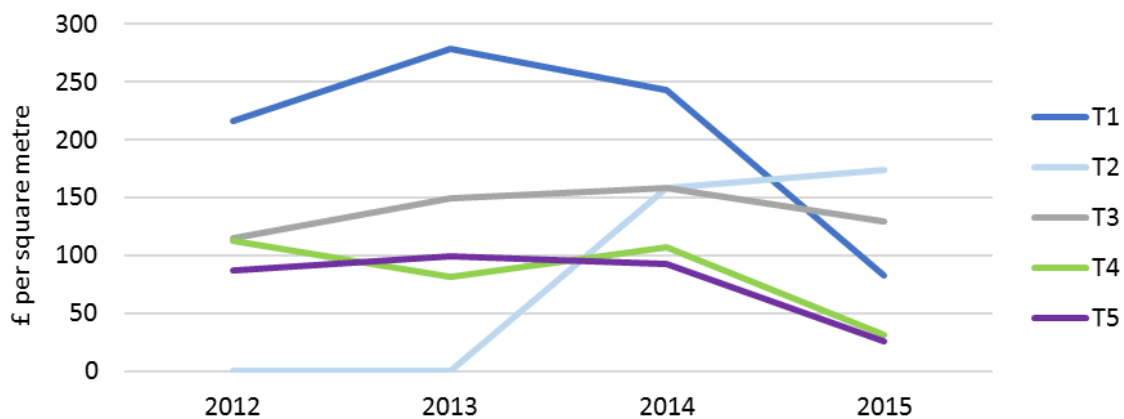
Figure B.8: Maintenance & equipment costs: Variance of HAL actual vs. the CAA's determination, Q6



Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

The variance in 2014 (9m) is primarily due to maintenance costs, which were £14m below the determination. HAL's 'stores and equipment' costs were 21% lower than the determination in 2015, but this category is small so the impact in £m terms is modest.

Figure B.9: HAL maintenance costs per square metre, by Terminal, 2012 - 2015³⁵

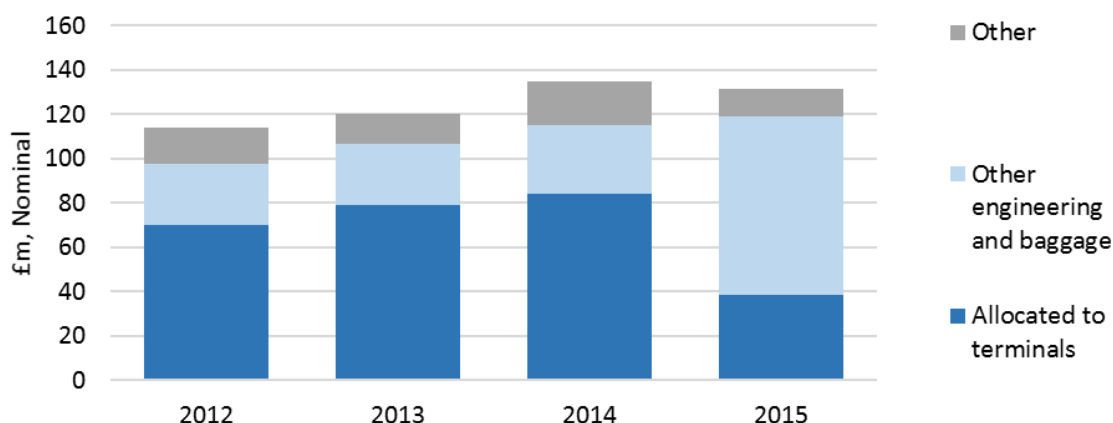


Focusing on 2014, it is interesting that costs for the new terminal [✂] are relatively high.

However, as the next chart shows, the fall in maintenance costs per square metre in 2015 seems primarily to be a cost allocation issue.

³⁵ T2 re-opened in June 2014

Figure B.10: HAL total maintenance costs, 2012 - 2015



This chart shows why the previous internal benchmarking of maintenance costs may not be fully appropriate. Between 2014 and 2015, a large proportion of costs switched to being centrally allocated (within 'other engineering and baggage'), as opposed to previously being allocated to specific terminals. This probably relates to the introduction of the T3IB system, although an explanation has not been provided.

B.1.4. Rent and rates

The CAA's determination

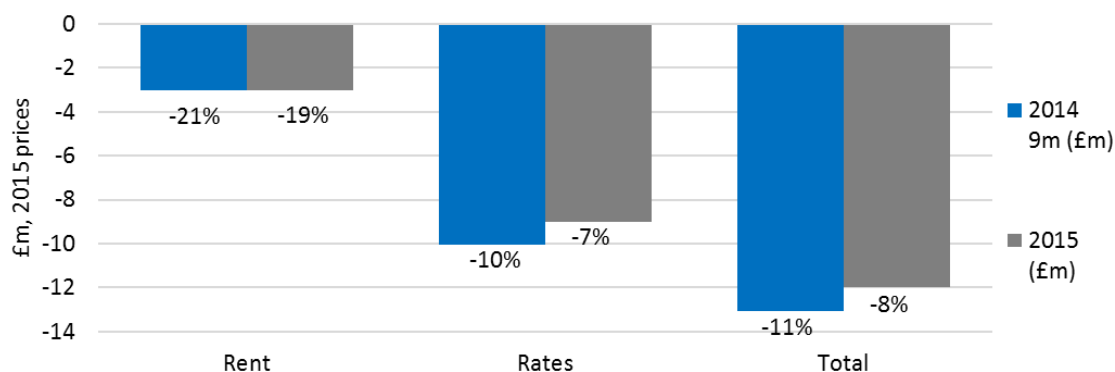
- Given HAL's significant ownerships of both Terminal buildings and offices (e.g. Compass Point). HAL rates costs³⁶ were estimated at £109m in 2013/14, versus rents of £16m.³⁷
- For rates costs in Q6, the CAA allowed two step increases: the first at the start of Q6 due to the opening of T2 and associated multi-story car park (although partially offset by the closure of T1); and the second in 2017 due to the upcoming rates revaluation. The increases are 14% and 9% (respectively) in real terms. Following the CAA's acceptance of SDG's advice, the size of this second step change was lower than HAL's proposal, and so the CAA has provided a cost pass-through mechanism for HAL in case the 2017 rates valuation causes a greater-than-expected increase in costs.
- For rents, the CAA has set an allowance that is fairly stable over Q6, except for a step-down (by 7% in real terms) in 2015 due to the vacation of the Heathrow Point West building.

³⁶ Rates are calculated as the rateable value (RV) of properties multiplied by the rate poundage multiplier.

³⁷ HAL Revised Q6 Business Plan, p.86-87.

Results and analysis

Figure B.11: Rent and rates: Variance of HAL actual costs versus the CAA's determination, Q6



Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

HAL's costs for rent and rates have been considerably below the determination. The variance is largest for rates in £m terms, but for rents in percentage terms.

B.1.5. Utility costs

The CAA's determination

At the time of the CAA's determination (2013), HAL had started to outperform its allowance for utility costs, although it incurred some large cost overruns (2009/10). HAL's utility cost performance for the start of Q5 is shown below.

Table B.2: Utility costs: HAL's actual costs versus the CAA's determination, Q5 up to 2011/12³⁸

Total Utility Costs (£m nominal)	2008/09	2009/10	2010/11	2011/12
Q5 Settlement	82.4	86.9	95.5	102.4
Actual	85.0	108.7	93.8	90.3
Variation to Settlement (%)	3.2%	25.1%	-1.8%	-11.8%

Source: HAL FBP, CAA Q5 settlement, Steer Davies Gleave analysis

- This was primarily due to a spike in electricity costs (2008), at which point HAL (BAA) entered into a hedge for electricity over the remainder of Q5 (although soon after the electricity price dropped again). As such, HAL's electricity expenditure in 2009/10 was 82% above its allowance.³⁹
- The CAA's subsequent determination allowed an increase in real utility costs (relative to the end of Q5) of 20% in 2014/15 and a further 8% increase in 2015/16, predominantly due to the opening of T2. HAL's cost allowance is stable for the remainder of Q6 (in real prices).

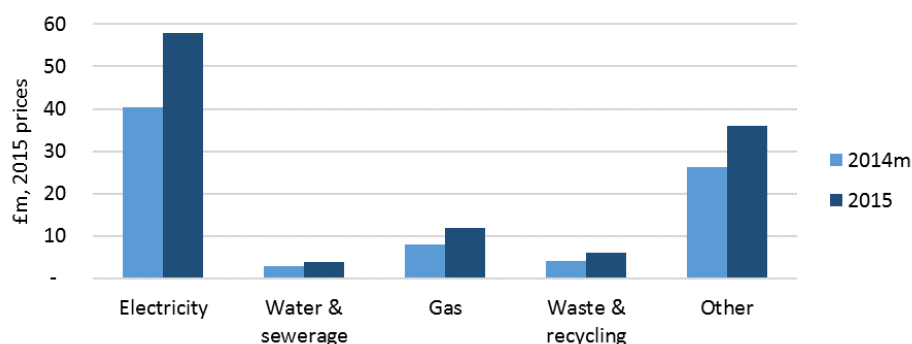
³⁸ SDG, Review of Other Operating Expenditure at Heathrow Airport, March 2013, p.18.

³⁹ SDG, Review of Other Operating Expenditure at Heathrow Airport, March 2013, p.24.

Results and analysis

A breakdown of HAL's utility costs for 2014 9m and 2015 is shown below.

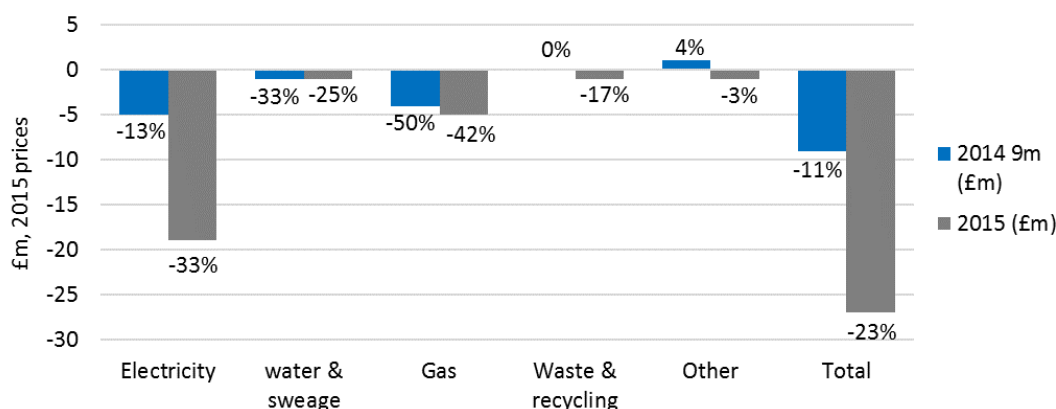
Figure B.12: HAL actual utility costs, Q6 to date ⁴⁰



Roughly half of HAL's utility expenditure is due to electricity costs.

The remainder is due to 'other' costs (c.30%), gas costs (c.10%), waste and recycling costs (c.5%), and water and sewerage costs (c.5%).

Figure B.13: Utility costs: Variance of HAL actual costs versus the CAA's determination, Q6



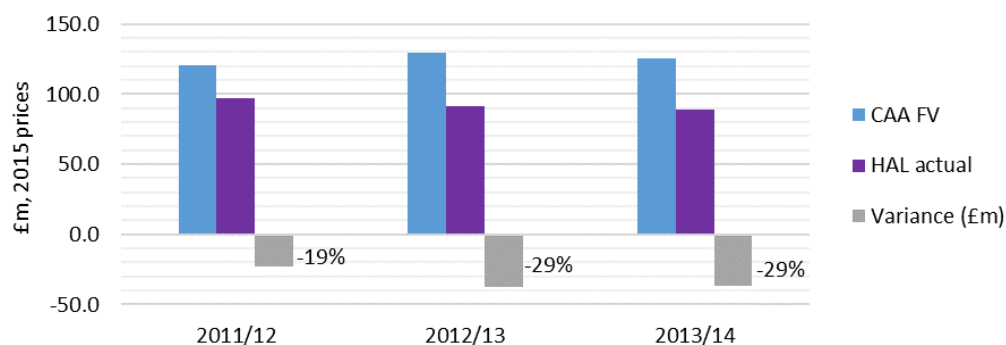
Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

For Q6 to date, HAL has outperformed the determination considerably.

Electricity costs create are the largest variance in £m terms, whilst gas costs vary the most in percentage terms.

⁴⁰ SDG, Review of Other Operating Expenditure at Heathrow Airport, March 2013, p.18.

Figure B.14: Utility costs: HAL's actual costs compared to the CAA's determination, second half of Q5



Notes: Variance is shown as £m (grey column size) and as a % of the determination (column label).

For the end of Q5, data on total utility spend is available. It shows that Heathrow continually outperformed its determination during 2011/12 – 2013/14.

B.1.6. Other costs

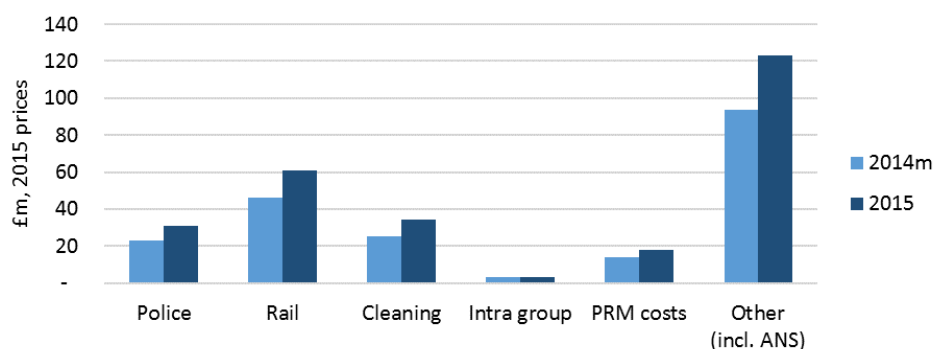
'Other' costs include cleaning, police, rail (Heathrow Express), intergroup costs (primarily due to charges to the owners / the Board, and for the Business Support Centre in Glasgow), Air Navigation Charges (NATS), Passenger with Reduced Mobility Costs (PRM), the CAA's Airport Licence Fees, and a range of other central support costs, e.g. procurement, marketing, communications, consultants, insurance, general expenses, and any other costs.

The CAA's determination

The CAA's determination does refer to 'other' costs but in a slightly different way. However, we are able to get a proxy for the entire Q6 determination by combining several of the categories in the CAA's determination: Central Support Services, Rail, Commercial, and Other. (Although we note there may be some overlap with staff costs.) Taking HAL's business plan proposals and adding the CAA's additional efficiency requirements, the CAA's final determination set a reduction in real costs of just over 3% per year.

Results and analysis

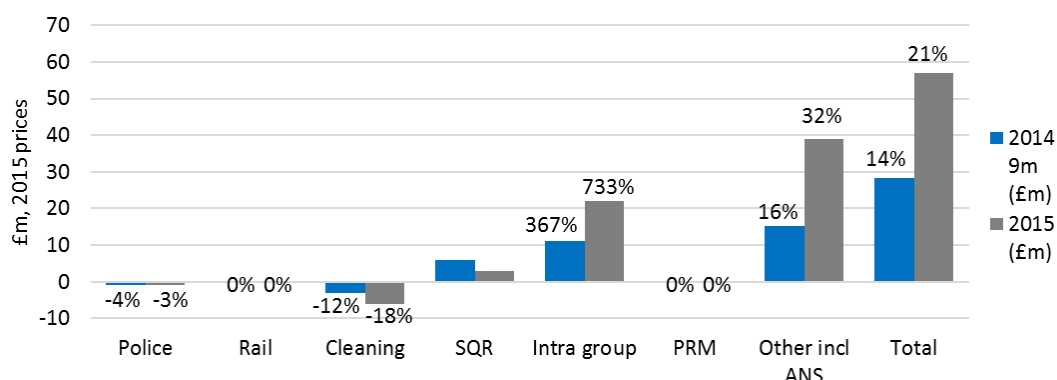
Figure B.15: Other costs, the CAA's determination, Q6



The 'other' sub-category is the largest component, followed by rail, police costs, cleaning, PRM (passengers with reduced mobility) and intragroup costs.

In the analysis below, we have used the categorisation used in the regulatory accounts, in order to have consistency between the CAA's determination and HAL's actuals.

Figure B.16: 'Other' costs: Variance of HAL actual costs versus the CAA's determination, Q6



Notes: Variance is shown as £m (column size) and as a % of the determination (column label).

- The main cost variances in £m terms are within intragroup costs and other costs.
- For intragroup costs, the allowance in each year of Q6 to date was very small (£3m), so with actual costs of £11m (2014 9m) and £22m (2015), the percentage variance is extremely large.
- The 'other' sub-category contains the largest rise in costs in £m terms.
- Based on data which is available for 2015, we have further explored the 'other' sub-category. At a detailed level, there are a number of cost variances from the determination, the main areas being general operational expenses, retail marketing, and other marketing and communications. Interestingly, capitalisation of 'other costs' was significantly lower than expected (by 56%), meaning fewer costs were moved from opex to capex, thereby increasing opex.

Figure B.17: Variance of HAL actual 'other' costs versus the CAA's determination, 2015

[✂]

Notes: Variance is shown as £m (bar size) and as a % of the determination (bar label).

- At a detailed level, there are a large number of cost variances in 2015, both in value terms and in percentage terms.
- The main cost overruns are for general operational expenses, retail marketing, and other marketing and communications.
- Capitalisation of 'other costs' was significantly lower than expected (by 56%), meaning fewer costs were moved from opex to capex, thereby increasing opex.

B.2. Comparison of HAL labour cost against benchmarks

Results and analysis

In the following graphs, we compare HAL's staff wages costs per man-year with the selected benchmarks from ASHE. All graphs are in nominal terms and 2012 is set as the base year for the index (2012=100). From discussions with HAL, we note that corporate restructurings occurred between 2012 and 2013 as all airports, other than Heathrow itself, were sold to other companies. Therefore, HAL's staff FTEs and associated costs increase between 2012 and 2013. In practice, the 2012 and 2013 years are financial years, beginning in April of the stated year. We have data only for 9 months of 2016 so we have pro-rated to create a full-year figure. The ASHE data for 2016 is provisional.

The largest sub-category within labour costs is security costs. The wider market for security labour costs has been very soft (i.e. wages have been relatively suppressed), with wages barely moving in nominal terms over the period. The Heathrow data indicates some large increases early in the period, but coming down again in 2015. By 2016, there may be some convergence with economy wage costs, if this part year is confirmed. We are reasonably hopeful that this is a well-defined data category.

Figure B.18: Heathrow's Average Unit Wage Costs for Security (£)

[✂]

Engineering costs are the next largest sub-category cost within Heathrow's overall labour costs. The unit wages costs for engineering initially exhibit a trend similar to that of security, with large increases in Heathrow's costs whilst the market labour cost experiences a gradual decline. Towards the end of the period, whilst the two do not converge towards one another, both market labour and Heathrow's engineering costs find themselves experiencing a trend of steady increase.

Figure B.19: Heathrow's Average Unit Wage Costs for Engineering (£)

[✂]

The only other category where the unit wage costs calculated from the data supplied by Heathrow appear plausible is Heathrow Express. As noted above, we have been unable to benchmark this against ASHE railway labour costs because the data appears to be badly distorted by the effect of industrial action in other parts of the railway sector. We have therefore benchmarked against a public service technical trade wage index. This wage index has been less soft (i.e. less suppressed) than private sector wages. Heathrow's railway unit wage cost shows a similar pattern to security, with early material increases later converging to close to the market labour cost. Nevertheless, in classes of labour, the relatively large increases early in the period, at a time when labour markets as a whole were very soft (e.g. wages were lower than they had been historically), is curious and merits further investigation.

Figure B.20: Heathrow Express Average Unit Wage Costs (£)

[✂]

The following three graphs illustrate unit wage costs for the remaining categories of Heathrow’s overall wage costs. Other operations in particular exhibits an erratic pattern, whilst the market labour cost remains relatively constant across the time period. Towards the end of the period however, other operations converges towards the market labour line.

Figure B.21: Heathrow’s Average Other Operation Unit Wage Costs (£)

[✂]

Interestingly, airside unit wage costs are the only category of Heathrow’s wages which lie underneath the market labour costs for this sector. Like Other operations however, they slowly appear to be converging during the end of the period examined.

Figure B.22: Heathrow’s Average Airside Unit Wage Costs (£)

[✂]

Baggage wage costs experience a continual steep incline for the duration of the time period, whilst market labour costs decrease at a significantly slower rate. This level of divergence is the most extreme out of all of Heathrow’s wage categories. The reason for this is unclear.

Figure B.23: Heathrow’s Average Baggage Unit Wage Costs (£)

[✂]

B.3. Quality metrics

B.3.1. HAL’s performance

As previously detailed, HAL releases a monthly service quality performance report, which combines individual terminal scores along with aerodrome congestion and control post queueing. The table below shows the full list of metrics that Heathrow report on with regards to both passenger experience and service level performance.

Table B.3: Service Quality Rebate metrics reported on*

Passenger Experience	
Department lounge seat availability	Wi-Fi
Cleanliness	Security
Wayfinding	CSA queues – Time queue < 5 minutes
Flight information	CSA queues – Time queue < 10 minutes
Service Level Performance	
Staff search	Pre-conditioned Air
Transfer search	Stand Entry Guidance
Control Post Security Search	Pier Service
PSE (General)	Arrivals Reclaims

Passenger Experience	
PSE (Priority)	Aerodrome congestion
Stands	Track Transit System – One Car
Fixed Electrical Ground Power	Track Transit System – Two Cars
Jetties	

**as of the March 2017 Heathrow Performance Report*

The graphs below provide an insight into Heathrow’s performance, first as an airport overall, and then by individual terminal.

Figure B.24: Metrics based on the performance of Heathrow Airport (average of individual terminal results)

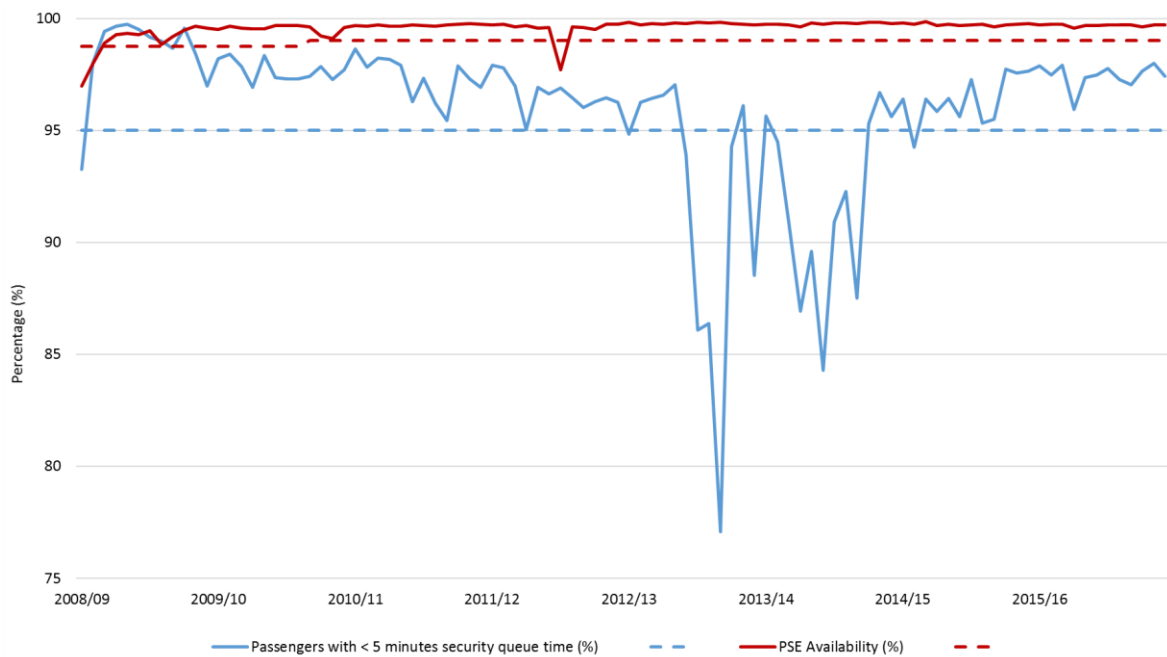
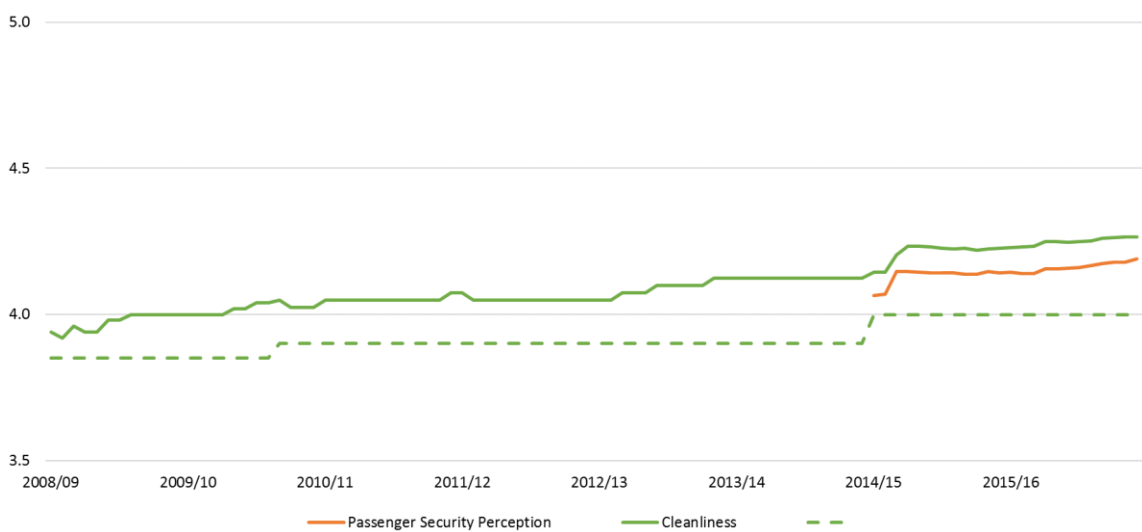


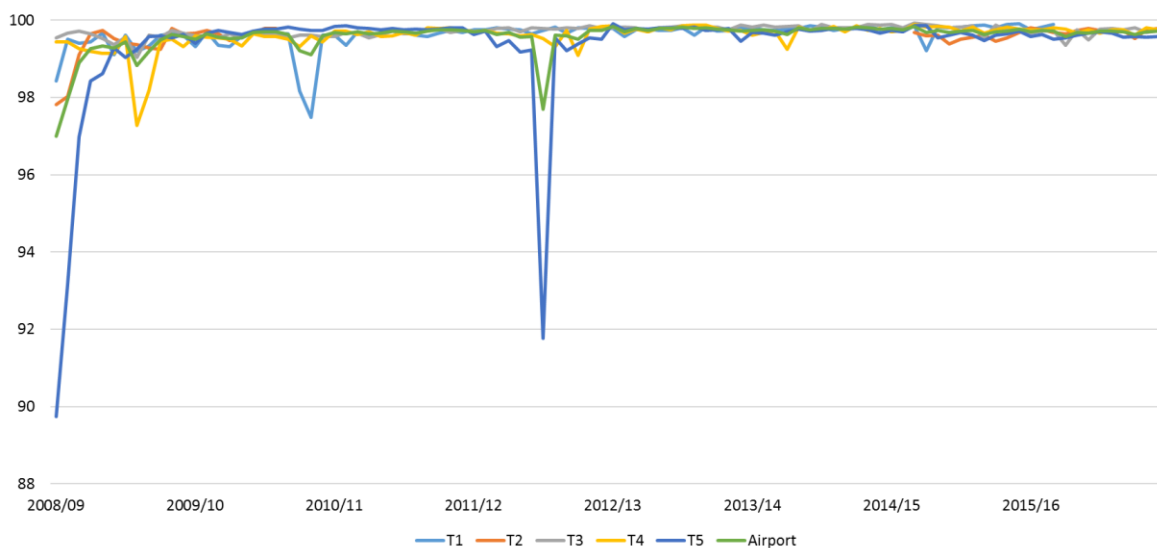
Figure B.25 Metrics based on passenger perception of Heathrow Airport (average of individual terminal results)



The key points from the chart above are as follows:

- Security queue time exhibits an initial decline before gradually increasing. Whilst the majority of performance lies above the target level, there is still a substantial proportion which falls underneath. However, due to the nature of the drop, particularly during 2013/14, suggests that enhanced security measures that were introduced in late 2012, including extra carry-on item searches,⁴¹ are partly responsible for the increase in security wait times.
- Perception by passengers of security is a relatively new performance metric to be introduced to the SQR scheme, and is yet to have a target level assigned. However, as shown in the figure above, passenger satisfaction with the security process has increased continually in the two years since it was first recorded, which is a promising start for Heathrow.
- Passenger perception of cleanliness exhibits continual growth across time, never dipping below the target level, suggesting that cleanliness levels at Heathrow are constantly improving. The step increase in target level also suggests that Heathrow are trying to encourage this improvement in cleanliness.
- Availability of general PSE however, does not increase over time but remains constantly high. Aside from a few instances in which availability drops below the target level, consistent performance in this area can be seen. Interestingly however, the target level for PSE availability remains constant across time, suggesting either that this is an ambitious target and there is little room for improvement, or that Heathrow and the airlines are content with this level.

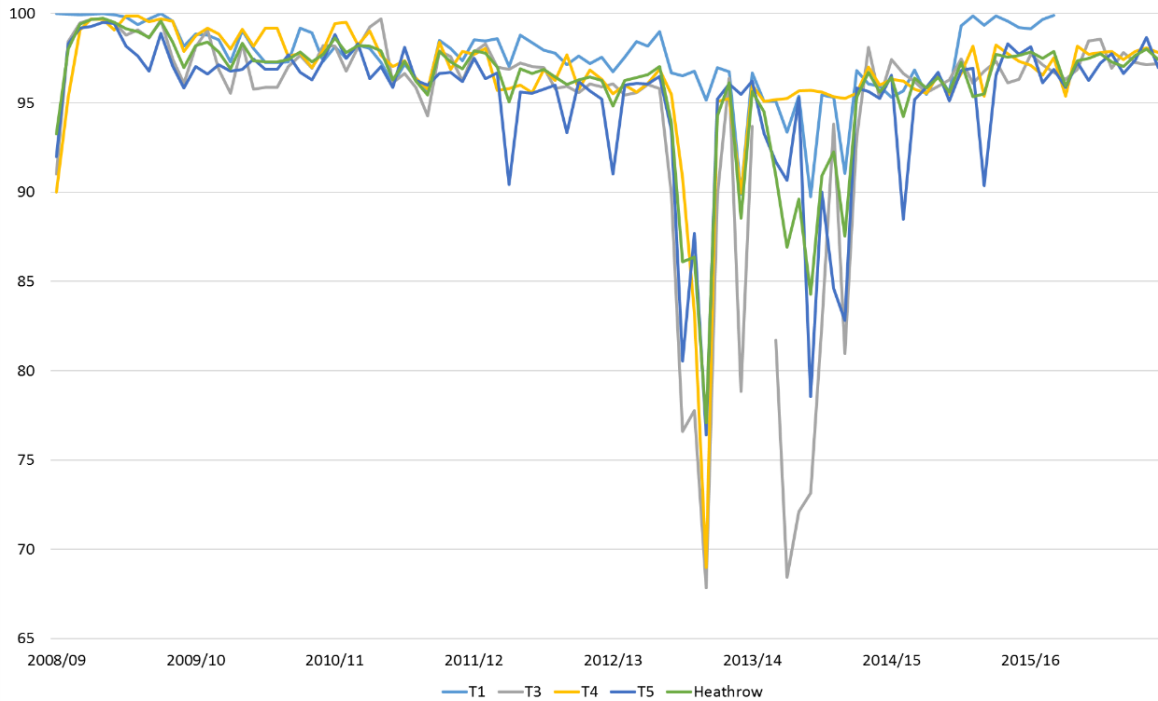
Figure B.26: Availability of Passenger Sensitive Equipment (General)



⁴¹ Source: <http://www.telegraph.co.uk/news/aviation/9622104/Tighter-security-sees-long-queues-at-Heathrow.html>

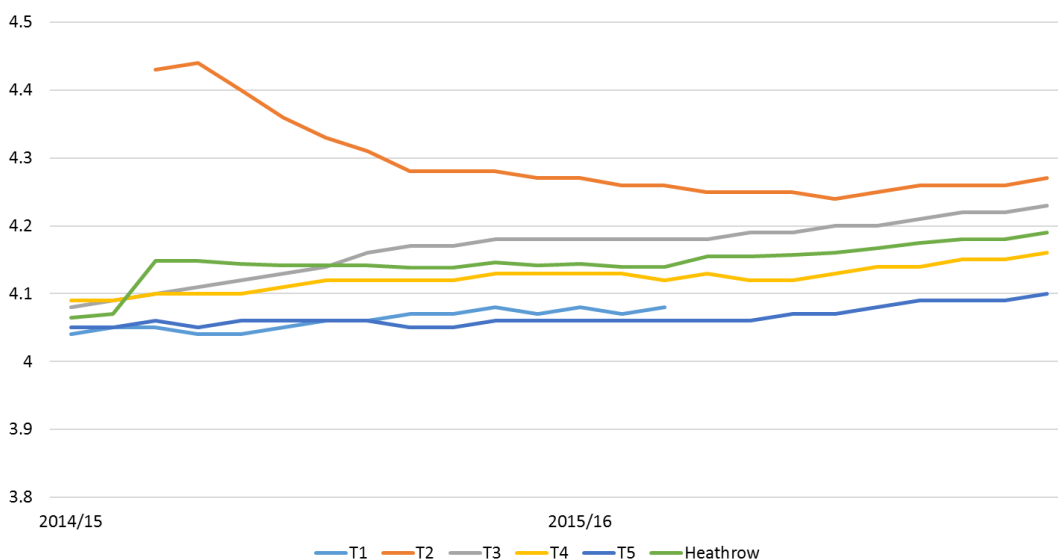
The availability of general PSE across Heathrow at first experienced an upward trend before peaking in 2012/13, and is now undergoing a very gradual decline over time. However, it is worth noting that average availability remains above 99%. The large drop in 2011/12 is due to Terminal 5, which experienced one month below 99%, but which has had considerable impact on the annual average and could therefore, be regarded as an outlier.

Figure B.27: Security Queue wait time of less than 5 minutes (%)



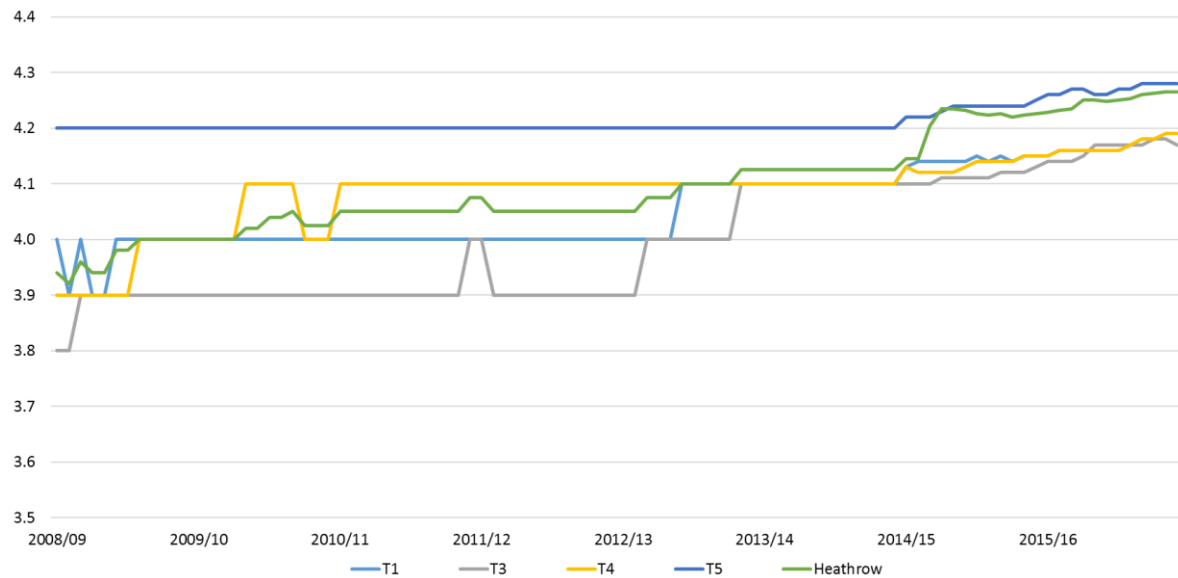
The % of security queue times, which are less than 5 minutes, experiences a dip during the period from 2012/13 to 2013/14 across all terminals. Aside from this period, the % of security queue times less than 5 minutes appear to remain consistently high, although appear to be experiencing a slight downward trend across time.

Figure B.28: Passenger Perception of Security



All terminals appear to be gradually increasing their passenger security satisfaction levels across 2014/15 and 2015/16, aside from terminal 2 who experienced an initial drop which may be attributable to the opening of the terminal. Overall, passenger satisfaction with security appears to be on the rise at Heathrow.

Figure B.29: Passenger Perception of Cleanliness



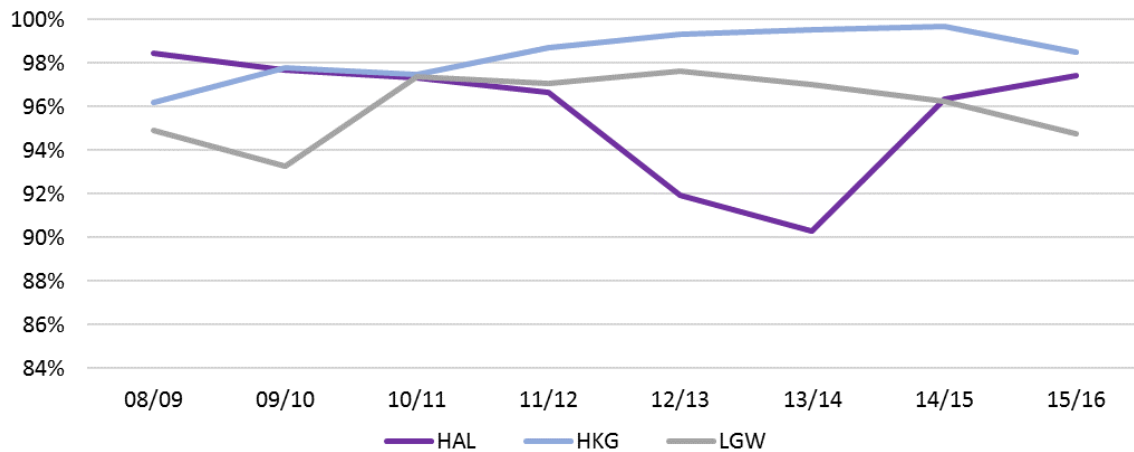
Passenger perception of cleanliness is gradually rising in each terminal across time, although it is often constant for long periods of time within each terminal. Overall, cleanliness levels appear to be on the rise across Heathrow according to passengers' perception.

B.3.2. Comparison of HAL's quality of service against other airports

Security waiting time: Results and analysis

Some airports provide data on the percentage of passengers whose security queue was below a specified benchmark. We have this data for HAL, Gatwick and Hong Kong, although Hong Kong's benchmark (4½ minutes) is slightly more aggressive than HAL / Gatwick's (5 minutes). This chart shows the percentage of passengers whose security queue was below the specified benchmark (5 minutes for HAL and Gatwick, 4½ minutes for Hong Kong).

Figure B.30: Security waiting times: Percentage of passengers waiting less than benchmark time



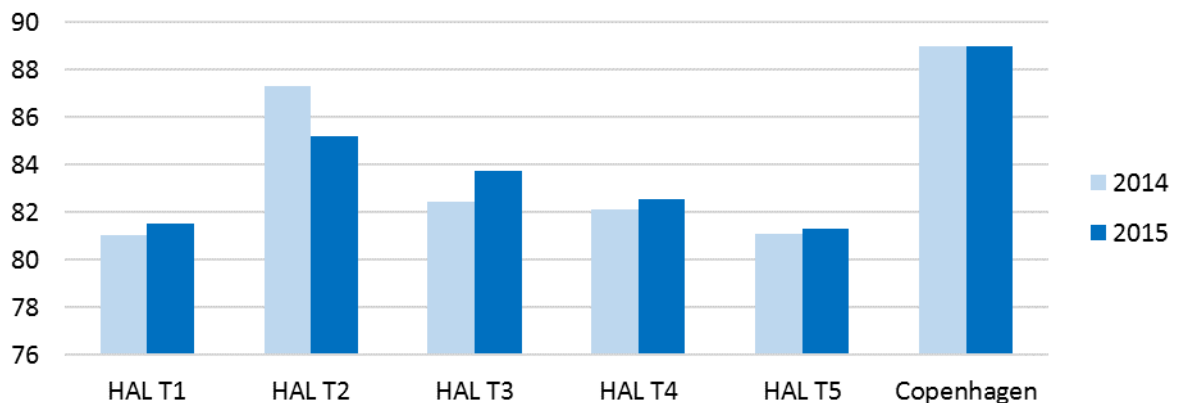
Since 2010/11, when all three airports had the same percentage, Hong Kong (HKG) has had the best security waiting time performance versus the benchmark. HAL had the worst until 2014/15, but has since significantly improved its performance and in 2015/16 was close to HKG.

HAL’s performance has generally been below Hong Kong, although only slightly lower in 2015/16. However, if HKG was to be assessed using the same 5-minute benchmark, its performance would appear even better when compared with HAL and LGW. Whilst this observation is noteworthy, the small sample size means that we do not place too much weight on this result.

Security perception: Results and analysis

Customer surveys are also undertaken to understand passengers’ satisfaction with security. Data availability is low, but HAL and Copenhagen both report on this measure for 2014 and 2015. HAL passengers report their satisfaction on a 0-5 scale whilst Copenhagen, asks passengers to record their security satisfaction on a 0-100 scale. Heathrow’s results have therefore, been converted to a base of 100 in order to allow for comparison with Copenhagen.

Figure B.31: Security perception, HAL and Copenhagen airports



In summary, all of HAL’s terminals score below Copenhagen in terms of passengers’ satisfaction with security, although four out of HAL’s five terminals improved their score between 2014 and 2015 (the exception was Terminal 2). Again, due to limited comparable data across airports, and the difficulty with international comparisons of perception given cultural differences in approaching such surveys, we do not place too much weight on this result.

B.3.3. Recognition and passenger satisfaction awards

The most recognised/prestigious airport awards are the *Skytrax World Airport Awards* and the *ACI ASQ awards* (based on passenger satisfaction ratings within the ASQ customer survey). HAL has received a number of awards from both of these bodies.

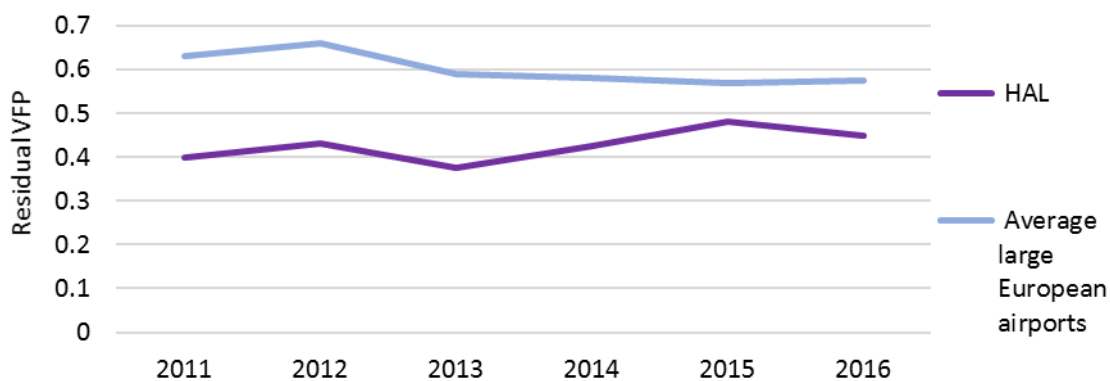
HAL has also received awards for shopping experience (World Airport Awards and Business Traveller Awards), environmental performance (Wildlife Trust and Green Apple), and sustainability (Sustainability Leaders Award). HAL also won IT Project of the Year 2015 for its Terminal 3 Integrated Baggage Facility.

B.4. Other studies

B.4.1. Air Transport Research Society

Results and analysis

Figure B.32: Residual VFP for large European airports, ATRS 2011 to 2016



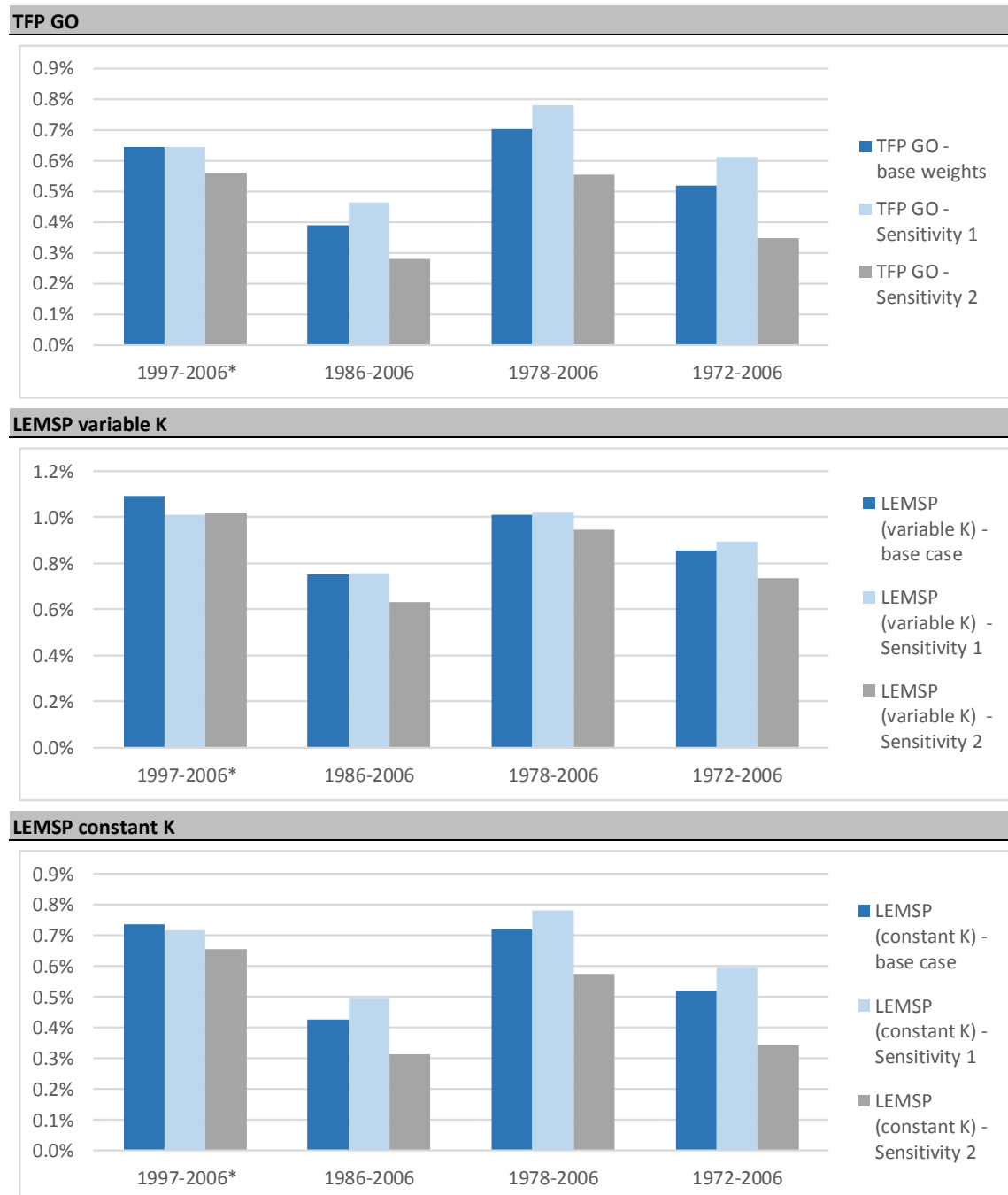
Source: Various ATRS reports and ‘Key Findings’ presentations

From an analysis of previous years’ data from ATRS, HAL has consistently been below the Residual VFP average for large European airports. However, over time HAL’s Residual VFP score has moved closer to the average.

B.5. Top down productivity metrics

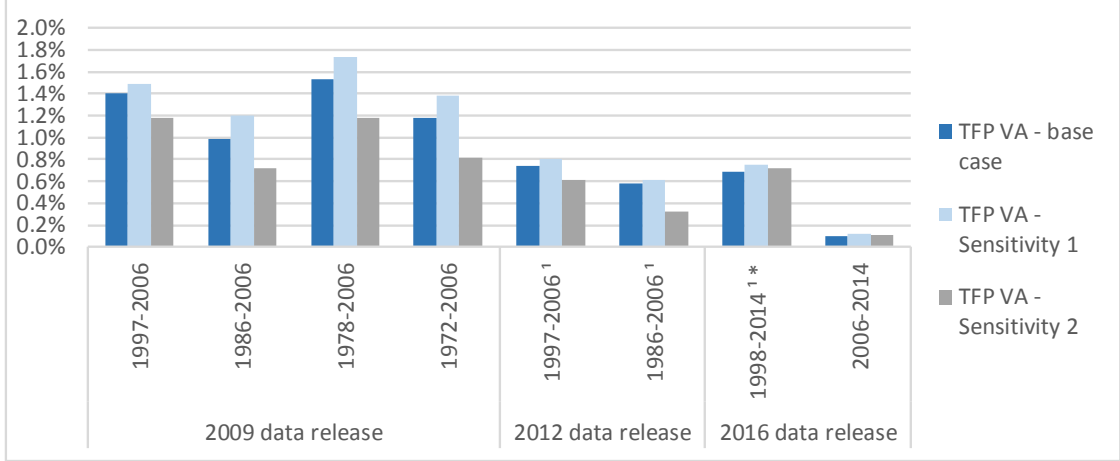
Here we present the range of results that underpin our summary in the main body of the report.

Figure B.33: Calculated productivity measures

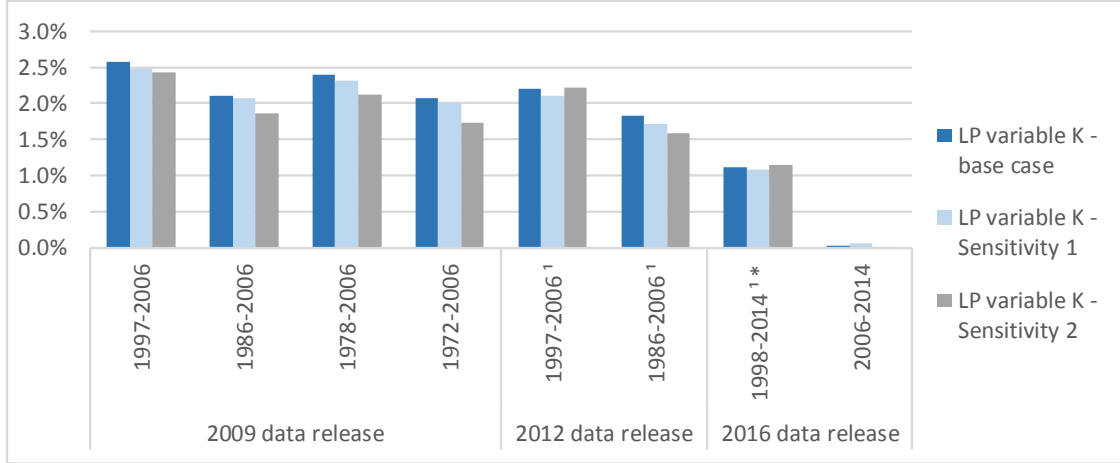


* indicates 'base case' time period.

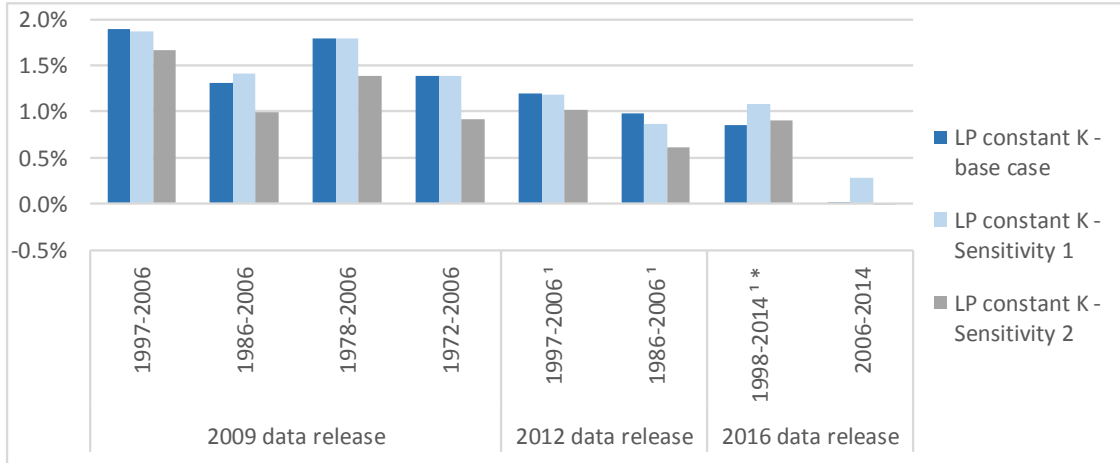
TFP VA



LP - variable K



LP - constant K



* indicates 'base case' time period. ¹ indicates included within the truncated range.

B.5.1. Top down unit cost metrics

RUOE – additional results

In this section, we present charts showing the average annual changes in operating productivity for HAL and selected comparators, based on observed changes in RUOE. Consistent with the results shown in Section 6.4.1, in the following charts we present reductions in RUOE, so productivity gains show as positive numbers. For example, if RUOE has changed by -3% per annum (on average), this equates to an operating productivity gain of +3% per annum.

The following charts show the average annual operating productivity gains, over different time periods, for HAL and selected comparators. The first chart compares HAL’s performance with other airports, whilst the second chart compares HAL against industries with similar characteristics.

Figure B.34: Average annual percentage reduction in RUOE for different 5-year periods: By airports

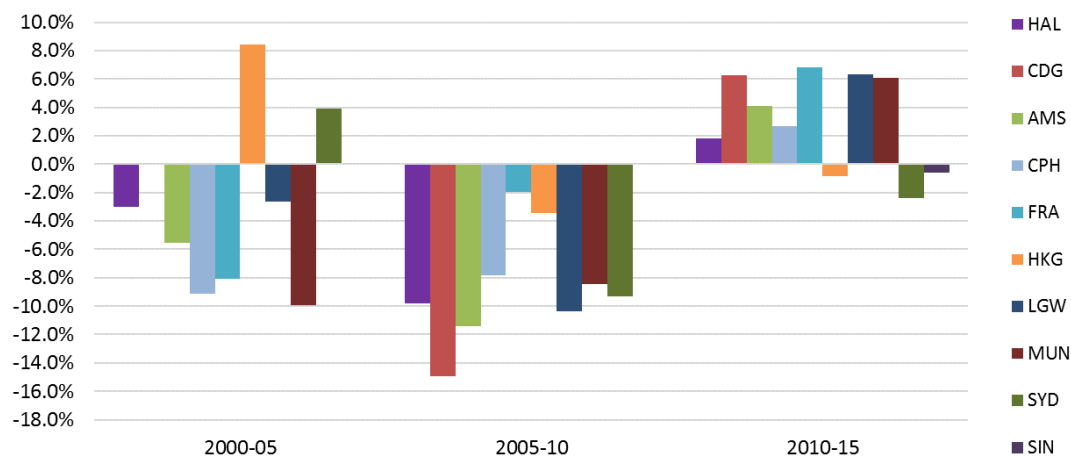
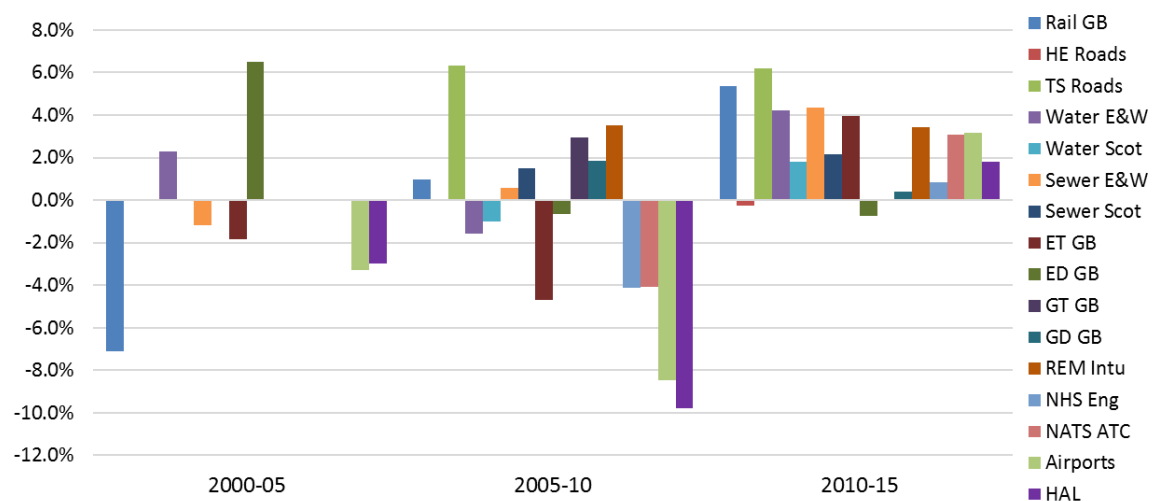


Figure B.35: Average annual percentage reduction in RUOE for different 5-year periods: By industry



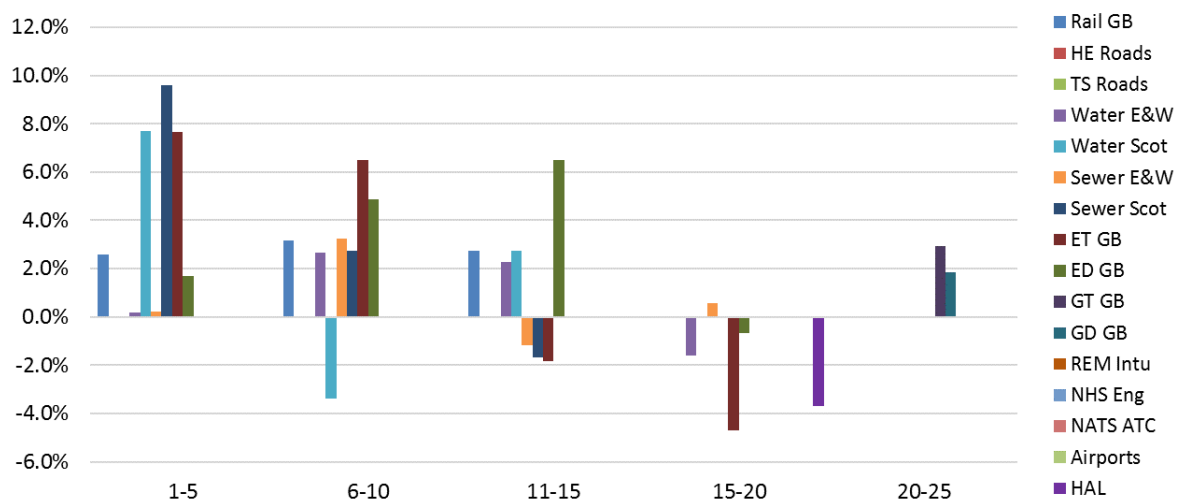
Note: ‘Airports’ average excludes HAL.

The main observations from the charts above are as follows:

- Per 5-year period, the *direction* of HAL’s operating productivity performance has been similar to other airports. Specifically, 2005-10 was a period of reducing operating productivity for the majority of airports, whilst in 2010-15 the majority of airports improved their operating productivity.
- Per 5-year period, HAL tended to be at the lower end of the range of operating productivity performance of the comparator industries.

The chart below illustrates average annual operating productivity changes for regulated industries that have been privatised. Operating productivities are presented for different numbers of years following privatisation or similar organisational change. For example, the period ‘1-5’ in the chart below signifies the average annual efficiency gains made by these industries in the first five years following privatisation or equivalent.

Figure B.36: Average annual percentage reduction in RUOE for HAL and other industries, by years since privatisation



For privatised industries, opex productivity gains tend to decline as time since privatisation increases. Although this is a relatively high level result with quite wide scatter, it provides some evidence to support our hypothesis that opex efficiencies tend to decline over time within regulated industries, as easy efficiencies (‘low hanging fruit’) are realised first. In several cases, we see that higher productivity gains have been obtained in years 6 to 10, before falling off later, so there may also be an element of learning in the early stages too.

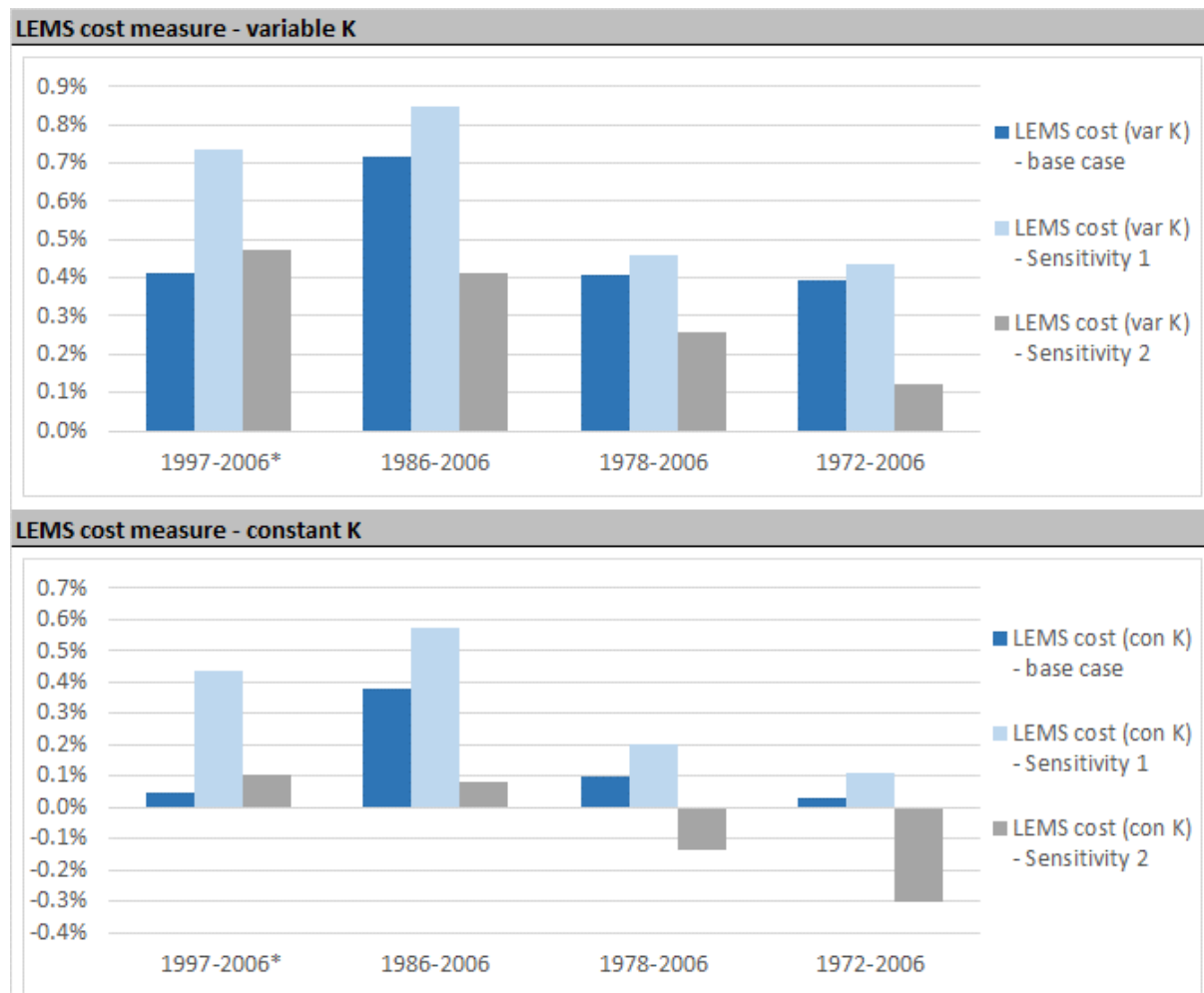
Partial factor productivity metrics

LEMS cost measure

The LEMS cost measure calculates the average annual percentage change in input costs (per unit of output) for the UK sectors deemed most similar to HAL. The LEMS cost measure includes both labour and intermediate inputs. It calculates the percentage *change* in operating costs, rather than the level at a point in time. It combines changes in LEMS productivity (from our top-down productivity metrics, presented earlier) with sector-specific variations in input and output prices, to provide a measure of cost efficiency.

We show reductions in unit costs (i.e. efficiency *gains*) as *positive* numbers. Whilst this may appear slightly counterintuitive, it has been done to achieve consistency with the top-down productivity metrics, where a positive number represents a productivity *gain*.

Figure B.37: LEMS productivity measures

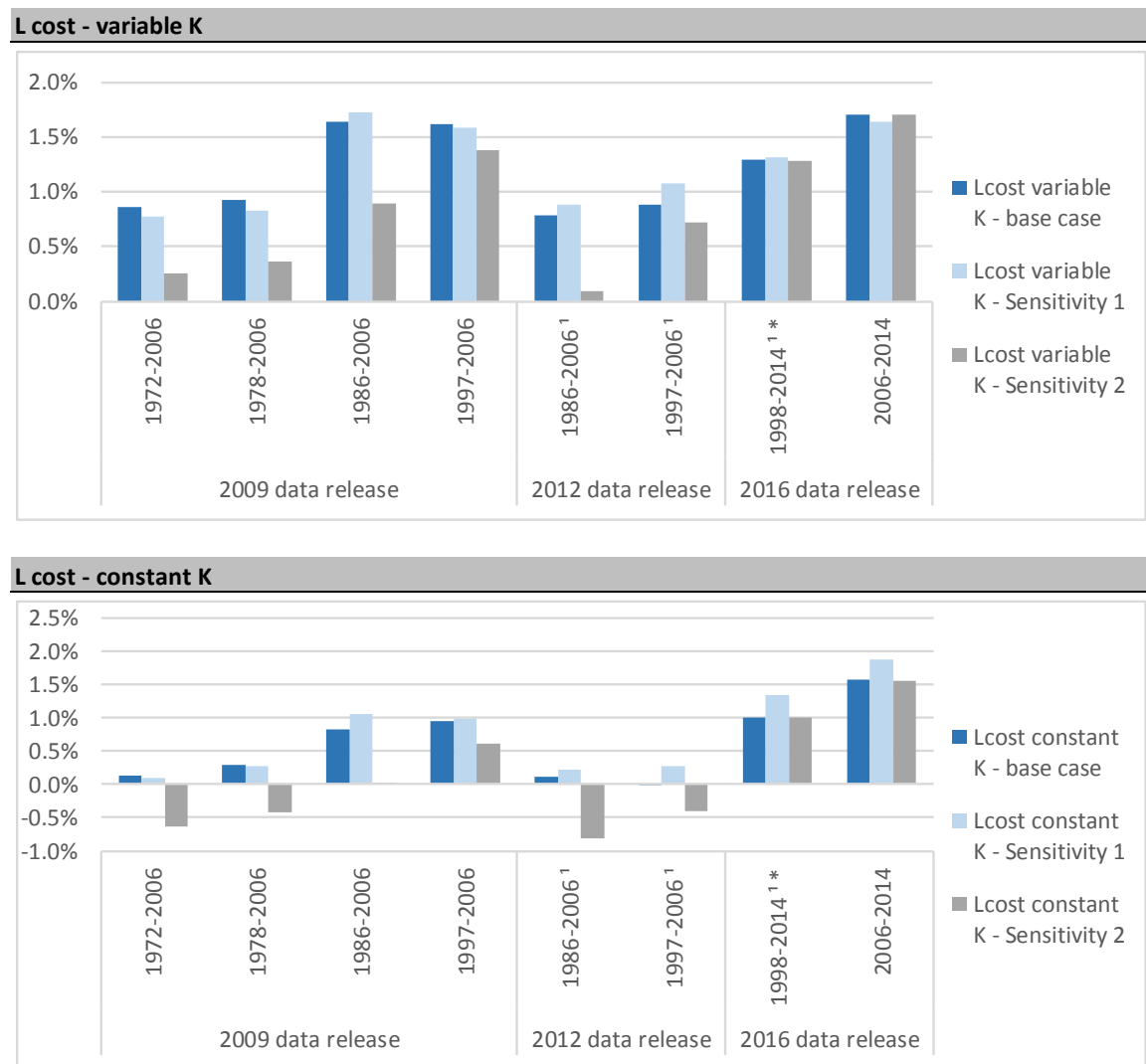


Sensitivity 2 utilises the “Hotel and Restaurant” sector as a comparator for HAL’s rent and rates costs. Because unit costs have increased for this category, the level of efficiency is lower, hence the difference in the charts above.

Labour (L) cost measure

The labour cost measure calculates the average annual percentage change in labour input costs (per unit of output) for the UK sectors deemed most similar to HAL. It is effectively the same as the LEMS cost measure, except that it only takes into account labour inputs, rather than labour and intermediate inputs. As noted above, we show reductions in unit costs (i.e. efficiency *gains*) as *positive* numbers, for consistency with our top-down productivity metrics.

Figure B.38: LP productivity measures



As with the LEMS cost measure (further above), the L cost measure is slightly lower under Sensitivity 2, due to the use of the *Hotel and Restaurants* sectors for the 2009 data / the *Accommodation and food service activities* sector for the 2012 and 2016 data.

ANNEX C CONFIDENTIAL ANALYSIS

[REDACTED]