BETA FOR RP3

A Report for NATS En Route plc

December 2019

Economic Insight Ltd

CONTENTS

1. Introduction and Executive Summary

This report for NATS En Route plc (NERL) sets out Economic Insight's estimates of the appropriate beta for NERL at RP3. This supplements our separate assurance review, which details our views on NERL's and the Civil Aviation Authority's (CAA's) evidence and arguments on the cost of capital more broadly. Our approach to beta estimation combines an objective framework for assessing systematic risk with comparator and temporal analysis. Our analysis suggests a range for NERL's asset beta of 0.53 to 0.63, with a point estimate of 0.60.

1.1 Introduction

NERL commissioned Economic Insight to provide an assessment of the appropriate level of beta to be used in calculating NERL's allowed rate of return for RP3. This report forms part of our wider work for NERL in support of its appeal of the CAA's RP3 price determination to the Competition and Markets Authority (CMA).

Table 1 summarises the CAA's and NERL's final positions on systematic risk at RP3. The CAA's considered that an asset beta of 0.46 was appropriate, which (combined with a debt beta of 0.1 and gearing of 60%) implies an equity beta of 1.00. NERL, on the other hand, argued that an asset beta of 0.57 and debt beta of 0.05 were appropriate, implying an equity beta of 1.35.

Table 1: Summary of CAA and NERL final positions on beta

Parameter	CAA			NERL
	RP2	Draft proposals	Final Proposals	Response to Draft Proposals
Gearing	60%	60%	60%	60%
Asset beta	0.505	0.46	0.46	0.57
Debt beta	0.10	0.13	0.10	0.05
Equity beta	1.11	0.96	1.00	1.35

Source: CAA; UK RP3 Decision Document – Appendix E

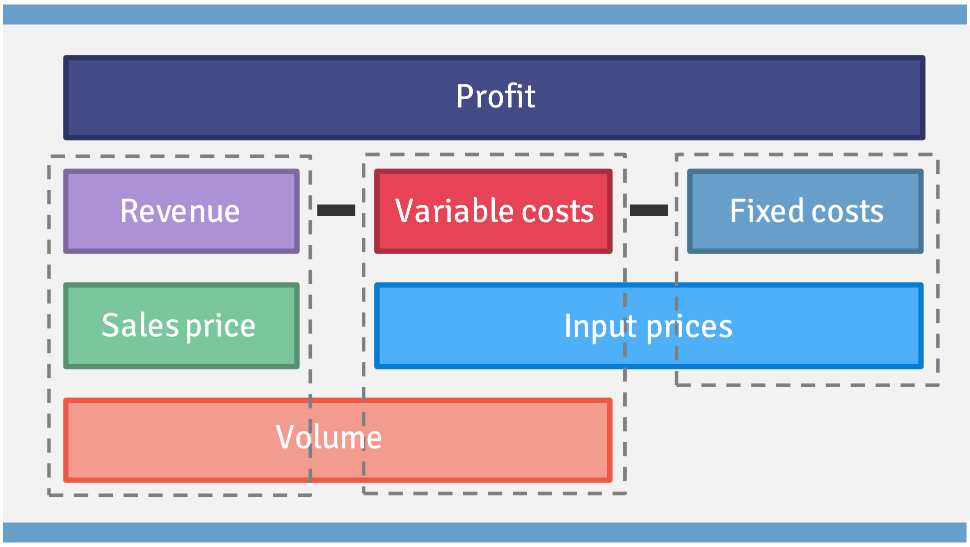
1.2 Executive Summary

1.2.1 Methodology and risk framework

The fact that NERL is not listed on a stock exchange means that direct market evidence on systematic risk is not available – and so comparator analysis is required in coming to a view on NERL's beta. To address common problems with such analysis, however, we use a methodology that incorporates: (i) an objective risk assessment framework; and (ii) a temporal analysis that assesses changes in risk since RP2, taking the asset beta from RP2 as its starting point.

Our risk framework is based on the observation that overall systematic risk can be decomposed into three components: (i) revenue risk, in turn determined by price and volume risk; (ii) cost risk, which primarily relates to input prices; and (iii) the structure of cost and revenue, including operating leverage. We summarise the components of our risk assessment framework in Figure 1.

Figure 1: Systematic risk framework

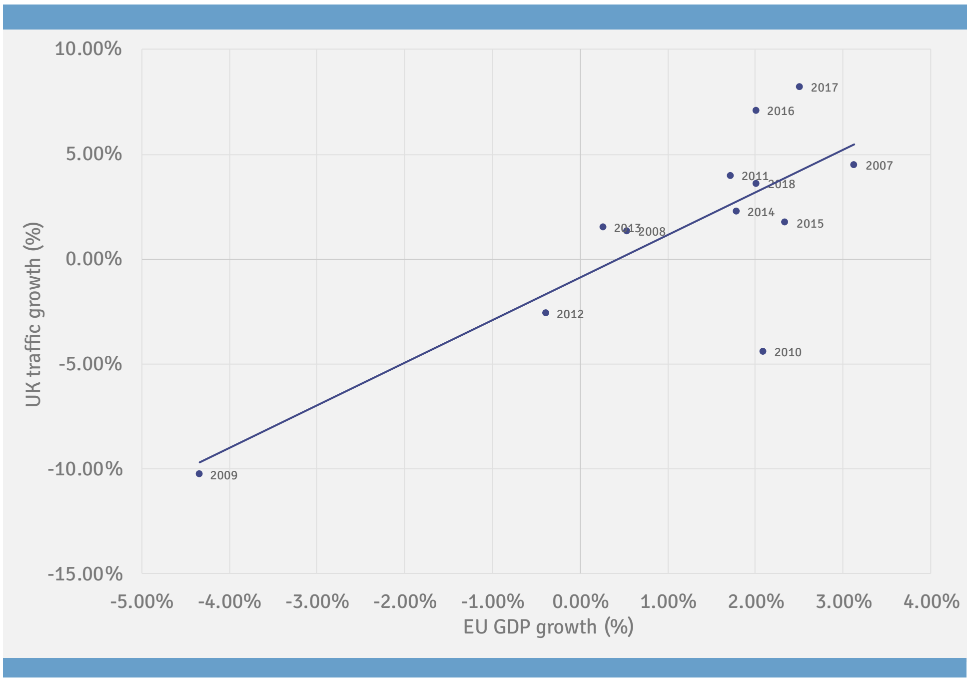


Source: Economic Insight

Applying the risk framework to NERL, our main conclusions were as follows.

- While its price cap limits sales price risk, NERL remains exposed to volume risk. Analysis of the relationship between UK total service units (TSUs) and European Union (EU) gross domestic product (GDP) growth indicates that this includes a material systematic component, as demonstrated in the scatter plot in Figure 2.

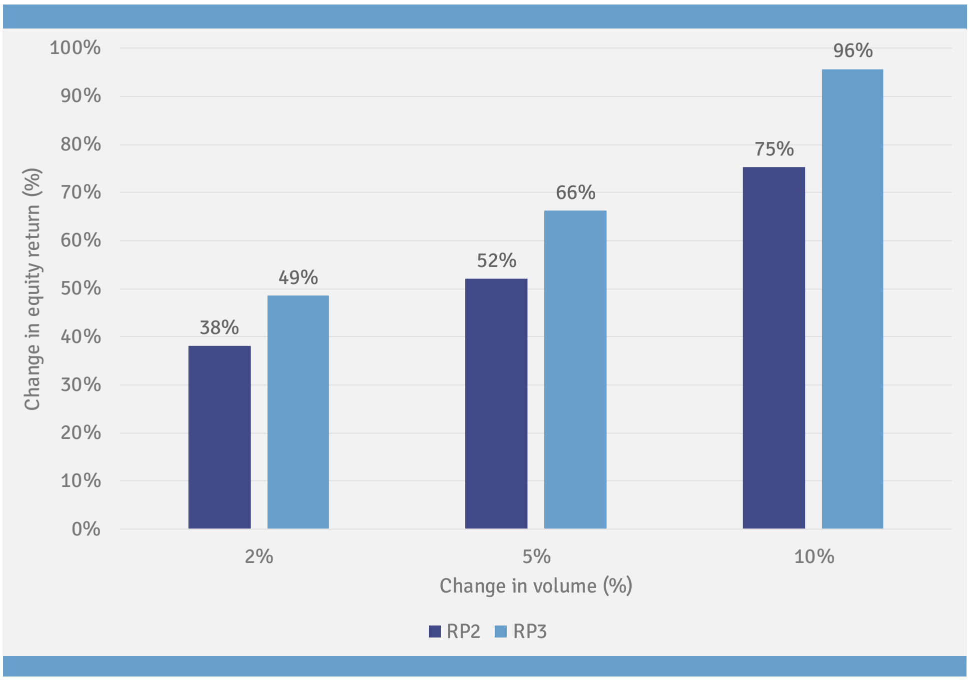
Figure 2: Scatter plot of percentage changes in UK traffic and EU GDP



Source: Economic Insight calculations based on STATFOR and World Bank data

- NERL has a somewhat 'fixed' cost base, combined with allowed returns (on capital) that are a relatively small part of its revenue. This further contributes to systematic risk exposure. We illustrate this in Figure 3 below, which shows the impact of 2%, 5% and 10% changes in volumes on NERL's equity returns (assuming a notional financial structure). As can be seen equity returns can vary significantly with changes in volume – and, importantly, this is true to a greater extent at RP3 relative to RP2.

Figure 3: Impact of lower allowed return on changes in realised equity returns



Source: Economic Insight calculations based on CAA figures

1.2.2 Assessment of potential comparators

'by starting from a 'long list' and narrowing down, we avoid 'pre-judging' which comparators are most relevant.'

To address the limitations of comparator analysis identified in our cost of capital assurance review, we start with a *longlist* of potential comparators, which we narrow down in a transparent and systematic manner using our risk framework. The long list of potential comparators drew on those considered by the CAA and NERL and is summarised in Table 2. The key point is that, by starting from a 'long list' and narrowing down, we avoid 'pre-judging' which comparators are most relevant.

Table 2: Potential comparators

Sector	Companies
Air Navigation Services	ENAV.
Airports	Aéroports de Paris, Aena, Auckland, Copenhagen, Frankfurt, Sydney, Vienna, Zurich.
Airlines	Air France-KLM, easyJet, International Airlines Group, Lufthansa, Ryanair.
Energy	Centrica, National Grid, SSE.
Water	Pennon, Severn Trent, United Utilities.

Source: Economic Insight

Applying our risk assessment framework to the potential comparators reveals Aéroports de Paris and ENAV to be of most relevance to NERL, as set out in Table 3.

Table 3: Application of risk framework to comparators

Comparator	Revenue		Cost	Cost structure	Overall
	Price	Volume			
Air Navigation Services					
ENAV	Similar	Lower	Similar	Lower	Similar/Lower
Airports					
Aéroports de Paris	Similar	Lower	Similar	Lower	Similar/Lower
Aena	Similar	Higher	Similar	Lower	Indeterminate
Auckland	Higher	Higher	Higher	Lower	Indeterminate
Copenhagen	Higher	Higher	Higher	Similar	Indeterminate
Frankfurt	Similar	Lower	Similar	Lower	Lower
Sydney	Higher	Higher	Higher	Lower	Indeterminate
Vienna	Similar	Lower	Higher	Lower	Lower
Zurich	Higher	Higher	Higher	Lower	Indeterminate
Airlines					
Air France-KLM	Higher	Higher	Higher	Indeterminate	Higher
easyJet	Higher	Higher	Higher	Indeterminate	Higher
IAG	Higher	Higher	Higher	Indeterminate	Higher
Lufthansa	Higher	Higher	Higher	Indeterminate	Higher
Ryanair	Higher	Higher	Higher	Indeterminate	Higher
Utilities					
Centrica	Indeterminate		Indeterminate	Indeterminate	Indeterminate
National Grid	Indeterminate		Indeterminate	Lower	Indeterminate
Pennon	Lower		Lower	Lower	Lower
Severn Trent	Lower		Lower	Indeterminate	Lower
SSE	Indeterminate		Indeterminate	Indeterminate	Indeterminate
United Utilities	Lower		Lower	Indeterminate	Lower

Source: Economic Insight

1.2.3 Beta analysis

Comparator analysis

Our comparator analysis drew on best practice in beta estimation, as identified in our cost of capital assurance review, by using Europe-wide equity indices for Eurozone countries and focusing on two and (where possible) five-year estimation windows for beta. In the case of both ENAV and Aéroports de Paris, we applied adjustments reflecting differences in relative risk with respect to NERL.

Table 4 sets out our estimates, based on ENAV's beta.[1] We begin with ENAV's two-year unlevered beta estimates (there being insufficient data to estimate over a longer

[1] *ENAV's gearing is sufficiently low that debt beta assumptions do not affect the implied asset beta.*

timeframe). We then apply: (i) an adjustment to reflect the lower risk exposure of ENAV's terminal services; and (ii) an adjustment to reflect ENAV's lower operating leverage. This suggests an asset beta range of 0.53 to 0.56.

Table 4: Beta estimate based on ENAV

Scenario	Unlevered beta	ENAV en route beta	Operating leverage adjustment
Low	0.46	0.48	0.53
High	0.46	0.50	0.56

Source: Economic Insight analysis based on Thomson Reuters data

Table 5 sets out our estimate based on Aéroports de Paris' beta. We begin with unlevered betas over two- and five-year timeframes. We then apply an adjustment based on Aéroports de Paris' lower operational gearing, which implies a range of 0.55 to 0.63.

Table 5: Beta estimate based on Aéroports de Paris

Timeframe (years)	Unlevered beta	Debt beta	Asset beta	Operating leverage adjustment
5	0.49	0.05	0.50	0.55
	0.49	0.10	0.51	0.56
2	0.55	0.05	0.56	0.62
	0.55	0.10	0.58	0.63

Source: Economic Insight analysis based on Thomson Reuters data

Temporal analysis

Our temporal analysis is summarised in Table 6. Overall, it suggests *higher* systematic risk at RP3 than at RP2, due to: uncertainty associated with the UK's membership of the EU; higher operating leverage; and an increase in regulatory discretion.

Table 6: Changes in risk profile since RP2

Category		Change since RP2
Revenue	*Sales price risk*	Higher
	Volume risk	Higher
Cost		Similar
Cost and revenue structure		Higher

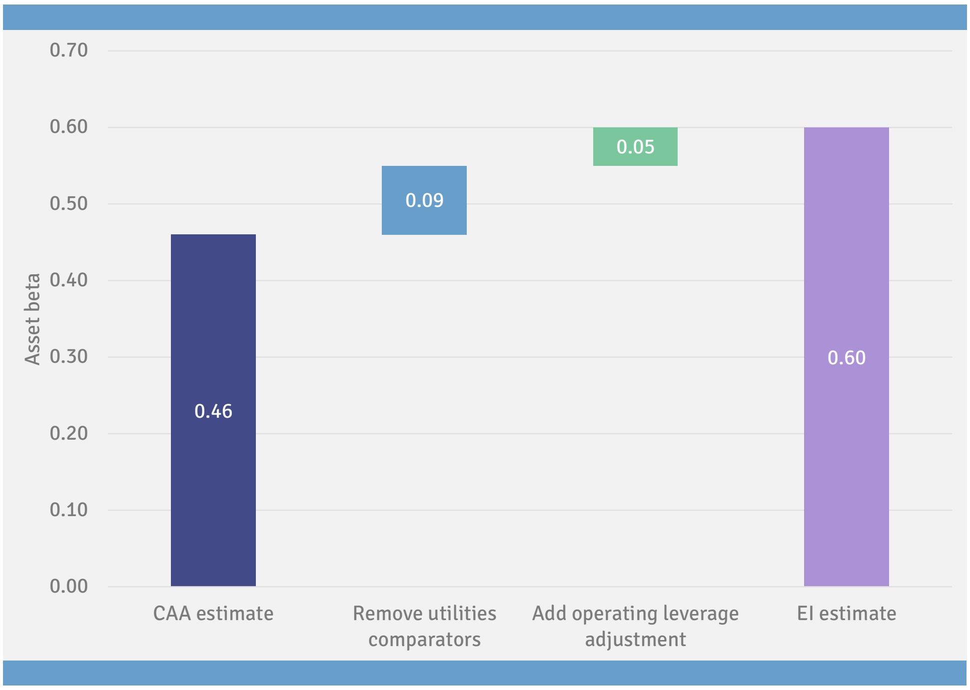
Source: Economic Insight

Overall conclusion on beta

Drawing on the comparator analysis, our recommended range for beta is 0.53 to 0.63. Our point estimate of 0.60 reflects that we have not been able to make explicit adjustments to reflect some factors (such as capacity constraints) that imply that NERL has higher systematic risk than our recommended comparators.

The CAA based its 0.46 asset beta point estimate on Europe Economics' analysis, with this value chosen as the lower end of a 'constraint range' based on utilities comparators (with the upper end of the constraint range based on airport comparators). Drawing these together, the 0.14 difference between our estimate and the CAA's comprises (i) approximately 0.9 from the removal of utilities comparators; and (ii) approximately 0.05 from the application of an adjustment for operating leverage. We set this out in Figure 4.

Figure 4: Reconciliation with CAA beta analysis



Source: Economic Insight calculations

The CAA's estimate also drew on Europe Economics' analysis of ENAV's beta. In this case, differences with our estimates arise primarily because: (i) Europe Economics includes evidence from equity betas estimated using domestic indices for Eurozone countries; and (ii) Europe Economics either does not adjust for differences in relative risk and operating leverage, or adjusts for NERL's higher operating leverage while applying a downward adjustment for relative risk, which does not accurately reflect the lower systematic risk of ENAV's terminal services.

1.3 Structure of this report

The remainder of this report is structured as follows.

- Section 2 describes our methodology for estimating NERL's beta and applies our risk framework to NERL.
- Section 3 presents our selection of NERL's most relevant comparators, based on our risk framework.
- Section 4 sets out our beta analysis, including comparator and temporal approaches.
- The appendix sets out more detail on airport regulation and further evidence on operational intensity.

2. Methodology and Risk Framework

This chapter sets out our overarching methodology for estimating the appropriate asset beta for NERL at RP3. We begin with a high-level overview of our approach, before going on to set out our objective framework for thinking about the systematic risk of NERL and potential comparators. We then set out our assessment of NERL's risk profile, based on this framework.

2.1 Overview of our approach

OUR APPROACH INCLUDES A SYSTEMATIC FRAMEWORK FOR THINKING ABOUT RISK IN TOTALITY.

Our approach to beta estimation combines a comparator analysis with a systematic framework for thinking about risk in totality. This ensures robust comparator selection, as well as providing a framework for determining adjustments to beta estimates and understanding how risk has changed over time.

Comparator analysis is required in the absence of direct market evidence on beta for UK en route navigation services. This approach uses estimated betas for listed companies with similar risk profiles (suitably adjusted) to infer the appropriate beta for the regulated company. Where multiple comparators are used, evidence on observable betas will need to be brought together; for example, by averaging or another more sophisticated weighting technique. Comparator analysis is also useful as a sense check on beta estimates, even where direct market evidence is available.

Using a systematic risk framework addresses two important issues when comparator analysis is used to address the lack of direct market evidence on beta.

- **Firstly, there is often a wide set of possible comparators, none of which are fully comparable with the company of interest.** In practice, this can result in a 'pick and mix' approach to the use of comparator beta data, in which parties estimate large numbers of comparator betas and then 'assert' the similarity of particular favoured comparators, generally focusing on a small number of the totality of factors affecting systematic risk. The lack of focus on systematic risk *in totality* also makes the process of adjusting betas more difficult.

- **Secondly, good regulation requires consistency and predictability,** but a pure comparator analysis may not attach due weight to regulatory precedent, as changes in favoured comparators can imply large changes in beta that are not driven by any fundamental, evidence-based, changes in systematic risk (and thus, may not be intuitively sensible, as they might imply changes in investor risk over time that do not accord with reality).

The key stages of our methodology are as follows.

1. We begin by setting out our systematic framework for thinking about risk, drawing on economic and finance theory. We then apply this framework to NERL to understand the most important determinants of its level of non-diversifiable risk.

'To avoid the risk of a 'pick and mix' approach ... we use the risk framework to identify only the most relevant potential comparators, based on risk in totality.'

2. We undertake a comparator selection process, again based on the risk framework. This begins with a long list of potential comparators, based on those cited in previous studies. To avoid the risk of a 'pick and mix' approach, rather than proceeding directly to beta estimation, we use the risk framework to identify only the most relevant potential comparators, based on risk in totality.
3. Having selected a narrower set of comparators, we then proceed to analyse evidence on their betas. As part of this, we use our risk framework to determine appropriate adjustments, where feasible.
4. Following this, we undertake a temporal comparison of how NERL's risks have changed, relative to RP2. Using the beta determined at RP2 as a starting point, we then draw out the implications for beta at RP3.
5. Finally, we draw together the comparator analysis and temporal comparisons into an overall estimate for beta at RP3.

2.2 Risk framework

THREE OVERARCHING FACTORS DETERMINE SYSTEMATIC RISK: REVENUE RISK, COST RISK, AND COST AND REVENUE STRUCTURE.

Three overarching factors determine the overall level of systematic risk that companies face.[2] These are: (i) revenue risk; (ii) cost risk; and (iii) revenue and cost structure. Of these, (i) and (ii) reflect that, thinking of a company as an asset, associated cash flows are determined by the profits that the company makes, which are by definition equal to the revenues it earns less the costs that it incurs. Further, (iii) reflects the fact that the structure of revenues and costs affects the way that revenue risk and cost risk interact to determine overall systematic risk.

Revenue risk

Revenue is, by definition, equal to the product of the *quantities* of goods and services sold and the *prices* at which they are sold, meaning that revenue risk comprises: (i) volume risk and (ii) sales price risk.

- The main determinant of **volume risk** is demand in the relevant industry. This in turn depends on several factors, including (but not limited to) consumers' incomes and preferences, the presence of substitute goods/services etc. While firms in competitive markets face the risk that customers switch to rival firms, this risk is for the most part *not* considered systematic, as investors have the option in investing in multiple firms in the same industry.[3]

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2 *This can be thought of as follows. The total value of an asset is the present discounted value (PDV) of its cash flows. This, in turn, equals the PDV of the asset's revenues, less the PDVs of its fixed and variable costs:* $PDV(Cash\ Flow) = PDV(Revenue) - PDV(Fixed\ Costs) - PDV(Variable\ Costs)$ *or* $A = R - F - V$. *The systematic risk of these cash flows equals the weighted sum of the betas of revenue, fixed costs and variable costs, with weights determined by revenue, fixed and variable costs as a share of the value of the asset:*

$$\beta^{Asset} = \frac{R}{A} \cdot \beta^{Revenue} - \frac{F}{A} \cdot \beta^{Fixed\ Costs} - \frac{V}{A} \cdot \beta^{Variable\ Costs}.$$

As such, the beta of the asset depends on the betas of revenue, fixed and variable costs and their PDVs.

3 *In theory competition risk may be systematic in some circumstances, for example if firms compete more vigorously during downturns. In most circumstances, however, any systematic element is unlikely to be material.*

- **Sales price risk** is, in competitive industries, determined by industry supply and demand. This is turn depends on factors including consumers' willingness to pay; competitive dynamics; and the costs that firms incur in production.

Regulation affects both revenue and price risk. At a basic level, regulatory frameworks set the 'rules of the game' for regulated companies. Therefore, regulation directly determines 'to whom' risk is allocated and to what degree. For example, price caps remove firms' upside pricing risk, while leaving them fully exposed to volume risk. Revenue caps, on the other hand, remove upside revenue risk in totality. Regulation may also affect systematic risk in other ways, however. Regulatory risk (the extent to which the actions of a regulator either affect the totality of risk, or its allocation, in a way that is not 'codified' transparently in the regulatory framework itself) has been shown to have a systematic component.[4] For example, regulators may come under greater pressure to keep prices down during periods of low growth than during periods of high growth, with the result that poor economic performance across the economy is correlated with tougher price controls for regulated companies.

Cost risk

Assessing cost risk is more complicated than is the case for revenue risk, as in some circumstances fluctuations in costs can have the effect of offsetting revenue fluctuations, thereby stabilising overall profits. In considering cost risk, it is useful to distinguish between: (i) fixed costs, which do not vary with quantity; and (ii) variable costs, which do.

- **Input prices** are a key determinant of both fixed and variable cost risk. The associated level of systematic risk will, therefore, depend on firms' input mix, and the extent to which the price of these inputs moves with the wider economy.

- In addition to its impact on revenue risk, **volume**, by definition, affects variable costs. The same factors cited above in the context of revenue risk therefore also affect variable cost risk.

While the costs that firms incur are also affected by their own efficiency and, in the case of capital expenditure, ability to deliver capital projects, this does not generally affect systematic risk. This is because, in a manner similar to competition risk, the risk of inefficiency in a particular firm could (in most circumstances) be diversified away by investing across multiple firms in the same industry.

Cost and revenue structure

The structure of costs and revenues determines how revenue and cost risk interact to determine the overall level of systematic risk. There are two key parts to this: (i) the balance between profits and revenues (i.e. overall profitability); and (ii) the balance between fixed and variable costs (sometimes referred to as 'operating leverage', with

[4] *For more on the impact of 'regulatory events' on systematic risk, see Arthur Havenner & Thomas Hazlett & Zhiqiang Leng, 2001. "The Effects of Rate Regulation on Mean Returns and Non-Diversifiable Risk: The Case of Cable Television," Review of Industrial Organization, Springer; The Industrial Organization Society, vol. 19(2), pages 149-164, September & Regulatory Risk and the Cost of Capital Determinants and Implications for Rate Regulation.*

higher operating leverage implying that fixed costs play a greater role in a firm's overall cost structure).[5]

- The intuition for the former is simply that fluctuations in profitability matter more when a firm's margins are already 'thin'.
- The intuition for the impact of operating leverage on systematic risk is that variable costs have a stabilising impact on total profits. Variable costs can offset fluctuations in revenue attributable to changing volumes, whereas fixed costs cannot. For example, when revenues increase because of higher volumes, variable costs increase in a similar manner - and lower the overall impact on profits.

We show the impact of operating leverage in the stylised example in Table 7. In the two baseline scenarios, volumes equal ten and the firm in question earns profits of £30, with revenues of £100 and total costs of £70. For the same fall in demand, profits fall by a greater amount in the higher fixed costs scenario.

Table 7: Stylised example of impact of cost structure

Calculation		Lower fixed costs		Higher fixed costs	
Scenarios		Baseline	Fall in demand	Baseline	Fall in demand
Price	A	£10	£10	£10	£10
Volume	B	10	5	10	5
Revenue	C = A × B	£100	£50	£100	£50
Input price	D	£5	£5	£2	£2
Variable costs	E = D × B	£50	£25	£20	£10
Fixed costs	F	£20	£20	£50	£50
Total costs	G = E + F	£70	£45	£70	£60
Profit	H = C - G	£30	£5	£30	-£10

Source: Economic Insight

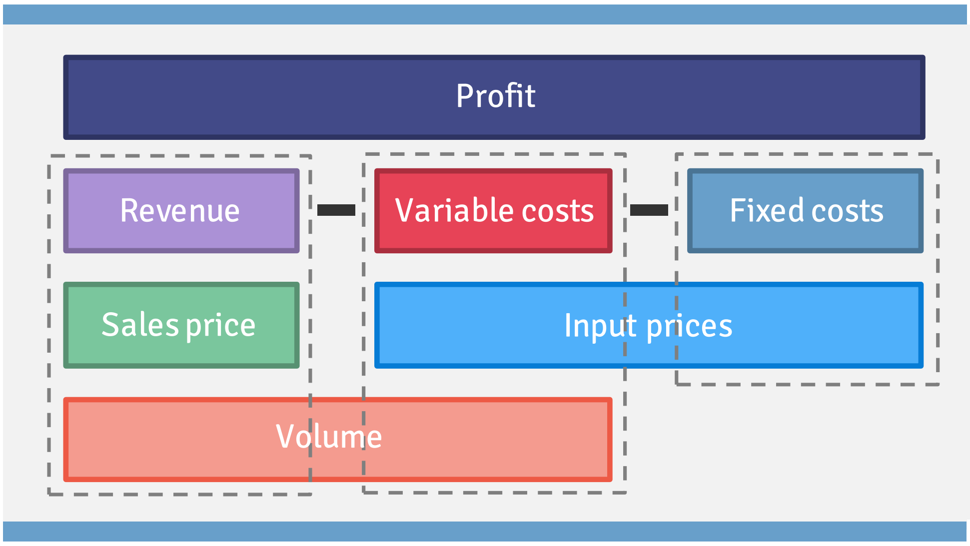
[5] *As above,* $\beta^{Asset} = \frac{R}{A} \cdot \beta^{Revenue} - \frac{F}{A} \cdot \beta^{Fixed\ Costs} - \frac{V}{A} \cdot \beta^{Variable\ Costs}$*. In addition to the betas of revenue, fixed costs and variable costs, the relativities between A, R, F and V determine the relative weight that is attached to these.*

'Coming to a view on overall systematic risk requires: (i) assessing risk across all of the categories in our framework; and (ii) understanding interactions between different types of risk.'

Overall systematic risk

Figure 5 summarises the main components of our risk framework. Coming to a view on overall systematic risk requires: (i) assessing risk across all of the categories in our framework; and (ii) understanding interactions between different types of risk.

Figure 5: Systematic risk framework



Source: Economic Insight

2.3 Application of risk framework to NERL

We now apply the risk framework set out in the preceding section to NERL. This provides useful background and preparation for the comparisons between NERL's systematic risk and that of potential comparators set out in the next chapter. We address in turn: (i) revenue risk; (ii) cost risk; (iii) cost and revenue structure; and (iv) interactions.

2.3.1 Revenue risk

NERL'S SALES PRICE RISK IS CAPPED, BUT IT IS EXPOSED TO A DEGREE OF VOLUME RISK THROUGH ITS RISK SHARING MECHANISM.

Sales price risk

Price cap regulation reduces sales price risk. The presence of a price cap implies that upside pricing risk is eliminated. In theory, NERL could still be exposed to downside risk, if customer willingness to pay fell below the level of the cap. In practice, this is not a realistic scenario, in view of the combination of high willingness to pay and charges set on a cost-reflective basis. The primarily source of sales price risk for NERL therefore comes from regulatory risk.

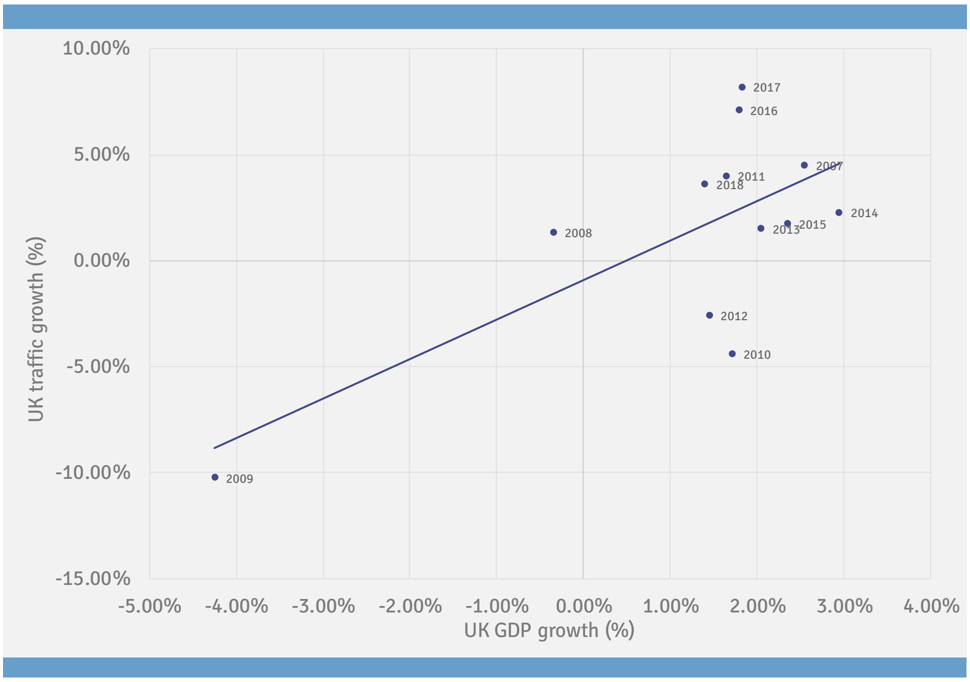
Volume risk

NERL has a traffic risk sharing mechanism, which reduces its exposure to volume risk. This is based on deviations in outturn service units from forecasts. NERL is fully exposed to fluctuations in volumes within 2% of the forecast level, bears 30% of risk associated with fluctuations of 2% and 10% around forecast levels, and is insulated from deviations from forecast levels above 10%.[6]

Turning to demand itself, empirical evidence suggests that demand for air travel displays a material degree of systematic volatility. Studies of the income elasticity of demand for air travel, i.e. the amount by which air travel increases when GDP increases, generally suggest values greater than 1. For example, a global meta study[7] (incorporating 40 previous studies) of air travel income elasticities finds a central estimate of 1.19, suggesting that a 1% increase in GDP is associated with a 1.19% increase in air travel, with little difference across continents. Some UK studies[8] have found elasticities in the region of 2, implying that a 1% increase in GDP is associated with an increase in air travel of around 2%.

To explore this further, we investigated the relationship between annual changes in UK TSUs and GDP growth, both for the UK and EU. Figure 6 and Figure 7 show scatter plots of percentage changes in UK TSUs and, respectively, UK and EU real GDP. Both of these show strong positive relationships between changes in TSUs and growth rates, consistent with the income elasticity estimates described above.

Figure 6: Scatter plot of percentage changes in UK traffic and UK GDP



Source: Economic Insight calculations based on STATFOR and World Bank data

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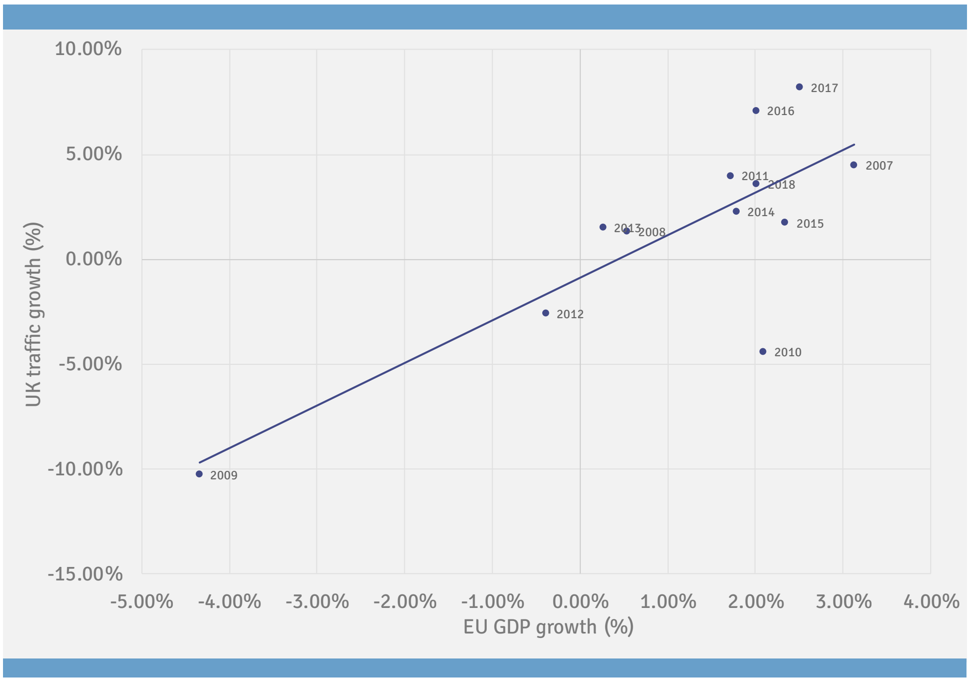
6 *'Commission Implementing Regulation (EU) 2019/317 of 11 February 2019 laying down a performance and charging scheme in the single European sky and repealing Implementing Regulations (EU) No 390/2013 and (EU) No 391/2013.' European Commission (2019).*

7 *'The income elasticity of air travel: A meta-analysis'. Annals of Tourism Research, 49. Gallet, C.A. and Doucouliagos, H. (2014); page 141-155.*

8 *. 'Demand for leisure air travel and limits to growth'. Journal of Air Transport Management, 6(2). Graham, A. (2000); page 109-118.*

Figure 7: Scatter plot of percentage changes in UK traffic and EU GDP



Source: Economic Insight calculations based on STATFOR and World Bank data

2.3.2 Cost risk

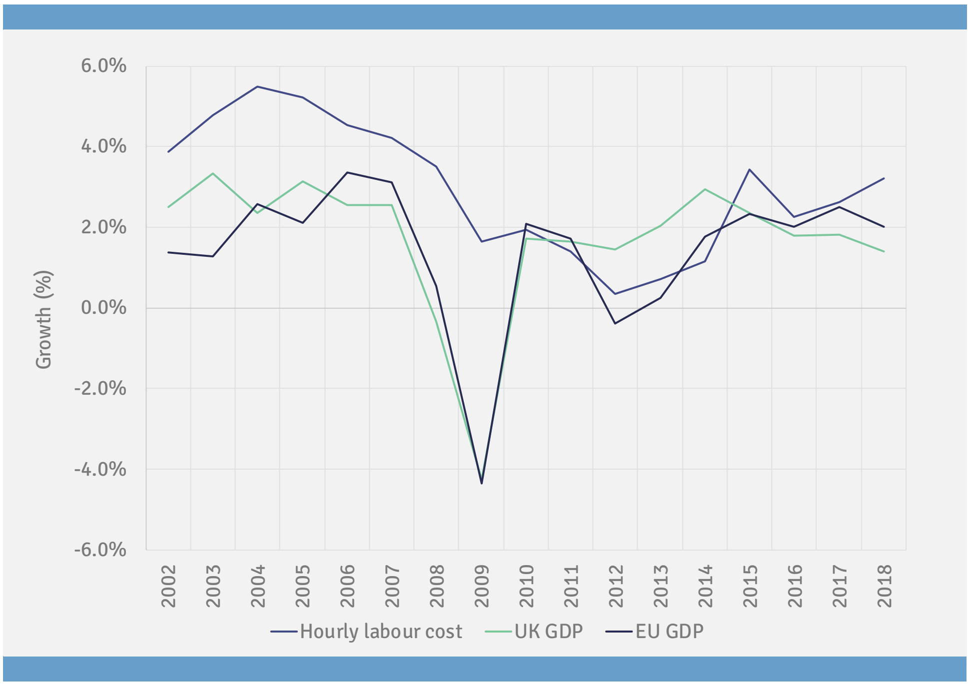
NERL has some protection from general price inflation, through indexation in the price control. Aside from aspects of the regulatory structure, however, the absence of detailed granular cost information for potential comparators makes assessments of cost risk more difficult than the other parts of our risk framework.

For example, we do not have detailed data on the *composition* of costs for most comparators – and so cannot understand the proportion of total costs that are accounted for by categories such as: energy; labour; materials; chemicals; machinery etc. Further, nor is detailed information on the more granular makeup of costs within these categories (and how such costs vary over time) available in the public domain (because public accounts typically provide only very limited cost decomposition data). Hence, it is not feasible for one to analyse, for example, which input price risks are systematic, or to what degree. For example, the mix of skilled versus unskilled labour and the types of chemicals a company uses will affect systematic input price risk.

As such, our approach to comparing NERL's input price risk with potential comparators begins with the observation that labour is NERL's main input cost, accounting for some 68% of its operating costs. In view of this, we assess similarity in terms of cost risk by comparing labour costs as a proportion of operating costs for potential comparators.

In this context, we note that there are good reasons in principle to expect labour costs to have a material systematic component, with upward pressure on wages during periods of prosperity - and downward pressure during periods of low growth. Figure 8 shows percentage changes in hourly UK labour costs against real GDP growth in the UK and EU, demonstrating a broad correlation.

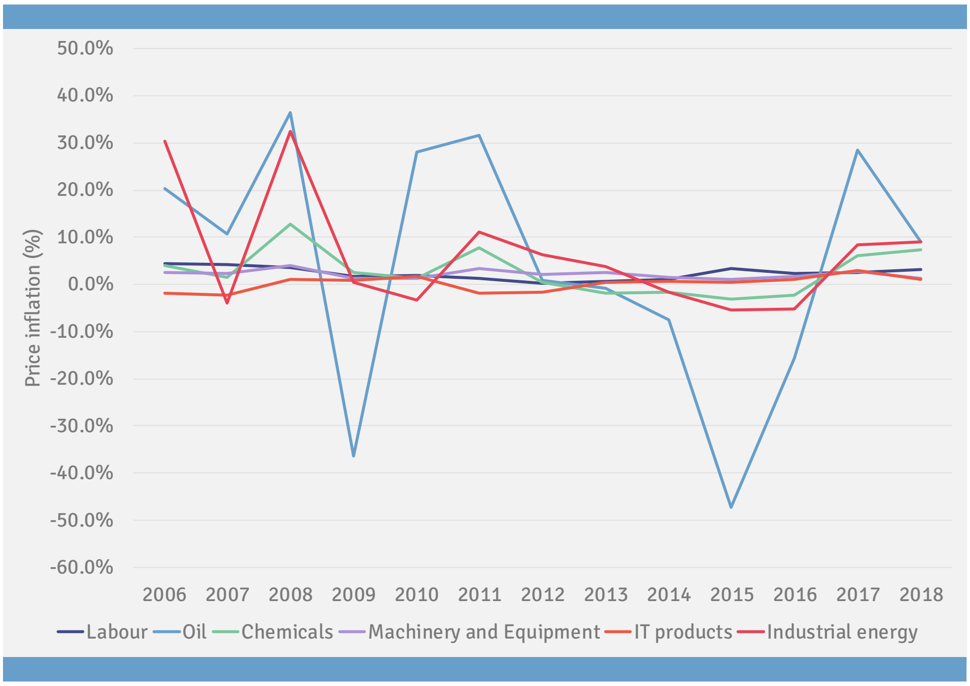
Figure 8: Percentage changes in hourly labour costs (UK) against GDP



Source: Economic Insight calculations; Office for National Statistics (ONS)

More generally, however, it is difficult to draw strong conclusions from this observation. There are good reasons to expect prices *in general* to have a material systematic component. In addition, labour costs are among the most stable input costs. For example, Figure 9 shows a time series for input price inflation between 2006 and 2018 for: labour, oil, chemicals, machinery and equipment, IT products and industrial energy.

Figure 9: Time series of input price inflation, 2006-2018



Source: Economic Insight calculations; ONS, World Bank, BEIS

2.3.3 Cost and revenue structure

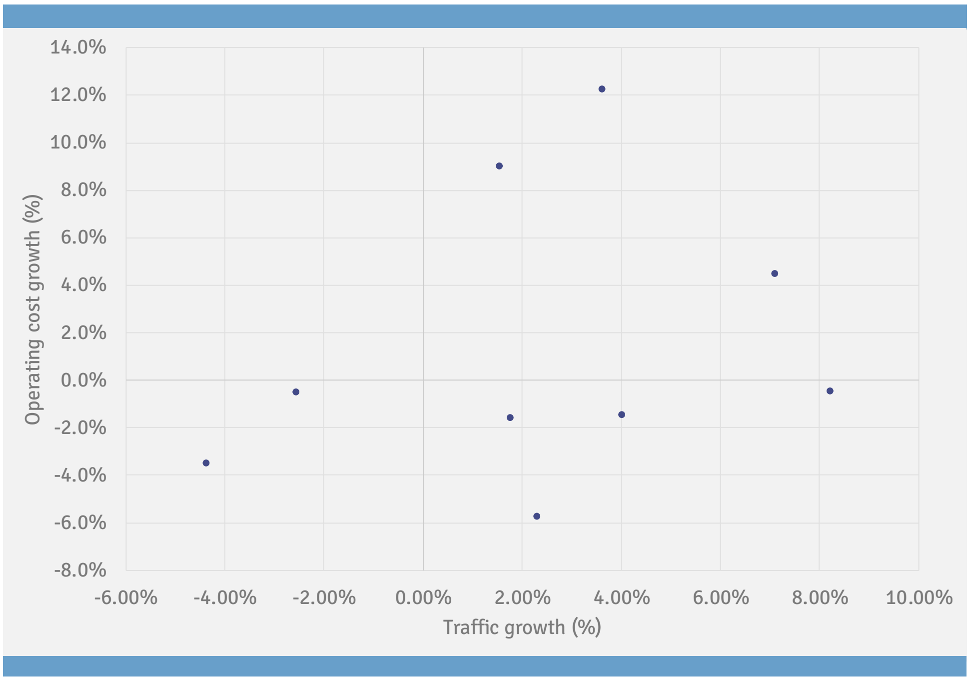
NERL NEEDS TO INCUR COSTS TO MAINTAIN ITS NETWORK, EVEN WHEN DEMAND FLUCTUATES.

Turning to cost and revenue structure, NERL's operating leverage is high, as its costs (which are predominantly opex, and within that, predominantly labour related) do not change strongly in response to changes in volumes. This is because NERL's costs occur primarily because of the need to *maintain its network as a whole,* rather than being generated by particular TSUs. As such, when volumes decline, there are relatively few costs that NERL can avoid continuing to incur.

Assessing operating leverage in practice is complicated by the absence of reliable data on fixed and variable costs, as accounting data does not generally distinguish between the two. Instead, we explored the relationship between changes in NERL's total operating costs and TSUs. The intuition for this is that, if operating leverage is low and the bulk of costs are variable, then there will be a strong relationship between changes in total costs and changes in TSUs.

Figure 10 shows a scatter plot of percentage changes in operating costs (displayed on the vertical axis) against percentage changes in traffic growth (in TSUs, displayed on the horizontal axis). This does not suggest a strong relationship. While this evidence is not conclusive (as it is possible that changes in other cost drivers have obscured the relationship) it is nevertheless consistent with NERL having relatively high operating leverage.

Figure 10: Scatter plot of percentage changes in operating cost and traffic for NERL

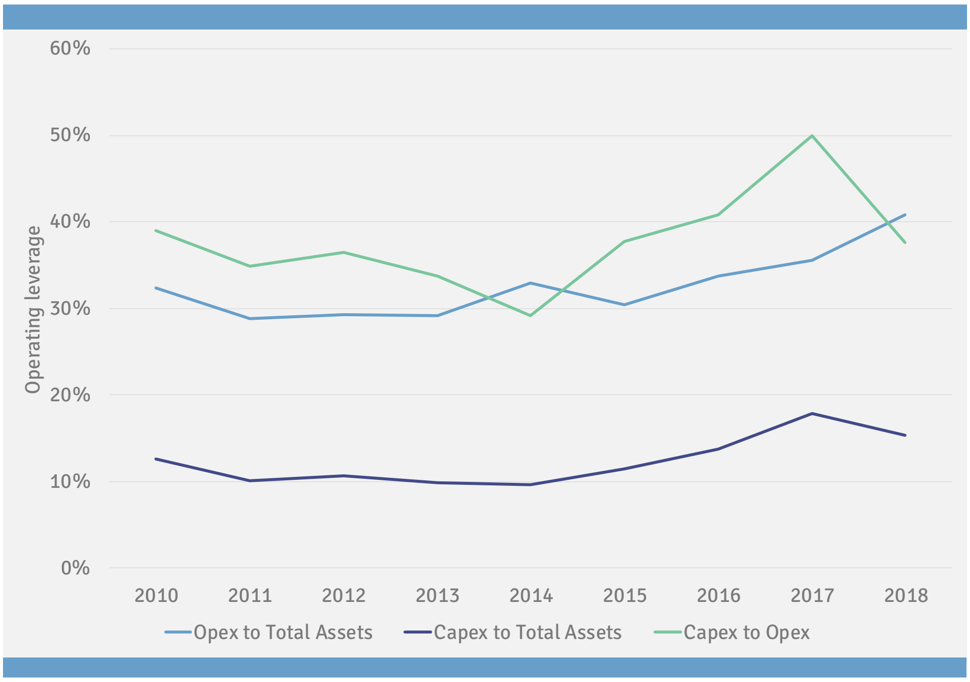


Source: Economic Insight calculations based on NERL regulatory accounts and STATFOR data

In the absence of reliable data on the split between fixed and variable costs, we examined three measures of operational intensity. The measures are: (i) opex to total assets; (ii) capex to total assets; and (iii) capex to opex. These are broad proxies for operating leverage, which have been used more widely to assess NERL's operating leverage (including by PwC[9], NERA[10] and Europe Economics[11]). Further, the CMA considered ratios related to (i) and (ii) in its price determination for Bristol Water at PR14.[12]

Figure 11 shows these measures for NERL from 2010 to 2018, with NERL's regulatory asset base (RAB) used to measure total assets. It is again difficult to draw strong conclusions without considering evidence on corresponding measures for potential comparators, which we turn to in the next chapter of this report.

Figure 11: Operational intensity measures for NERL



Source: Economic Insight calculations based on NERL regulatory accounts

Finally, with respect to the balance between revenues and profits, we note evidence that NERL's cash flows are somewhat 'thin'. For example, when commenting on its own financeability testing of NERL's return on regulatory equity (RORE), the CAA's Final Decision states: *"in our stress tests, RORE reduces to close to zero or negative. This reflects the relatively high sensitivity of RORE to the changes in regulatory returns from lower traffic and higher costs, given the relatively small size of NERL's RAB."*[13]

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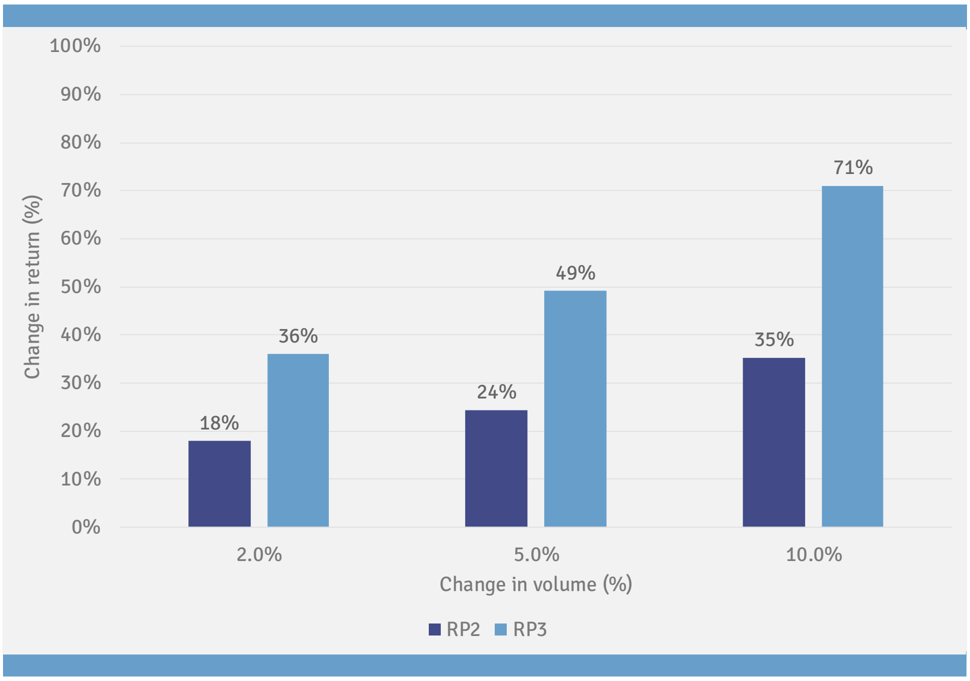
9 *'Estimating the cost of capital for NERL: A report prepared for the Civil Aviation Authority (CAA).' PwC (2014); pages 43-44.*
10 *'NERL's Asset Beta for RP3: A Report for NERL.' NERA (2018); page 30.*
11 *'Components of the Cost of Capital for NERL.' Europe Economics (2018); page 22.*
12 *In its PR14 Bristol Water price determination, the CMA considered the ratio of totex (which includes opex and capex) to regulatory capital value. 'Bristol Water plc: A reference under section 12(3)(a) of the Water Industry Act 1991.' CMA (2015), A10(1)-26.*
13 *'UK RP3 CAA Decision Document: Appendices.' CAA (August 2019); page 83.*

To illustrate how the balance between revenues and profits affects systematic risk, we build on some illustrative calculations previously set out by NERA, which show how this affects the relationship between volume changes and realised returns.[14] At RP2, the allowed return accounted for 10.3% of revenue, falling to 5.1% in the CAA's RP3 proposals. Figure 12 shows the consequences of this for the change in realised return in response to volume fluctuations of 2%, 5% and 10%.[15] For example, this shows that with the structure of costs and revenues at RP2, a 2% change in volume would lead to an 18% change in realised returns; whereas with the RP3 structure this has a 36% impact on realised returns. Across the three scenarios, the changes in cost and revenue structure at RP3 effectively double the variation in realised returns.

Figure 12: Impact of lower allowed return on changes in realised returns



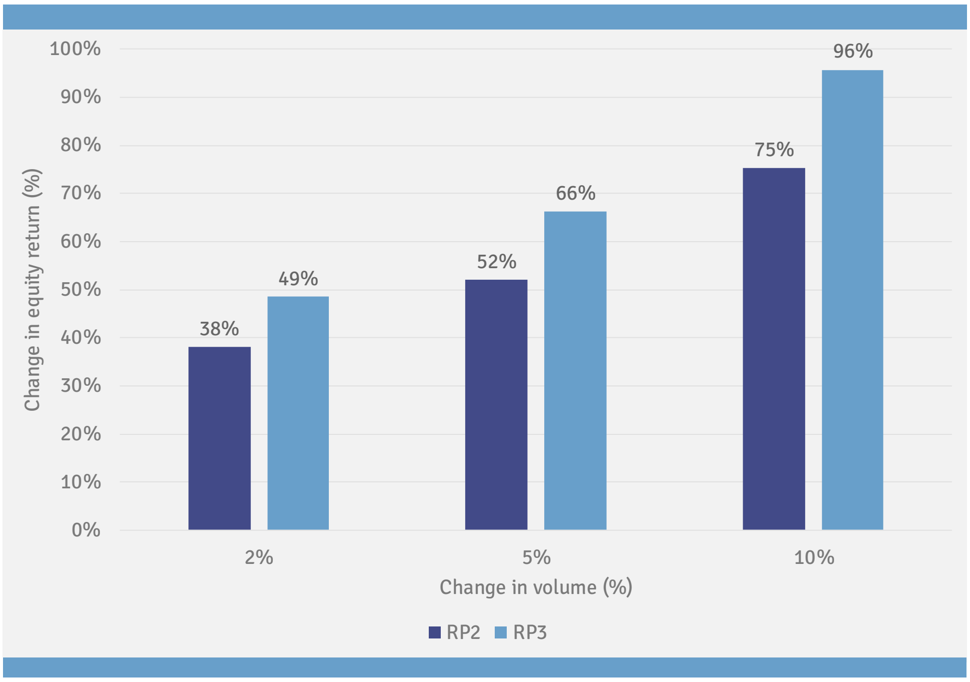
Source: Economic Insight calculations (using NERA methodology) based on CAA data

[14] *'Cost of Equity for RP3.' NERA (2019); page 30.*

[15] *The impact on realised returns is calculated by changing total revenue in proportion with volume changes, adjusting for NERL's risk sharing mechanisms, with costs assumed to change by 7.5% of the change in volumes. See 'Cost of Equity for RP3.' NERA (2019); page 30.*

In addition, we have calculated the equivalent impact on realised *equity returns*.[16] Figure 13 shows that changes to the structure of costs and revenues lead to material increases in the variability of equity returns, relative to RP2. For example, where a 10% change in volumes previously led to a 75% change in realised equity returns, the impact with the RP3 cost and revenue structure is 96%.

Figure 13: Impact of lower allowed return on changes in realised equity returns



Source: Economic Insight calculations based on CAA data

16 This calculation is based on the split between the costs of debt and equity in the CAA's WACC determinations for RP2 and RP3.

3. Assessment of potential comparators

In this chapter we set out our assessment of potential comparators for NERL. We first set out the 'long list' of potential comparators, drawing on those used historically by the CAA and NERL for estimating beta. To consider overall systematic risk holistically, we then apply our risk framework to determine which have a similar risk profile to NERL, focusing on revenue risk; cost risk; and revenue and cost structure.

To reduce the potential for cherry-picking beta estimates, our methodology for comparator analysis begins with a wide set of potential comparator firms, which we narrow down based on the application of our risk framework. To identify potential comparators, we have focused on listed companies in sectors that have historically been used to assess NERL's beta, including those examined by the CAA's and NERL's consultants. These comparators are as follows.

- Air Navigation Service Providers (ANSPs) – in practice, only the Italian air traffic operator ENAV is available as a potential comparator.
- Airport operators – with listed firms including Aéroports de Paris, Aena, Auckland, Copenhagen, Frankfurt, Sydney, Vienna and Zurich.
- Airlines – the largest listed European airlines being Air France-KLM, easyJet, International Airlines Group, Lufthansa and Ryanair.
- UK Utilities – which include energy (Centrica, National Grid and SSE) and water (Pennon, Severn Trent and United Utilities).

We now apply the risk framework set out in the preceding chapter to each of the comparator groups.

3.1 Air Navigation Services

As set out above, the only available ANSP comparator is the Italian operator ENAV. While the presence of a listed ANSP is clearly of some use, there are important respects in which ENAV differs from NERL. The most important of these are as follows.

- ENAV faces different operating conditions to NERL, which may give rise to differences in systematic risk. This relates to a wide range of factors, including traffic volumes, alongside cost and regulatory risk.
- ENAV's observed beta will reflect a 'mix' of activities relating to en route and terminal services, whereas only en route activities are relevant for NERL.

In this context, it is helpful to note the sources of ENAV's revenue, which we set out in Table 8. Specifically, en route services account for 75% of ENAV's revenues, with terminal services accounting for the remaining 25%. ENAV's terminal services comprise three 'charging zones' which, as we set out in Table 8, are subject to different types of regulation.

Table 8: ENAV revenue split between en route and terminal services

Area	Description	Percentage of ENAV revenue
En route	En route	75%
Terminal zone 1	Rome Fiumicino	5%
Terminal zone 2	Milan Linate, Milan Malpensa, Venice, Bergamo	7%
Terminal zone 3	40 other airports and the Italian Air Force	13%

Source: ENAV Investor Presentation September 2019, p12-13

We now apply the risk framework set out in the preceding chapter to ENAV, to assess its systematic risk relative to NERL.

3.1.1 Revenue risk

Our overall assessment is that ENAV's revenue risk is *lower* than NERL's, mainly due to lower volume risk associated with ENAV's terminal services.

Sales price risk

For the most part ENAV is subject to price cap regulation in a similar manner to NERL, with some differences across terminal zones. Specifically, we understand that en route services and terminal zones 1 and 2 are, like NERL, subject to price cap regulation. Terminal zone 3, accounting for 13% of revenue, has a different regulatory framework, which includes full cost recovery. We summarise this in Table 9.

Table 9: ENAV revenue split between en route and terminal services

Area	Percentage of ENAV revenue	Regulation
En route	75%	Price cap
Terminal zone 1	5%	Price cap
Terminal zone 2	7%	Price cap
Terminal zone 3	13%	Cost pass-through

Source: ENAV Investor Presentation September 2019, p12-13

Volume risk

DIFFERENCES IN REGULATION MEAN THAT ENAV FACES LOWER VOLUME RISK THAN NERL.

ENAV faces lower volume risk than NERL. This is primarily because regulation lowers ENAV's demand risk, but there is also some evidence that traffic growth in the UK shows more systematic variation.

- Due to its regulatory structure, ENAV's exposure to demand risk varies across en route and terminal services, with differences in the volume risk it faces at different airports.

- Around 80% of ENAV's regulated revenues are effectively exposed to the same level of volume risk as NERL. This comprises the 75% of ENAV's regulated revenue accounted for by en route services, and the 5% of terminal zone 1 revenue, which has the same risk sharing mechanism as en route.
- The remaining 20% of ENAV's regulated revenues are not exposed to any volume risk. Specifically, the 7% of revenues from terminal zone 2 enjoy full protection from volume risk, while the 13% from terminal zone 3 are subject to full cost pass-through. We summarise this in Table 10.

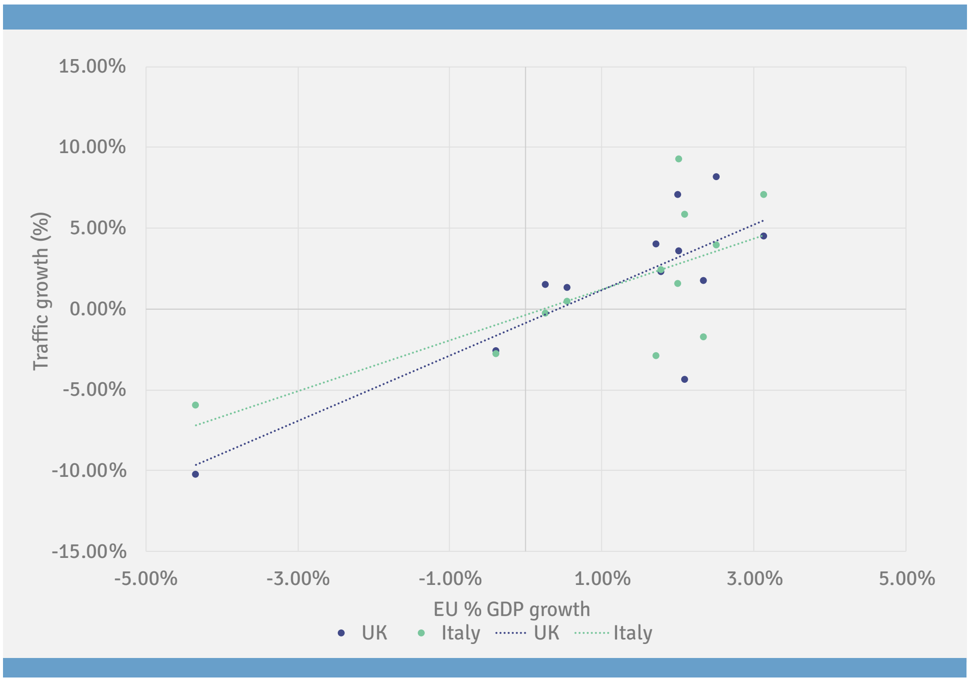
Table 10: ENAV exposure to volume risk

Area	Percentage of ENAV revenue	Exposure to volume risk
En route	75%	As NERL
Terminal zone 1	5%	As NERL
Terminal zone 2	7%	Zero
Terminal zone 3	13%	Zero

Source: ENAV Investor Presentation September 2019 p12-13, Economic Insight analysis

- To compare systematic demand volatility between ENAV and NERL, we compared the relationship between changes in total TSUs in Italy and the UK and GDP growth.
  - **Our overall conclusion is that NERL appears to face greater systematic risk.** We illustrate this in the scatter plot in Figure 14. The horizontal axis shows % GDP growth in the EU for years from 2007 to 2018. The vertical axis shows annual percentage changes in TSUs. The higher slope of the line for UK traffic growth implies a stronger link between changes in economic conditions and traffic.

Figure 14: Relationship between traffic growth and GDP



Source: STATFOR, World Bank and Economic Insight calculations

- **Table 11 confirms this relationship across several specifications.** The coefficient shows the slope of the relationship between traffic growth and GDP growth, with a higher coefficient indicating a stronger relationship. When compared both with respect to domestic growth and growth in the EU, changes in volume appear to be more systematic for NERL than ENAV.

Table 11: Relationship between traffic and GDP growth for UK and Italy

Traffic growth	GDP Growth	Coefficient
UK	UK	1.86
Italy	Italy	1.48
UK	EU	2.03
Italy	EU	1.58

Source: Economic Insight calculations based on STATFOR and World Bank data

3.1.2 Cost risk

Our overall assessment is that NERL is exposed to broadly similar but potentially higher cost risk than ENAV.

- Labour costs represent the bulk of operating costs for both companies. ENAV's staff cost represent 81% of its operating costs, compared to around 68% for NERL.[17] We are not aware of reasons as to why input cost risk should be materially different, except to the extent that NERL's potentially higher volume risk translates into higher variable cost risk (as total variable costs increase with volumes).

- Regulation affords ENAV greater protection from cost risk than NERL. NERL and ENAV both enjoy protection from inflation risk. For terminal zone 3, ENAV benefits from full cost recovery, which means that revenues are adjusted to offset input price fluctuations. For en route services and other terminal zones, we expect the level of cost risk to be broadly similar.

3.1.3 Cost and revenue structure

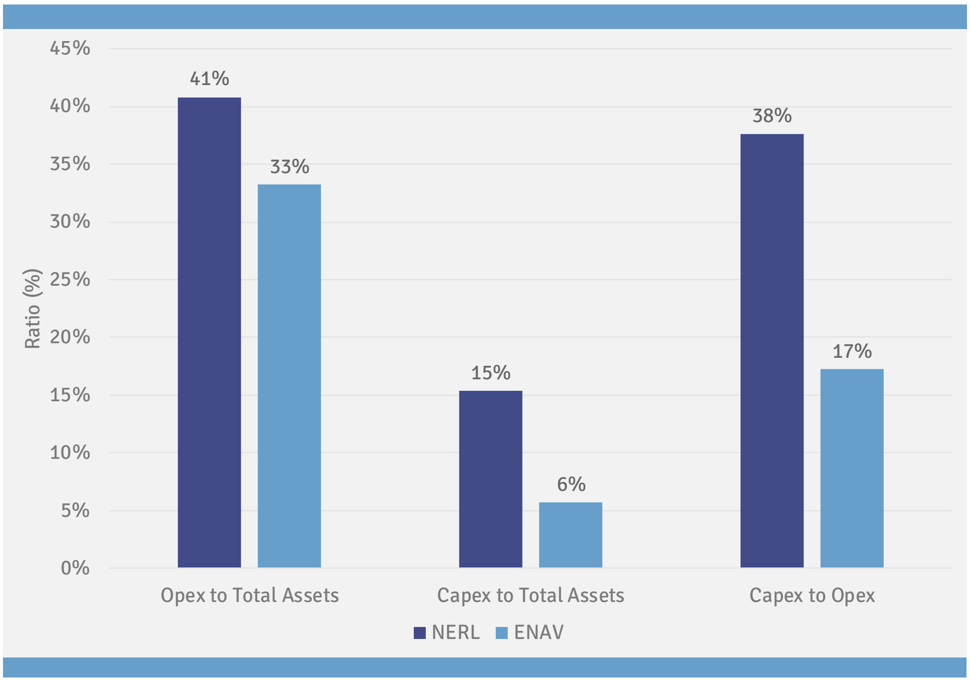
EVIDENCE SUGGESTS ENAV'S OPERATIONAL INTENSITY IS LOWER THAN NERL'S.

As we set out above, the structure of costs and revenues affects systematic risk in two ways: (i) systematic risk is higher when variable costs account for a smaller proportion of total costs (i.e. when operating leverage is higher); and (ii) systematic risk is higher when margins are thinner.

In the absence of direct evidence on the proportions of fixed and variable costs, we have examined measures of operational intensity, namely the ratios of: opex to total assets; capex to total assets and capex to opex. In general, these measures suggest that NERL has higher operating leverage than ENAV, as we summarise in Figure 15.

[17] *'ENAV Annual Financial Report 2018,' page 70.*

Figure 15: Operational intensity measures, 2018



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

3.1.4 Conclusions

Our overall conclusion is that, while ENAV is clearly of relevance to an assessment of the appropriate level of beta for NERL, there are strong reasons to expect that the level of systematic risk implied by its beta estimates will be *lower* than the appropriate level for NERL. This is set out in Table 12, which summarises our assessment of ENAV across the categories of our risk framework.

Table 12: Application of risk framework to ANSPs

Comparator	Revenue		Cost	Cost structure	Overall
	Price	Volume			
ENAV	Similar	Lower	Similar	Lower	Similar/Lower

Source: Economic Insight

The differences in risk between the two companies relate primarily to the following:

- some of ENAV's terminal services have lower exposure to demand risk than ENAV's (and NERL's) en route services;
- there is evidence to suggest that NERL's demand has a greater correlation with market conditions than ENAV's; and
- NERL's operating leverage is higher than ENAV's.

Despite these differences, we consider than ENAV should be maintained as a potential comparator, both because it is the only ANSP comparator and because we expect that suitable adjustments can be made to render its beta comparable with NERL's.

3.2 Airports

As set out above, potential listed airport comparators include: Aéroports de Paris, Aena, Auckland, Copenhagen, Frankfurt, Sydney, Vienna, and Zurich. Europe Economics also includes betas from determinations for regulated UK airports in its analysis. As no UK regulated airports are listed, however, the only market evidence used in determining betas for UK regulated airports are those listed above. As such, estimates for UK airports convey no additional market information, risk being out of date and may reflect adjustments based on UK airports' risk relative to international comparators that are irrelevant for NERL. We consider it preferable to assess directly differences in risk between NERL and listed comparators, as this approach is both more transparent and less prone to error.

At the outset, we note that regulation is a key driver of differences in risk between airports. An important distinction is between airports subject to price cap regulation and those with looser regulatory arrangements.

- Aéroports de Paris, Aena and Vienna are subject to price cap regulation.
- Auckland, Copenhagen, Frankfurt, Sydney and Zurich are subject to price monitoring regimes, in which they propose their own charges, which are subject to scrutiny and/or monitoring from a regulator and stakeholders.

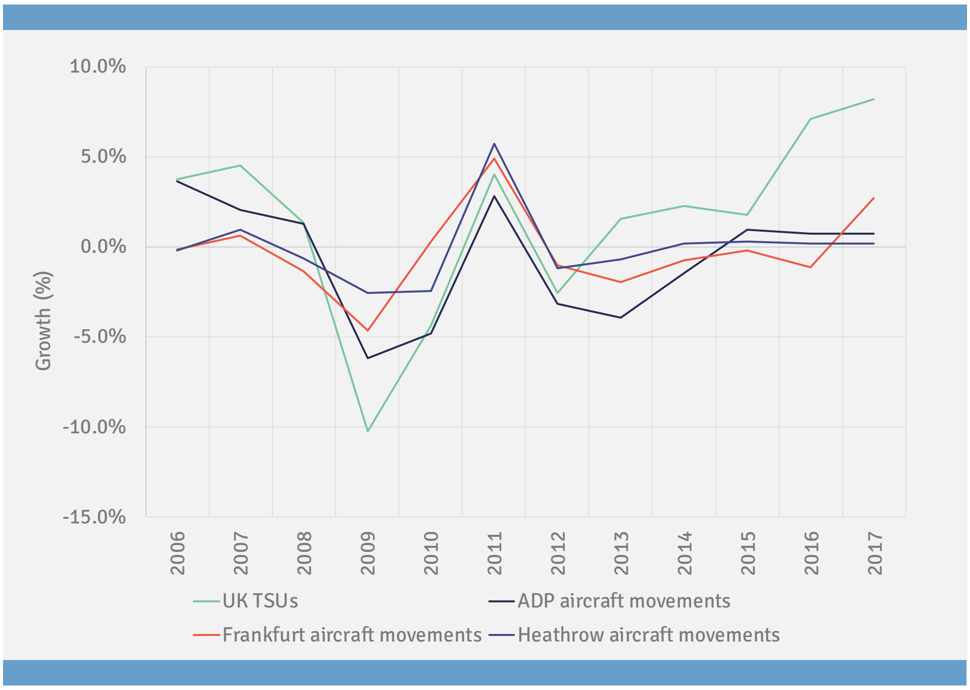
We now assess: (i) revenue risk; (ii) cost risk; and (iii) cost and revenue structure for these potential comparators.

3.2.1 Revenue risk

DIFFERENCES IN REGULATION LEAD TO MATERIAL DIFFERENCES IN SYSTEMATIC RISK ACROSS AIRPORTS.

We note that demand for air travel is the key determinant of revenue risk for both NERL and the airport comparators. While airports generate revenue from multiple sources (including landing charges, retail activity, and parking), these are all driven by the number of passengers that use the airports. As such, we expect a material degree of commonality between airport demand and ANSP demand. To explore this initial contention, we compared changes in UK TSUs against changes in aircraft movements at Frankfurt, Charles de Gaulle and Heathrow in Figure 16. We note both that all of the series show a material degree of correlation with one another and that, despite being the only UK airport, the series for Heathrow is not obviously more strongly correlated with UK TSUs than the other series.

Figure 16: Growth in UK TSUs and aircraft movements at selected airports



Source: ACI Annual Traffic Statistics Collection, STATFOR

In spite of this important common factor, our overall assessment is that the potential airport comparators vary considerably with respect to the similarity of the revenue risk they face compared to NERL (for example, due to differences in regulation). Of the potential comparators, Aéroports de Paris' revenue risk appears to be most similar to that of NERL.

Sales price risk

Our overall assessment of the level of price risk that airport comparators faces is as follows.

- Of airports subject to a price cap, we consider that Aéroports de Paris faces a similar level of price risk to NERL, as it has a similar form of price cap regulation. Aena also appears to have a similar price cap. The level of Vienna's cap, on the other hand, varies with traffic growth.[18] In practice, this will tend to make its prices more volatile, but in a way that interacts with volumes to stabilise overall revenue.

- We expect airports that are not subject to price regulation to have higher pricing risk than NERL, as they have full flexibility to adjust their prices in response to market changes.
  - In the cases of Sydney and Auckland, the airports' monitoring arrangements would appear to give them flexibility to change prices.
  - Copenhagen also appears to be subject to price monitoring arrangements.
  - Frankfurt's regime, while light touch, is somewhat more complicated, requiring the airport to initiate tariff reviews. This implies a greater degree of

[18] *Vienna's maximum charge is set at inflation less 0.35 times traffic growth. See 'Flughafen Wien Annual Report 2017'; page 39.*

price stability than for Sydney and Auckland, potentially to a level similar to that for NERL.

Table 13: Assessment of price risk for airport comparators

Airport	Level of price risk
Aéroports de Paris	Similar
Aena	Similar
Auckland	Higher
Copenhagen	Higher
Frankfurt	Similar
Sydney	Higher
Vienna	Similar
Zurich	Higher

Source: Economic Insight

Volume risk

On volume risk, our overarching conclusion is that there is significant variation across airports in their similarity to NERL. Again, however, Aéroports de Paris appears to be most similar to NERL, although its capacity constraints potentially imply a lower level of this risk.

AEROPORTS DE PARIS HAS A SIMILAR RISK-SHARING MECHANISM TO NERL, THOUGH CAPACITY CONSTRAINTS WILL REDUCE VOLUME RISK.

In spite of the common drivers in demand, differences in volume risk are driven by two factors: (i) differences in regulation, meaning that exposure to demand risk varies across the airports; and (ii) some airports are operating at, or around, maximum capacity (unlike NERL). With respect to (ii), capacity constraints naturally cap upside volume risk. Further, the existence of excess demand provides a further buffer on downside volume risk.

- Turning first to regulation, reflecting the variety of ways in which the airports are regulated, the extent of exposure to volume risk varies.
  - Aéroports de Paris is, like NERL, exposed to volume risk within a deadband, around a central volume projection, with risk sharing outside this range. In Aéroports de Paris's case, outside the deadband risk is shared 50% on the upside and 20% on the downside.
  - We expect that the structure of Frankfurt's regulation provides a material degree of insulation from volume risk. Frankfurt does not have a defined regulatory period and can call for tariff reviews in the event that traffic forecasts deviate from projections. In practice, we expect that this gives Frankfurt a material degree of insulation from volume risk.
  - The form of Vienna's price cap provides a degree of insulation from exposure to volume risk, as falls in traffic volumes enable it to charge higher prices. Further, unlike Aéroports de Paris (and NERL), there is no deadband within which Vienna faces full volume risk. As such, Vienna's exposure to volume risk may be lower than NERL's.
  - Aena, Auckland, Copenhagen and Sydney are fully exposed to demand risk.

- Moving on to capacity constraints, our research indicates that these are most important for Aéroports de Paris and Frankfurt.
  - Aéroports de Paris appears to face some capacity constraints. Its 2018 annual report notes that wide-body capacity is 'currently saturated', [19] and sets out an investment plan that is required to meet international traffic capacity demands[20], In addition, Paris Orly Airport appears to be operating at full capacity, with 33.1 million total passengers in 2018[21] at the level of stated capacity[22].
  - Frankfurt Airport appears to be operating at capacity. Traffic figures in 2018 reached 69.5 million[23], at the level of stated capacity[24].
  - Aena's airports are varied in terms of capacity saturation. Madrid Barajas International Airport appears to have spare capacity, 2018 passengers of 57.9 million[25] being below stated capacity of 70 million[26]. Barcelona Airport and Palma de Mallorca Airport appear to be closer to full capacity, but both are yet to be saturated[27].
  - Auckland Airport is undergoing a major terminal expansion[28] to accommodate projected 40 million passengers by 2044. Yearly passenger numbers in 2018 totalled 20.9 million[29].
  - Copenhagen Airport had 30.3 million passengers in 2018[30]. Current terminal capacity is 32 million passengers per year, with options to expand to 40 million passengers per year[31].
  - Sydney Airport is not yet operating at full capacity, with one report stating that it will become constrained only after 2025[32].
  - Vienna Airport's current passenger traffic of 27 million in 2018[33] is below stated capacity of 30-32 million[34].
  - Zurich Airport seems to be operating at full capacity. Passenger numbers in 2018 reached 31.1 million[35], around its stated level of capacity[36].

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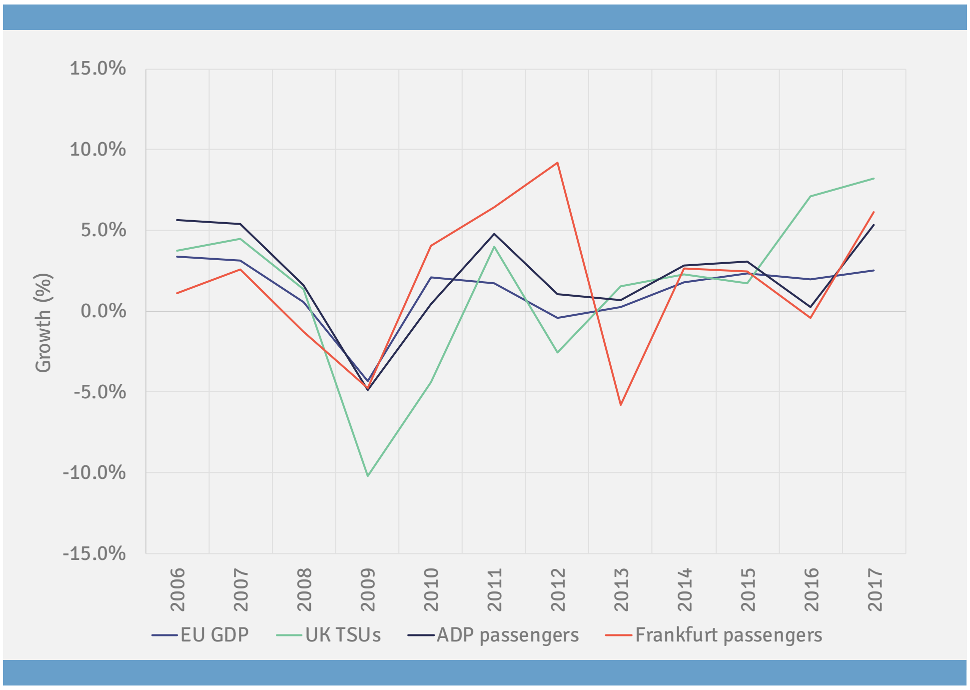
19 *'Aéroports de Paris Registration Document and Annual Financial Report 2018.' page38.*
20 *'Aéroports de Paris Registration Document and Annual Financial Report 2018.' page59.*
21 *See Groupe Aéroports de Paris December 2018 Press Release (https://www.parisaeroport.fr/en/group/finance/investor-relations/traffic)*
22 *See Aéroports de Paris-Orly description (https://www.parisaeroport.fr/en/professionals/airlines-services/airlines-our-platforms/airlines-paris-orly)*
23 *See Fraport 2018 Monthly Traffic Results (https://www.fraport.com/content/fraport/en/our-company/investors/traffic-figures.html#id_tab__our-company_investors_traffic-figures_frankfurt-airport__)*
24 *See Eurocontrol Public Airport Corner (https://www.eurocontrol.int/tool/airport-corner)*
25 *See Aena traffic 2018 statistics (http://www.aena.es/en/corporate/air-traffic-statistics.html)*
26 *See Eurocontrol Public Airport Corner (https://www.eurocontrol.int/tool/airport-corner)*
27 *See Eurocontrol Public Airport Corner (https://www.eurocontrol.int/tool/airport-corner) and Fraport 2018 Monthly Traffic Results (https://www.fraport.com/content/fraport/en/our-company/investors/traffic-figures.html#id_tab__our-company_investors_traffic-figures_frankfurt-airport__)*
28 *See Auckland Airport news (https://corporate.aucklandairport.co.nz/news/latest-media/2019/airfield-expansion-kicks-off-next-phase-auckland-airports-major-infrastructure-build)*
29 *See Auckland Airport monthly traffic updates in December 2018 (https://corporate.aucklandairport.co.nz/news/publications/monthly-traffic-updates)*
30 *See Copenhagen Airport Traffic statistics news (https://www.cph.dk/en/about-cph/investor/traffic-statistics/20192/1/cph-traffic-2018-a-record-of-30-3-million-travellers)*
31 *See Eurocontrol Public Airport Corner (https://www.eurocontrol.int/tool/airport-corner)*
32 *See report commentary (https://www.smh.com.au/business/sydney-airport-to-reach-capacity-by-2025-20130109-2cfvq.html)*
33 *See Vienna Airport 2018 traffic results (https://www.viennaairport.com/en/company/investor_relations/news/traffic_results?news_beitrag_id=1547640734879)*
34 *See Eurocontrol Public Airport Corner (https://www.eurocontrol.int/tool/airport-corner)*
35 *Zurich Airport news centre article (https://www.zurich-airport.com/the-company/media/news-center/2019/jan/mm-20190110-verkehrsstatistik-dezember-2018?cat=medienmitteilung)*
36 *See Eurocontrol Public Airport Corner (https://www.eurocontrol.int/tool/airport-corner)*

If capacity constraints do lead to lower systematic risk, this implies that they will have a dampening effect on the response of airport volumes to changes in economic conditions. To test this, we plotted changes in: (i) passenger numbers at Frankfurt and Charles de Gaulle airports; (ii) aircraft movements at the same airports; and (iii) UK TSUs against EU GDP.

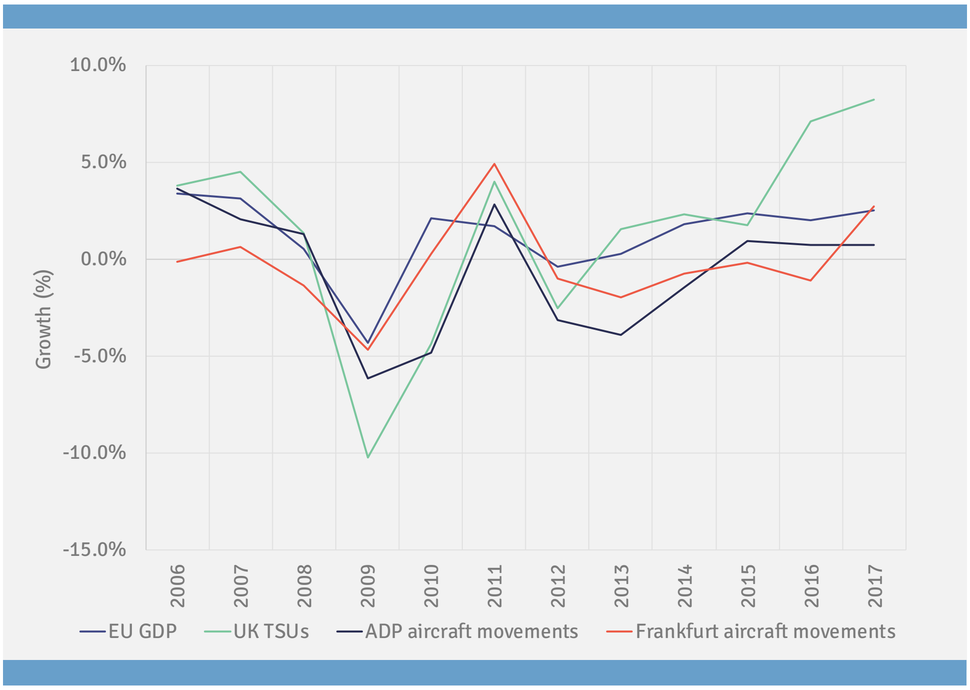
We show this in Figure 17. Importantly, while the impact of the financial crash is seen in 2009 for all of the series, the proportionate impact is much greater for UK TSUs than for passenger numbers at either Charles de Gaulle or Fraport. Further, in Figure 18 we show that a similar relationship holds between aircraft movements and EU GDP growth.

Figure 17: Changes in passenger numbers plotted against EU GDP growth



Source: ACI Annual Traffic Statistics Collection, STATFOR

Figure 18: Changes in aircraft movements plotted against EU GDP growth



Source: ACI Annual Traffic Statistics Collection, STATFOR

We summarise our conclusions on volume risk in Table 14.

Table 14: Assessment of volume risk for airport comparators

Airport	Exposure to volume risk	Capacity constraints
Aéroports de Paris	Similar	Yes
Aena	Higher	Mixed
Auckland	Higher	No
Copenhagen	Higher	No
Frankfurt	Lower	Yes
Sydney	Higher	No
Vienna	Lower	No
Zurich	Higher	Yes

Source: Economic Insight

3.2.2 Cost risk

We have limited information to compare cost risk between airports and NERL, although our overarching conclusion is that similarity in regulation implies that Aéroports de Paris and Aena are most similar to NERL.

- With respect to variable costs (i.e. costs which change with volumes), the similarity in drivers of volumes between NERL and airports suggests a degree of comparability.
- Staff costs account for a material proportion of airports' operating costs, but a lower proportion than for NERL. For example, analysis of annual reports

indicates that labour costs accounted for 48% of Frankfurt's[37] total operating expenditure in 2018 and 34% of Aéroports de Paris' operating expenditure[38] (the latter figure excludes security and sub-contracting[39]).

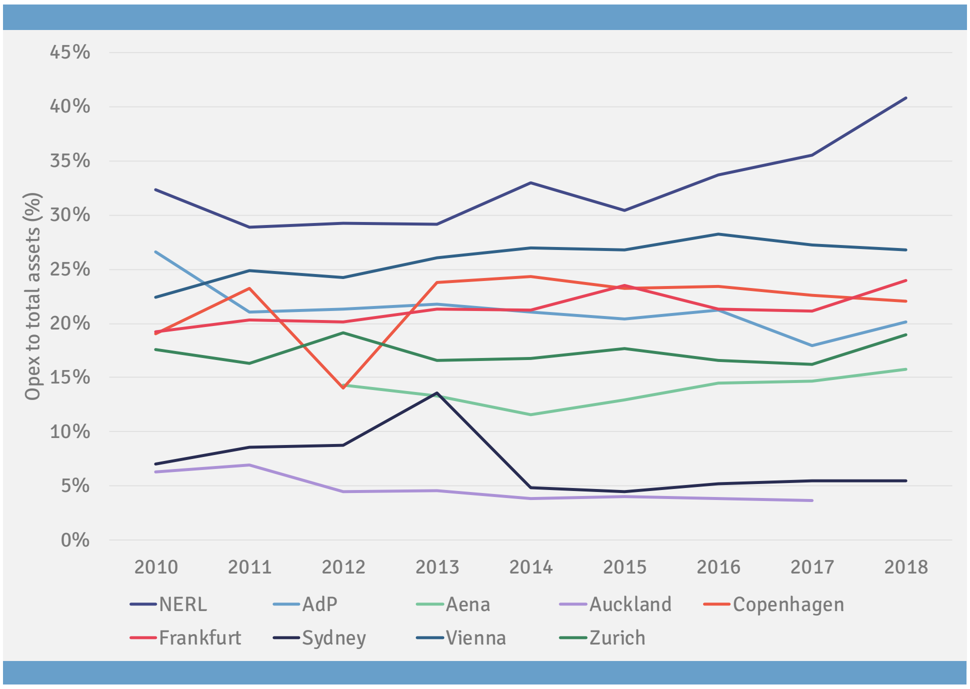
- Cost risk is likely to be more comparable to NERL's for airports with inflation-indexed price caps. NERL enjoys a degree of protection from inflation risk, which is also true of Aéroports de Paris and Aena, and potentially Frankfurt due to the possibility of reopeners.

3.2.3 Cost and revenue structure

Again, our assessment of operating leverage focuses on measures of 'operational intensity', namely the ratios of: opex to total assets; capex to total assets and capex to opex. Our overall conclusion is that this evidence suggests that NERL faces a higher proportion of fixed costs than the airport comparators.

Figure 19 compares NERL and the potential comparator airports with respect to the ratio of opex to total assets (opex to RAB for NERL) for 2010-18. It shows NERL's opex as a proportion of RAB to be higher than equivalent figures for all airports, NERL's 2018 value being 41% compared to 27% for the highest airport (Vienna).

Figure 19: Opex to Total Assets (airports)



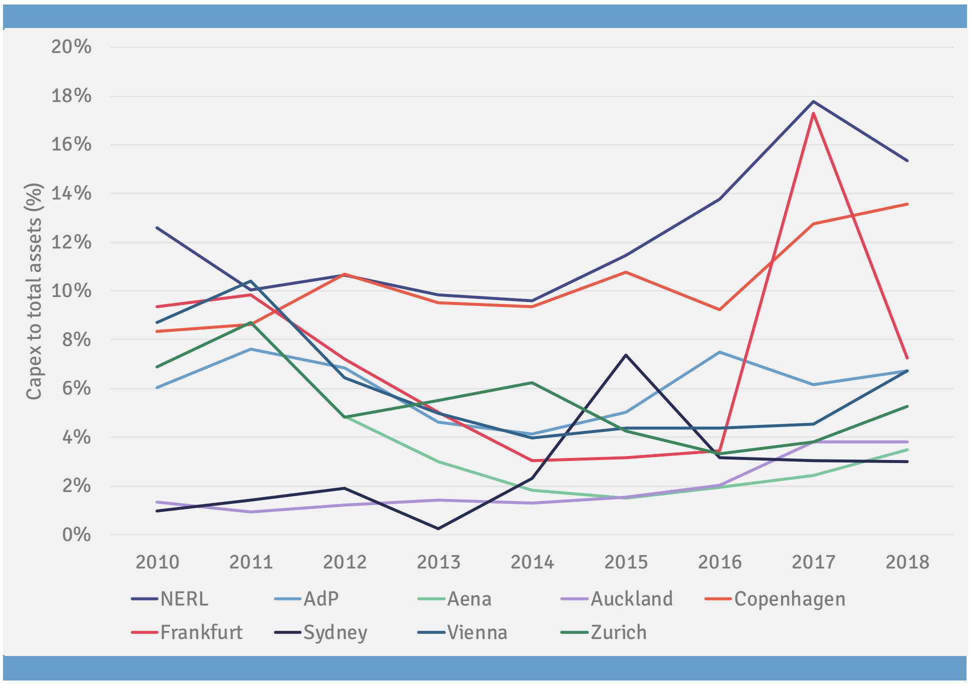
Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

Figure 20 compares NERL and the potential comparator airports with respect to the ratio of capex to total assets (capex to RAB for NERL) for 2010-18. The figure shows NERL's capex as a proportion of RAB to be significantly higher than equivalent figures for most airports, with the exception of Copenhagen, which has a similar level to

[37] *'Fraport Annual Report 2018.' page 242.*
[38] *'Aéroports de Paris registration document 2018.' page 105.*
[39] *'Aéroports de Paris registration document 2018.' page 267.*

NERL. NERL's ratio of capex to total assets for 2018 was 15%, compared to 14% for Copenhagen and between 3% and 7% for other airports.

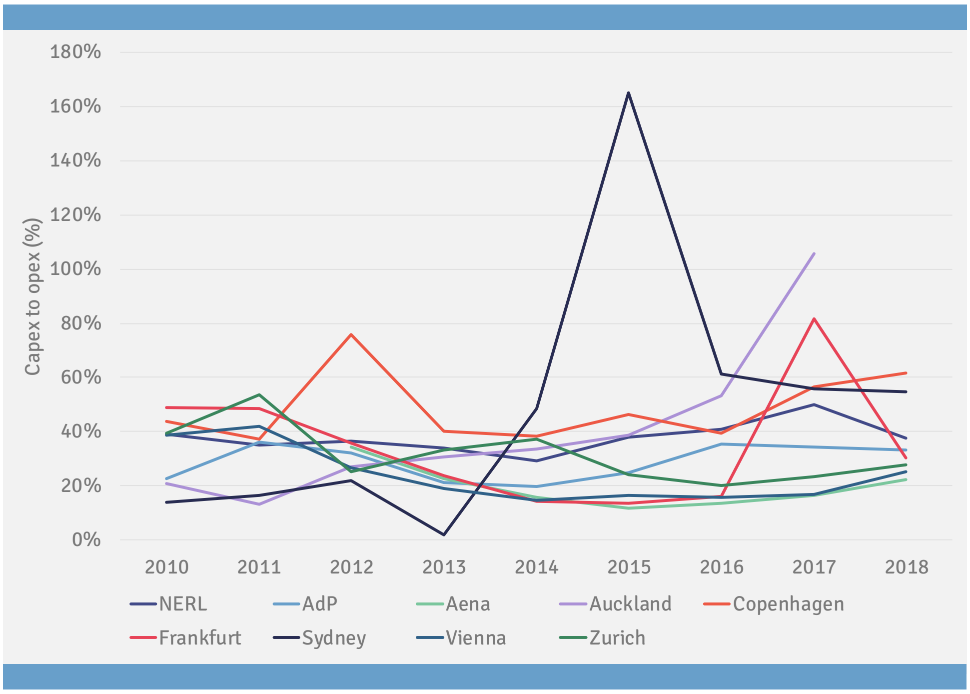
Figure 20: Capex to Total Assets (airports)



Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

Figure 21 compares NERL and the potential comparator airports with respect to the ratio of capex to opex for 2010-18. On this measure, NERL's operational intensity is towards the middle of the range for the listed airports. NERL's ratio of capex to opex for 2018 was 38%, with other airports' figures lying in the range 22% to 62%.

Figure 21: Capex to Opex (airports)



Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

3.2.4 Conclusions

We expect Aéroports de Paris to face a broadly similar level of risk to NERL, although the impact of capacity constraints suggests that in practice this may be lower. We also expect Frankfurt and Vienna to face lower risk. Across most potential airport comparators, it is difficult to draw firm conclusions as to comparability with NERL. On the one hand, many are subject to higher revenue risk, but most also have lower operating leverage than NERL. Overall, we recommend that Aéroports de Paris should be included as a comparator. We summarise this assessment in Table 15.

Table 15: Application of risk framework to airports

Comparator	Revenue		Cost	Cost structure	Overall
	Price	Volume			
Aéroports de Paris	Similar	Lower	Similar	Lower	Similar/Lower
Aena	Similar	Higher	Similar	Lower	Indeterminate
Auckland	Higher	Higher	Higher	Lower	Indeterminate
Copenhagen	Higher	Higher	Higher	Similar	Indeterminate
Frankfurt	Similar	Lower	Similar	Lower	Lower
Sydney	Higher	Higher	Higher	Lower	Indeterminate
Vienna	Similar	Lower	Higher	Lower	Lower
Zurich	Higher	Higher	Higher	Lower	Indeterminate

Source: Economic Insight

3.3 Airlines

As set out above, we have considered the largest European airlines as potential comparators: Air France-KLM, easyJet, International Airlines Group, Lufthansa and Ryanair.

3.3.1 Revenue risk

FULL EXPOSURE TO VOLUME AND PRICE RISK MEANS AIRLINES' SYSTEMATIC RISK IS HIGHER THAN NERL'S.

Our overall conclusion is that airlines face higher systematic revenue risk than NERL, because they are exposed both to higher price and volume risk than NERL.

- On **sales price** risk, Whereas NERL is a monopoly provider subject to a binding price cap, airlines are fully exposed to both upside and downside price risk. Airlines therefore have higher systematic price risk than NERL.
- On **volume risk**, whereas NERL has a degree of protection from its risk sharing arrangements, airlines are fully exposed to this risk. In addition, as airlines earn sales on a per-passenger basis, rather than a service unit basis, their volumes may be inherently more variable. While airlines also face competition risk, which NERL does not, as set out above, we think the impact of this on systematic risk is likely to be limited.

3.3.2 Cost risk

Our overall assessment is that airlines are likely to be subject to higher cost risk than NERL, though again it is difficult to draw firm conclusions.

- Labour costs are a smaller proportion of operating costs for airlines than is the case for NERL. For example, analysis of company reports suggests that labour costs represented 17% of operating expenditure for easyJet[40] and 23% total operating costs for IAG[41].
- Aviation fuel, the price of which is volatile, makes up a substantial proportion of airlines' costs. Evidence shows fuel costs as a percentage of expenditure for airlines (worldwide) from 2011 to 2019 ranging from 20% to over 30% of costs.[42]
- An important source of this difference is regulation. Specifically, airlines have no protection against inflation risk, whereas NERL does.

3.3.3 Cost structure

We have again compared the potential airline comparators with NERL against measures of operational intensity. Overall, it is difficult to draw strong conclusions from this assessment, as the evidence is mixed. This may be a result of certain features of the airline industry. Airlines earn revenues on a per-passenger basis but incur variable costs on a per-flight basis. As such, smaller fluctuations in demand manifest themselves in changes in load factors in the first instance, with costs being

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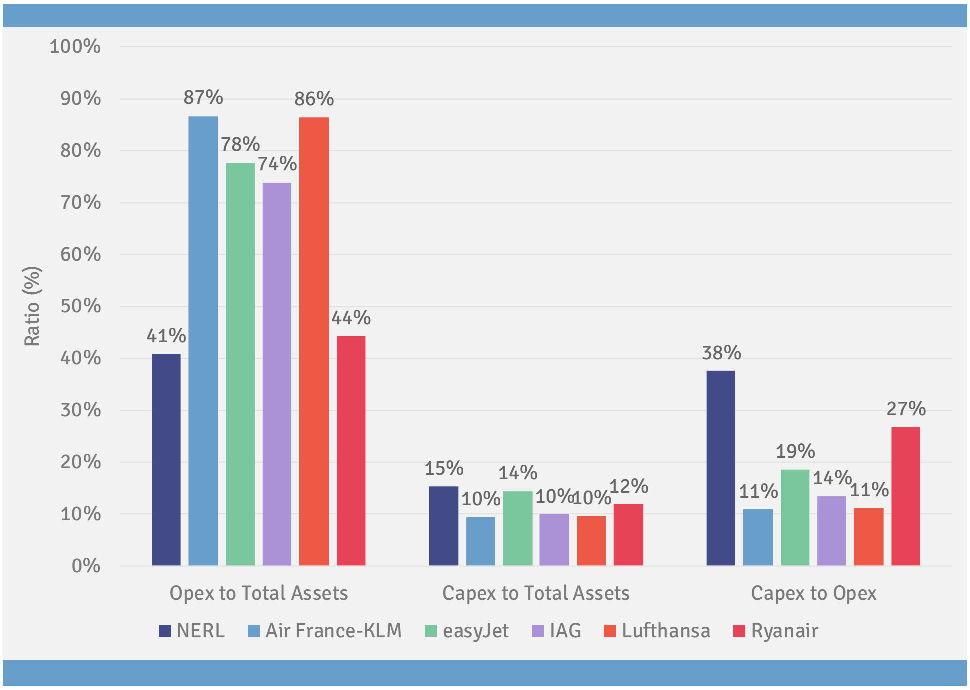
40 *'easyJet plc Annual Report and Accounts 2018.' page 30, 104.*
41 *'International Airlines Group Annual Report and Accounts 2018.' page 116.*
42 *Statista: airline fuel costs as a percentage of expenditure.*

relatively stable. However, in response to large changes in demand, airlines may respond by adding and removing particular routes.

To illustrate this, Figure 22 shows the measures for 2018 for NERL and potential airline comparators. NERL appears below the potential comparators on one measure (opex to total assets), at a similar level on capex to total assets, and above the potential comparators on capex to opex.

Figure 22: Operational intensity measures (airlines)



Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

3.3.4 Conclusions

Our overall conclusion is that, despite sharing similar demand drivers, airlines' systematic risk is materially higher than NERL's, as set out in Table 16. As such, we do not recommend the inclusion of airlines within the set of potential comparators.

Table 16: Application of risk framework to airlines

Comparator	Revenue		Cost	Cost structure	Overall
	Price	Volume			
Air France-KLM	Higher	Higher	Higher	Indeterminate	Higher
easyJet	Higher	Higher	Higher	Indeterminate	Higher
IAG	Higher	Higher	Higher	Indeterminate	Higher
Lufthansa	Higher	Higher	Higher	Indeterminate	Higher
Ryanair	Higher	Higher	Higher	Indeterminate	Higher

Source: Economic Insight

3.4 Utilities

As we set out above, the following utilities comparators from the water and energy sectors have been cited in assessing NERL's beta: Centrica, National Grid, Pennon, Severn Trent, SSE and United Utilities. The inclusion of evidence from these companies has been a key point of contention. Europe Economics argues that the analysis of utility betas is informative, because 'similarity in the regulatory regime' implies that 'UK regulated utilities' constitute potential comparators.[43] Given that Europe Economics' rationale for including utility comparators was based on similarity in regulatory regime, we think it is important to consider the extent to which regulated networks constitute a material proportion of these companies businesses.

Table 17 summarises the sectors the potential utility comparators operate in and the proportion of UK regulated network revenues they earn. From this, it appears that only Severn Trent and United Utilities earn the bulk of their revenue from UK regulated networks, and therefore accord with Europe Economics' rationale for the inclusion of utility companies as comparators. The energy companies cited operate across the energy supply chain and, in the case of Centrica, do not generate any network revenues. In this context, we note that while there is a default tariff cap in the energy supply sector, the regulatory regime in energy supply is markedly different from that applying to regulated networks.

Table 17: Potential utility comparators' operations

Company	Network sectors	Other sectors	Countries	UK regulated network revenues (%)
Centrica	None	Power generation, energy retail	UK, Ireland, US	0%
National Grid	Electricity transmission, gas transmission	Energy investment, commercial operations	UK, US	28%
Pennon	Water networks, wastewater networks	Water and wastewater retail, waste management	UK	39%*
Severn Trent	Water networks, wastewater networks	Water and wastewater retail	UK	90%*
SSE	Electricity transmission, electricity distribution, gas distribution	Electricity generation, gas production, gas storage, energy retail	UK	15%
United Utilities	Water networks, wastewater networks	Water and wastewater retail, waste management	UK	92%

*Source: Economic Insight analysis of company annual reports, *value includes residential retail*

43 *'Components of the Cost of Capital for NERL.' Europe Economics (2018); page 17.*

3.4.1 Revenue risk

REGULATED UTILITY NETWORKS ARE FOR THE MOST PART INSULATED FROM VOLUME RISK.

Our overall conclusion is that utilities face significantly lower revenue risk than NERL.

- Regulated networks in the UK are, for the most part, insulated from **both price and volume risk** as they are subject to total revenue, rather than price, caps. While NERL is insulated from price risk, it is still exposed to a material degree of volume risk. While, in some cases, regulated network companies are exposed to volume risk, though this is generally for specific limited elements of their price controls. For example, from PR19 water companies' bioresources activities will be subject to an average revenue control, with a volume forecasting accuracy incentive potentially contributing further volume risk.[44]

- Demand for water (and energy), and therefore volume risk, is significantly less systematic than for air travel. This is unsurprising, given the 'essential' nature of utilities compared with the 'discretionary' character of air travel. This is supported by the economic literature on income elasticities. While studies generally find income elasticities greater than one for air travel, these are below one for both water and energy. We summarise evidence from our review of literature on this topic in Table 18.

Table 18: Elasticity estimates for utilities industries

Sector	Area	Source	Elasticity
Air travel	UK	Graham (2000)[45]	2
	Global	Gallet, and Doucouliagos (2014)[46]	1.19
Electricity	UK	Bildirici et al. (2012)[47]	0.9
Residential electricity	UK	Clements and Madlener (1999)[48]	0.3-0.5
	UK	Narayan et al. (2007)[49]	0.14-0.66*
	UK	Bernstein and Madlener (2011)[50]	0.35
Residential water	Global	Dalhuisen et al (2003)[51]	0.43

*Source: Economic Insight literature review; *short-term and long-term elasticities respectively*

- The situation in utility retail bears some superficial similarities to NERL, with price caps in residential water and some parts of energy retail. We note, however, that in the water sector residential retail represents a very small proportion of total revenues in the sector. In energy retail, price caps apply to default tariffs and prepayment meters, but not to other tariffs. These caps therefore apply only to a subset of tariffs and are temporary, with the

[44] 'Delivering Water 2020: Our final methodology for the 2019 price review.' Ofwat (2017).
[45] 'Demand for leisure air travel and limits to growth.' Journal of Air Transport Management, 6(2). Graham, A. (2000); page 109-118.
[46] 'The income elasticity of air travel: A meta-analysis.' Annals of Tourism Research, 49. Gallet, C.A. and Doucouliagos, H. (2014); page 141-155.
[47] 'Economic growth and electricity consumption: Auto regressive distributed lag analysis.' Journal of Energy in Southern Africa, 23(4). Bildirici, M.E., Bakirtas, T. and Kayikci, F. (2012); page.29-45.
[48] 'Seasonality, cointegration, and forecasting UK residential energy demand.' Scottish Journal of Political Economy, 46(2). Clements, M.P. and Madlener, R. (1999); page 185-206.
[49] 'Electricity consumption in G7 countries: A panel cointegration analysis of residential demand elasticities.' Energy policy, 35(9). Narayan, P.K., Smyth, R. and Prasad, A. (2007); Page 4485-4494.
[50] 'Responsiveness of residential electricity demand in OECD countries: a panel cointegration and causality analysis.' Bernstein, R. and Madlener, R. (2011).
[51] 'Price and income elasticities of residential water demand: a meta-analysis.' Land economics, 79(2). Dalhuisen, J.M., Florax, R.J., De Groot, H.L. and Nijkamp, P. (2003). page 292-308.

prepayment meter cap due to end in 2020[52] and the default tariff cap extending to 2023 at the latest.[53]

- In non-regulated sectors, it is difficult to draw any strong conclusions as to the comparability or otherwise of volume risk with NERL. For example, while demand for generation activities is likely to be related to aggregate energy demand, other technology-specific factors will also play a very important role in determining the level of systematic volume risk. Overall, however, we consider it highly unlikely that activities such as energy generation represent an appropriate basis of comparison for NERL.

3.4.2 Cost risk

Overall, we expect regulated networks to have lower cost risk than NERL, though it is difficult to draw strong conclusions on this issue.

- Staff costs appear to be less important for utilities than for NERL, making it difficult to make comparisons as to relative levels of input price risk. For example, in annual reports labour costs are identified as constituting 26% of operating costs for Severn Trent[54], 14% for United Utilities[55] and 7% for Centrica[56].

- Both NERL and regulated networks enjoy a similar degree of protection from inflation risk, with indexed price caps. The companies' non-regulated businesses do not enjoy such protection and are therefore less comparable in terms in input price risk.

- The evidence cited above on income elasticities implies that the variable costs that NERL incurs are more sensitive to changes in economic conditions than are network utilities' variable costs.[57]

3.4.3 Cost and revenue structure

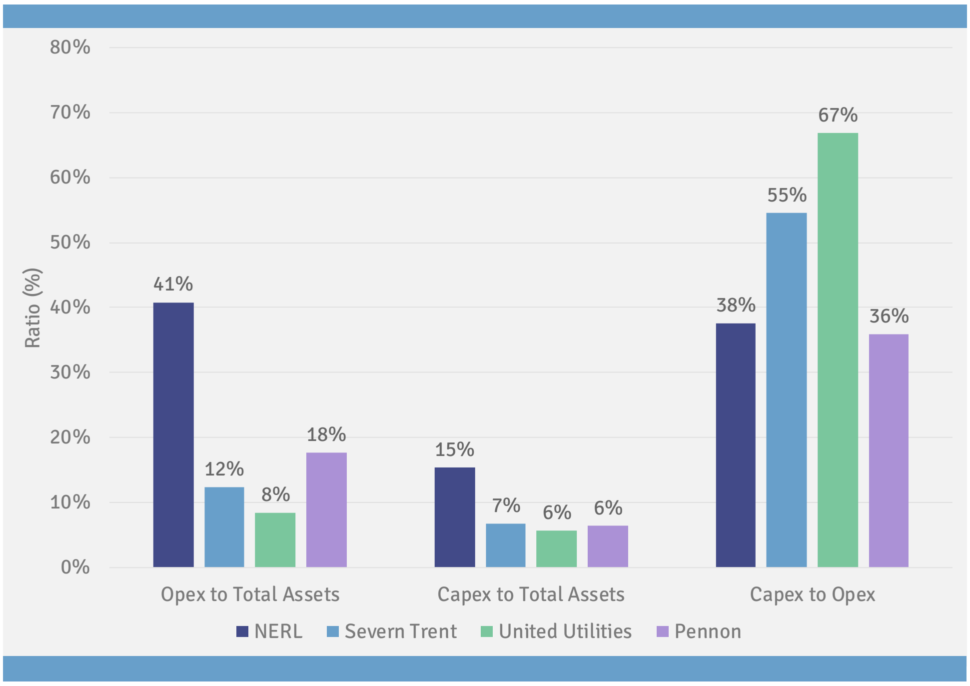
We have again compared the potential utility comparators with NERL against measures of operational intensity. As before, we assess this with respect to the ratios of: opex to total assets; capex to total assets; and capex to opex. Overall, evidence on similarities in the level of operational gearing between NERL and utilities comparators is inconclusive.

We show operational intensity measures for water companies in Figure 23. The evidence is mixed. On opex to total assets and capex to total assets, NERL's operational intensity appears higher than the potential comparators, though on capex to opex it appears lower than Severn Trent and United Utilities and around the same level as Pennon. In addition, we show equivalent metrics for companies in the energy

[52] https://www.ofgem.gov.uk/electricity/retail-market/market-review-and-reform/implementation-cma-remedies/prepayment-price-cap
[53] https://www.ofgem.gov.uk/gas/retail-market/market-review-and-reform/default-tariff-cap
[54] 'Severn Trent Plc Annual Report and Accounts 2019.' page 153.
[55] 'United Utilities Group PLC Annual Report and Financial Statements for the year ended 31 March 2019.' page 162.
[56] 'Centrica plc Annual Report and Accounts 2018.' page 144.
[57] This observation applies to the variable costs that NERL incurs and does not reflect any judgement as to the relative importance of fixed and variable costs in companies' total costs. It is therefore consistent with the observation that NERL has a relatively 'fixed' cost base.

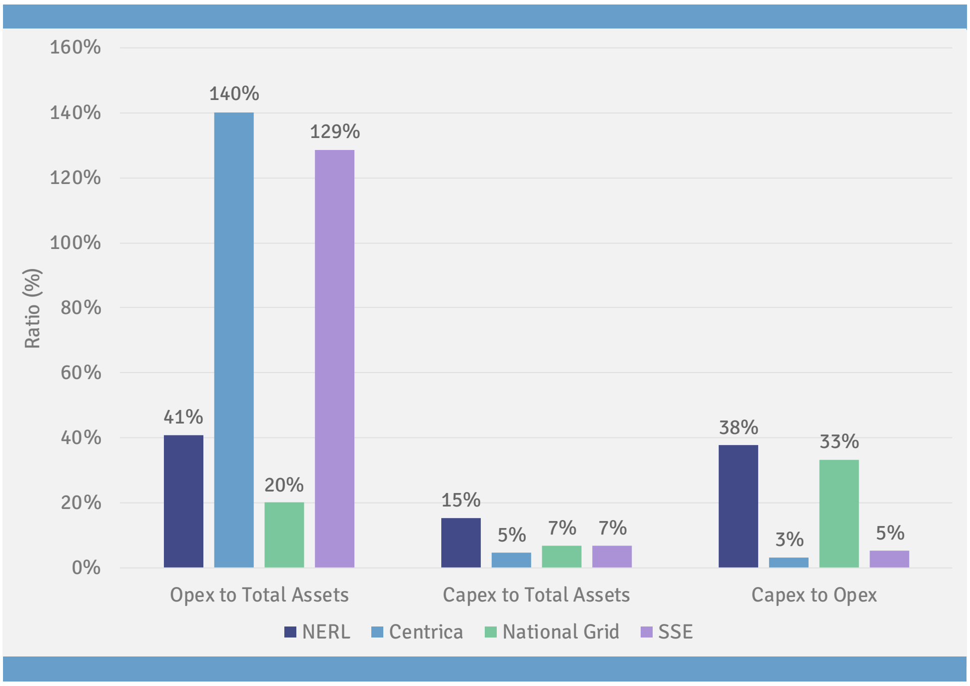
sector in Figure 24. Again, evidence is mixed. National Grid appears lower than or at a similar level to NERL across the three measures, whereas evidence is mixed for Centrica and SSE.

Figure 23: Operational intensity measures, 2018 (water)



Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

Figure 24: Operational intensity measures, 2018 (energy)



Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

3.4.4 Conclusions

Our overall conclusion is that utilities are not suitable to use as comparators, as they face both lower revenue and lower cost risk, as summarised in Table 19.

Table 19: Application of risk framework to utilities

Comparator	Revenue		Cost	Cost structure	Overall
	Price	Volume			
Centrica	Indeterminate		Indeterminate	Indeterminate	Indeterminate
National Grid	Indeterminate		Indeterminate	Lower	Indeterminate
Pennon	Lower		Lower	Lower	Lower
Severn Trent	Lower		Lower	Indeterminate	Lower
SSE	Indeterminate		Indeterminate	Indeterminate	Indeterminate
United Utilities	Lower		Lower	Indeterminate	Lower

Source: Economic Insight

3.5 Conclusion on potential comparators

Our assessment suggests that ENAV and Aéroports de Paris are suitable for comparator analysis, though in both cases adjustments may be necessary.

- **ENAV may provide a useful point of comparison, but there are good reasons to expect its systematic risk to be lower than NERL's** due to lower operating leverage and potentially lower systematic volume risk.

- **Similarly, Aéroports de Paris appears to face similar but lower systematic risk than NERL.** This is because of its lower operating leverage, and evidence that it faces some capacity constraints.

- **Airline comparators (on average) face materially higher systematic risk than NERL**, as they are exposed to both sales price and volume risk.

- **Utility companies face significantly lower risk than NERL**, as they are exposed to neither and demand for water and energy is more stable than air travel. **These are not, therefore, a good point of comparison for NERL.**

Table 20 draws together our assessment.

Table 20: Application of risk framework to potential comparators

Comparator	Revenue		Cost	Cost structure	Overall
	Price	Volume			
Air Navigation Services					
ENAV	Similar	Lower	Similar	Lower	Similar/Lower
Airports					
Aéroports de Paris	Similar	Lower	Similar	Lower	Similar/Lower
Aena	Similar	Higher	Similar	Lower	Indeterminate
Auckland	Higher	Higher	Higher	Lower	Indeterminate
Copenhagen	Higher	Higher	Higher	Similar	Indeterminate
Frankfurt	Similar	Lower	Similar	Lower	Lower
Sydney	Higher	Higher	Higher	Lower	Indeterminate
Vienna	Similar	Lower	Higher	Lower	Lower
Zurich	Higher	Higher	Higher	Lower	Indeterminate
Airlines					
Air France-KLM	Higher	Higher	Higher	Indeterminate	Higher
easyJet	Higher	Higher	Higher	Indeterminate	Higher
IAG	Higher	Higher	Higher	Indeterminate	Higher
Lufthansa	Higher	Higher	Higher	Indeterminate	Higher
Ryanair	Higher	Higher	Higher	Indeterminate	Higher
Utilities					
Centrica	Indeterminate		Indeterminate	Indeterminate	Indeterminate
National Grid	Indeterminate		Indeterminate	Lower	Indeterminate
Pennon	Lower		Lower	Lower	Lower
Severn Trent	Lower		Lower	Indeterminate	Lower
SSE	Indeterminate		Indeterminate	Indeterminate	Indeterminate
United Utilities	Lower		Lower	Indeterminate	Lower

Source: Economic Insight

4. Beta Analysis

This chapter sets out our analysis of beta. We first present our comparator analysis, based on the comparator selection exercise described in the preceding chapter. We then conduct a temporal analysis to determine the potential impact of changes in systematic risk at RP2 on the appropriate level of beta. Finally, we draw evidence together to generate an overall conclusion on beta, recommending a range of 0.53 to 0.63 with a point estimate of 0.60. Our point estimate is 0.14 higher than the CAA's, reflecting an increase of approximately 0.09 from the removal of utilities comparators and a further increase of approximately 0.05 from the application of an adjustment for operating leverage.

4.1 Comparator analysis

As set out in the preceding chapter, our risk analysis suggests that Aéroports de Paris and ENAV have the potential to be useful comparators, although in general their systematic risk is likely to be somewhat lower than NERL's, due primarily to NERL's higher operating leverage. We first set out our approach to beta estimation, drawing on the analysis set out in our cost of capital assurance report. We then go on to present beta estimates for our selected comparators, and then draw together the evidence implied by our comparator analysis, adjusting for differences in operating leverage and relative risk.

4.1.1 Approach to beta estimation

We now set out two key aspects of our approach to beta estimation: (i) the approach to unlevered beta estimation; and (ii) debt beta.

Estimation of unlevered beta

Before presenting comparator beta estimates, we briefly set out our approach to estimation. This is based on the arguments and recommendations set out in our cost of capital assurance report. In summary, our approach is as follows.

- We estimate equity betas based on daily returns data, using timeframes of two and five years where possible. We place greater weight on longer timeframes than, say, one-year beta estimates, primarily because longer timeframes are more consistent with other parameters in the price control.

- For Eurozone countries, we place most weight on betas estimated using European indices. As we set out in our cost of capital assurance review, we consider that the index used in beta estimation should reflect the investment opportunities available to investors in the asset in question. We expect a European index to represent better reflect these investment opportunities, for the following reasons:
  - marginal infrastructure investors have the ability and incentive to diversify internationally;

- the available European index (Europe Stoxx 600) has wide coverage in the spirit of the diversified 'market portfolio' underlying the capital asset pricing model; and
- available national indices generally contain only a limited number of large cap stocks.

- We calculate unlevered betas based on the ratio of net debt to enterprise value (net debt plus market capitalisation).

Debt beta

A company's overall level of systematic risk (asset beta) is equal to the weighted combination of its debt and equity betas, with weights determined by gearing.[58] While the main focus of beta estimation is generally placed on equity beta, judgement also needs to be made about the appropriate level of debt beta. In principle debt beta will be 'low' relative to equity beta. Indeed, one valid approach is to assume that debt beta is zero and focus on the analysis of 'unlevered beta'.[59] As we set out in our cost of capital assurance review, empirical evidence on debt beta is mixed.

- Direct econometric estimates of debt beta generally suggest values that are closed to zero, or even negative.

- Indirect estimates, in which debt beta is backed out of debt return data based on assumptions about defaults and other capital asset pricing model parameters naturally depend heavily on the assumptions made. However, they generally suggest values no greater than around 0.20.

- Regulatory precedent generally suggests values of up to 0.1.

As per our assurance review, we consider both direct and indirect estimates to be a valid source of evidence. However, we found that the existing indirect evidence is flawed, and is based on crude 'rules of thumb'. Hence, at this time there remains uncertainty as to the appropriate debt beta for NERL (and further evidence and thought is required on this matter). Consequently, in light of this, our pragmatic approach here is to consider scenarios for a low, but non-zero, debt beta of 0.05 and 0.1.

We now set out beta estimates for ENAV and Aéroports de Paris and assess their implications for the appropriate beta for NERL.

4.1.2 ENAV

4.1.2.1 Beta estimates

Table 21 shows two-year beta estimates for ENAV, based on a European index. We focus only on two-year estimates in the case of ENAV, as there is insufficient data to calculate betas based on longer timeframes. This suggests an unlevered beta of 0.46 for ENAV.

58 *That is to say,* $\beta^A = g \cdot \beta^D + (1-g) \cdot \beta^E$.

59 *Indeed, one valid approach is to assume that debt beta is zero and focus on the analysis of 'unlevered beta':* $\beta^U = (1-g) \cdot \beta^E$.

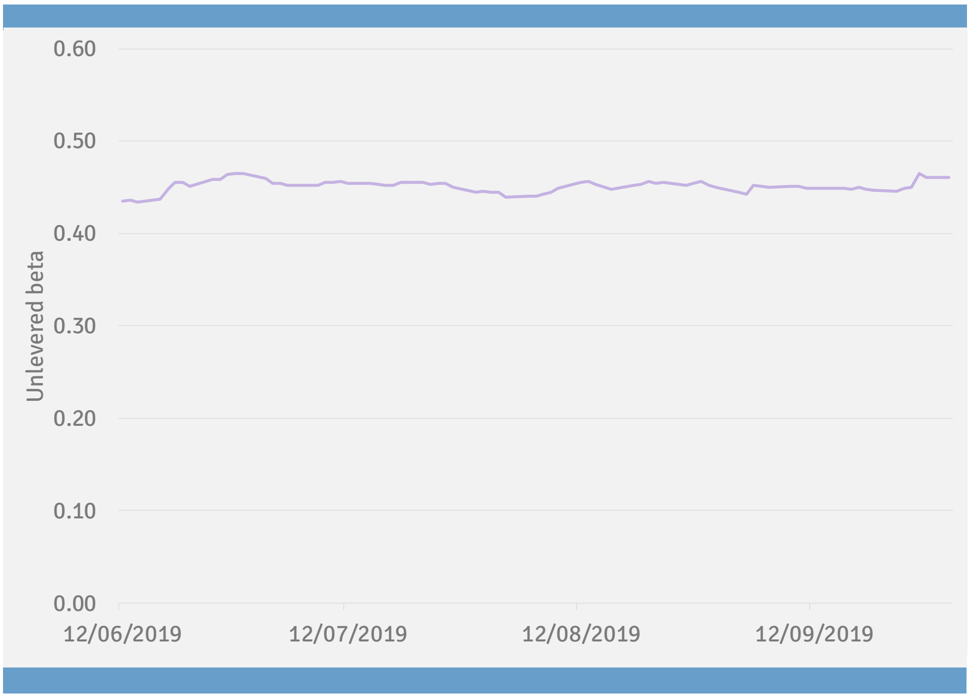
Table 21: Unlevered beta estimates for ENAV, 30/09/2018

Market index	Timeframe (years)	Unlevered beta/Asset beta
European	2	0.46

Source: Economic Insight calculations, Thomson Reuters data

Figure 25 shows rolling two-year beta estimates for ENAV, based on two-year windows. These estimates show a degree of stability over time, though we note that this is over a relatively short timeframe.

Figure 25: Rolling unlevered beta estimates for ENAV



Source: Economic Insight calculations based on Thomson Reuters data

4.1.2.2 Adjustments

Our assessment of ENAV's risk profile relative to NERL suggested that the two most important respects in which ENAV faced lower risk than NERL. These were the following.

- ENAV's terminal services are exposed to lower systematic risk than its en route services, because of differences in regulation.
- ENAV has lower operating leverage than NERL, which will tend to lower the extent of its systematic risk.

We apply adjustments to these estimates, based on the above. We have not adjusted for the apparent lower systematic component to ENAV's demand, set out in Table 11.

Lower risk exposure of ENAV's terminal services

Our risk assessment above identified that approximately 80% of ENAV's revenue, comprising en route services and terminal zone 1, had the same exposure to volume risk as NERL, whereas the remaining 20% (terminal zones 2 and 3) were not exposed to any volume risk, as summarised in Table 22.

Table 22: ENAV exposure to volume risk

Area	Percentage of ENAV revenue	Exposure to volume risk
En route	75%	As NERL
Terminal zone 1	5%	As NERL
Terminal zone 2	7%	Zero
Terminal zone 3	13%	Zero

Source: ENAV Investor Presentation September 2019 p12-13, Economic Insight analysis

This implies that we can think about ENAV's beta as the combination of two betas, namely: (i) a beta for terminal zones 2 and 3 subject to zero volume risk and therefore lower risk than NERL; and (ii) a more comparable beta for en route and terminal zone 1. Weights will reflect the value of assets accounted for by each of these two components. As such, we can adjust the estimated ENAV beta for the presence of the lower risk terminal zones 2 and 3. To do so, we make the following assumptions:

- We use the percentage of regulated revenue as a proxy for asset value, implying an 80:20 split.
- We use a range of 0.30 to 0.40 for the terminal zone 2 and 3 beta. This is based on the observation that the beta must be below ENAV's overall beta, and is consistent with estimates of beta for utilities, which also face limited demand risk.

Applying this adjustment increases beta estimates, as set out in Table 23, with the range for en route and terminal zone 1 beta increasing to 0.48 to 0.50.

Table 23: Application of adjustment for terminal services

Scenario	ENAV beta	Terminal zones 2 & 3 beta	En route & terminal zone 1 beta
Low	0.46	0.40	0.48
High	0.46	0.30	0.50

Source: Economic Insight calculations

Operating leverage

ENAV's operating leverage is also lower than NERL's. Following similar practice on the part of the CMA in its Bristol Water redetermination,[60] we applied an uplift based on the average of the three operational intensity metrics set out above, amounting to 11%.[61] The metrics and implied uplifts are summarised in Table 24.

[60] *The CMA's adjustment was based on comparisons of the ratio of operating cash flow to revenues between Bristol Water and listed comparators. The 13% adjustment at PR14 was calculated as the percentage increase required in Bristol's operating cash flow to revenue ratio to reach that of the comparator companies . In this case, going from 45% to 51% constitutes a 13% increase in the ratio. (See A10(1)-33 of the Appendices to the CMA's PR14 redetermination).*

[61] *The uplifts are calculated (in the same manner as Europe Economics' approach) as the percentage difference between 1+ the relevant ratios for NERL and ENAV. We note that this is slightly different to the CMA's approach, which was based on the percentage difference between ratios. The rationale for this is that the CMA was adjusting for a measure (operating cash flows to revenue) that relates to aggregate cash flows (taking into account costs and revenues), whereas the measures we have examined are intended to reflect differences in the balance between fixed and variable costs (i.e. they relate only to costs). Adjusting by the percentage difference in these ratios would overstate the required uplift, as the differential in risk would be applied to revenues as well as costs. Under the simplifying assumptions that the betas of revenue*

Table 24: Operational intensity measures for ENAV and NERL

Measure	NERL	ENAV	Implied uplift
Opex to total assets	41%	33%	6%
Capex to total assets	15%	6%	9%
Capex to opex	38%	17%	17%
Average			11%

Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

Applying this adjustment to the estimates above suggests an unlevered beta range of 0.53 to 0.56, as set out in Table 25.

Table 25: Application of adjustment for terminal services

Scenario	ENAV en route beta	Adjustment	Adjusted beta
Low	0.48	11%	0.53
High	0.50	11%	0.56

Source: Economic Insight calculations

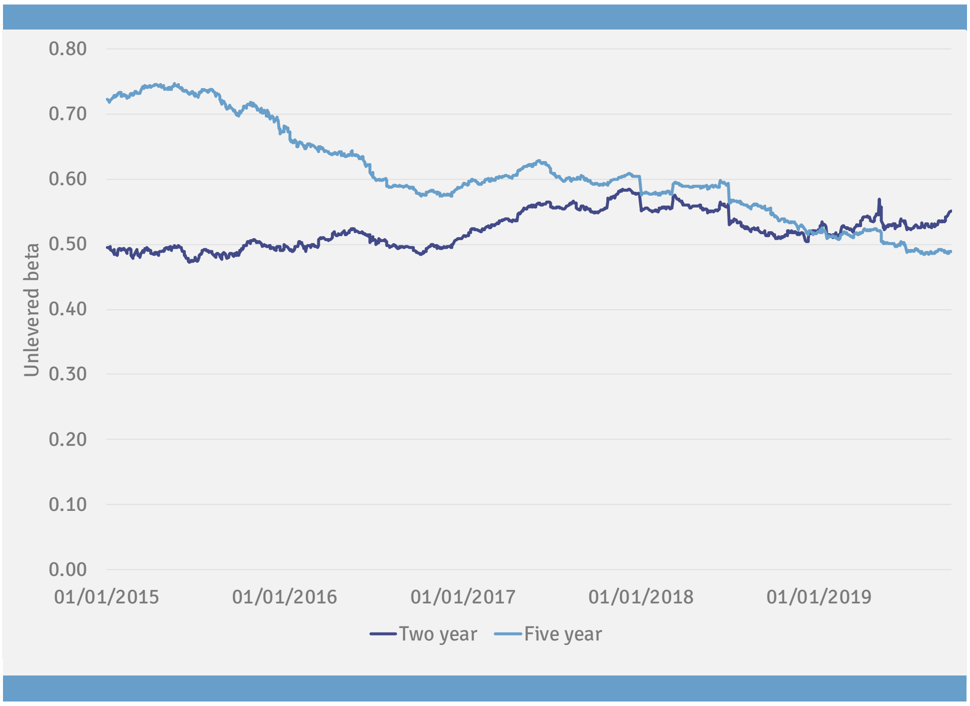
and variable costs are equal to one another and the beta of fixed costs is zero, then the relevant adjustment factor between two otherwise identical firms is 1 + the ratio of the PDV of fixed costs to the PDV of asset value (i.e. $1+\frac{F}{A}$, where F is the PDV of fixed costs and A is the PDV of cash flows).

4.1.3 Aéroports de Paris

4.1.3.1 Beta estimates

Figure 26 shows rolling two- and five- year beta estimates for Aéroports de Paris, based on European indices. These estimates also show a degree of stability over time, though the five-year beta estimates have gradually fallen since 2015, whereas the two-year estimates have risen.

Figure 26: Rolling unlevered beta estimates for Aéroports de Paris



Source: Economic Insight calculations based on Thomson Reuters data

Table 26 shows two- and five-year beta estimates for Aéroports de Paris on European market indices. Combined with debt betas of 0.05 and 0.10, this implies an asset beta range of 0.50 to 0.58.

Table 26: Unlevered beta estimates for Aéroports de Paris

Timeframe (years)	Unlevered beta	Debt beta	Asset beta
5	0.49	0.05	0.50
5	0.49	0.10	0.51
2	0.55	0.05	0.56
2	0.55	0.10	0.58

Source: Economic Insight calculations, Thomson Reuters data

4.1.3.2 Adjustments

As we set out earlier, Aéroports de Paris's operating leverage is somewhat below NERL's level. As such, we also apply a similar adjustment, based on the operational intensity ratios set out in the preceding chapter. These suggest an increase of around 10%, as set out in Table 27.

Table 27: Operational intensity measures for NERL and Aéroports de Paris

Measure	NERL	Aéroports de Paris	Adjustment
Opex to total assets	41%	20%	17%
Capex to total assets	15%	7%	8%
Capex to opex	38%	33%	3%
Average			10%

Source: Economic Insight calculations, Thomson Reuters data and NERL regulatory accounts

Applying this adjustment increases the implied asset beta range to 0.55 to 0.63, as set out in the Table 28.

Table 28: Unlevered beta estimates for Aéroports de Paris

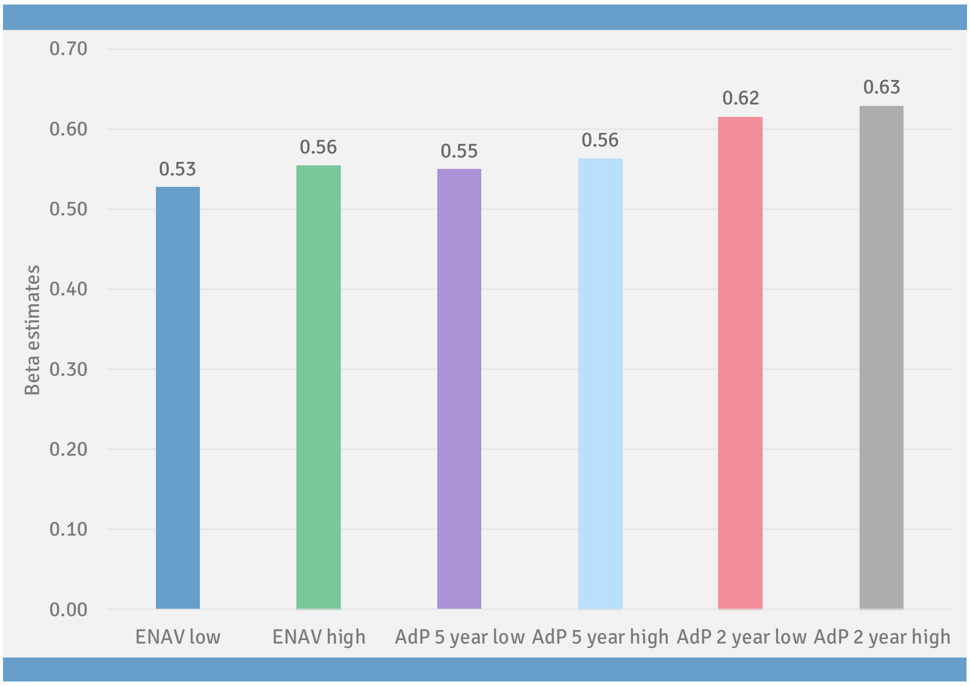
Timeframe (years)	Debt beta	Asset beta	Adjustment	Asset beta
5	0.05	0.50	10%	0.55
5	0.10	0.51	10%	0.56
2	0.05	0.56	10%	0.62
2	0.10	0.58	10%	0.63

Source: Economic Insight calculations

4.1.4 Conclusions from comparator analysis

Figure 27 summarises evidence from our comparator analysis. Overall our comparator analysis suggests a range for beta of 0.53 to 0.63. There are reasons to expect that the adjusted betas presented here may still understate NERL's systematic risk, as we have not made upward adjustments to reflect potential lower systematic volume risk for ENAV or for airport capacity constraints.

Figure 27: Range of beta estimates from comparator analysis



Source: Economic Insight calculations

4.2 Temporal Analysis

We now present our temporal analysis of beta. We find there are grounds to expect an increase in systematic risk since RP2, due to: (i) higher regulatory risk; (ii) higher volume risk associated with uncertainty over the UK's EU membership; and (iii) an increase in operating leverage. Adjusting the RP2 beta to reflect changes in the structure of costs and revenues implies a beta of 0.64.

4.2.1 Approach to temporal analysis

As set out above, we consider it important that due weight is attached to regulatory precedent. As such, we think that it is important to complement the comparator analysis set out in the preceding chapter with a temporal analysis, which takes as its starting point the beta determined at RP2 and considers the extent to which there are good reasons to expect this value to have changed. We then consider this as part of the range of evidence on beta, alongside the comparator analysis.

Our approach to temporal analysis is as follows.

- We begin by taking the beta the CAA determined at RP2 as the starting point for our analysis. This comprised an asset beta of 0.5, debt beta of 0.1, implying an equity beta of 1.11 at 60% gearing. We set this out in Table 29.

Table 29: Beta determined at RP2

Parameter	RP2 value
Gearing	60%
Asset beta	0.505
Debt beta	0.10
Equity beta	1.11

Source: CAA

- We then use the risk framework set out above to consider whether there are reasons to expect the drivers of NERL's systematic risk to have changed since RP2.

- We then draw the above analysis together to assess whether we expect the overall balance of systematic risk to have changed since RP2.

- Finally, where possible we apply adjustments to the RP2 beta value to provide an 'updated' value, reflecting our risk assessment.

4.2.2 Application of risk framework

We now apply our risk framework to assess changes since RP2 in the level of risk that NERL faces.

Revenue risk

Our overall conclusion is that NERL faces higher price and volume risk than at RP2.

- We consider that NERL may potentially face higher volume risk at RP3. We understand that exposure to risk will be the same at RP3, as the existing risk sharing mechanism is maintained.[62] However, we think that the level of volume risk itself may be higher at RP3. This primarily relates to risks associated with uncertainty over the UK's membership of the EU. We consider these risks to be primarily systematic in nature. To the extent that this issue results in fluctuations in NERL's volumes, it is also likely to lead to fluctuations in the wider economy.

- The CAA's changes to NERL's regulation imply higher sales price risk, which is likely to include a material systematic element. The changes involve a significant increase in regulatory discretion, with the CAA enabled to make ex-post adjustments to NERL's capex-related cash flows. As we set out in section 2.2, regulatory actions that are not transparently codified as part of the regulatory framework have been shown to have a material systematic component. The changes include:
  - an enhanced role for the Independent Reviewer, moving away from assessing the reliability of NERL's reporting to an assessment of capex performance; and
  - penalty-only financial incentives, imposed at the discretion of the regulator, for example the ex-post efficiency incentive, which allows the CAA to disallow capex that has already been incurred if it is retrospectively assessed as inefficient.

Cost risk

Overall, we expect NERL's cost risk at RP3 to be broadly similar to RP2. In a similar manner to price risk, there are reasons to expect NERL's input price risk to be broadly similar at RP3. Specifically, the extent of protection from inflation risk will remain the same and we are not aware of strong reasons to expect changes in systematic risk relating to input prices. However, for variable costs, there may be an impact from higher volume risk.

Cost and revenue structure

Changes in the structure of NERL's costs and revenues imply higher systematic risk at RP3 than at RP2. This is because: (i) evidence suggests operating leverage (i.e. the balance between fixed and variable costs) is higher; and (ii) changes in the composition of NERL's revenues imply higher systematic risk exposure.

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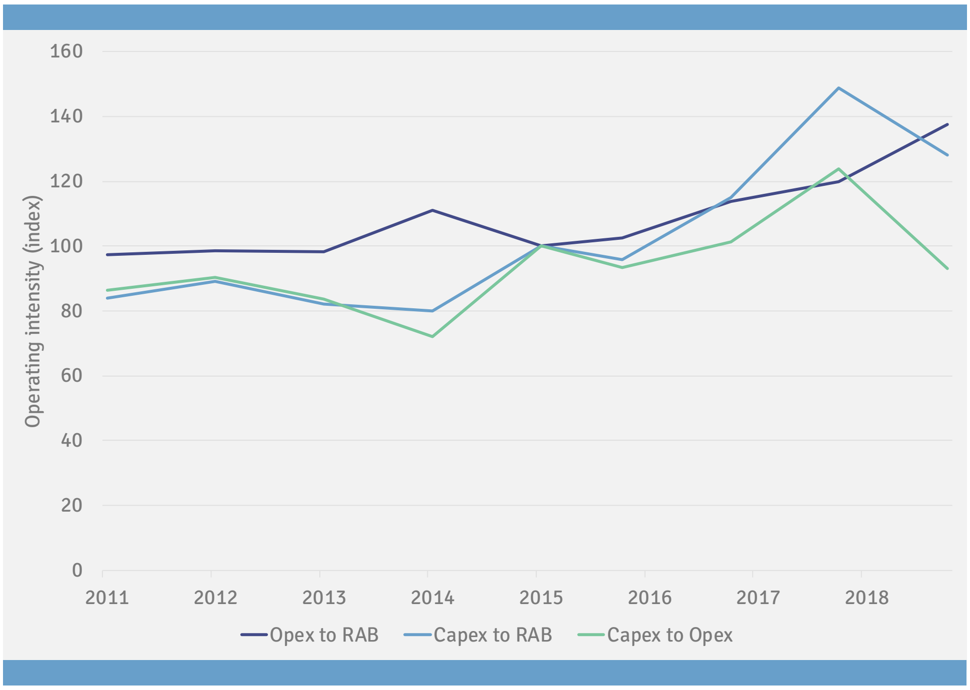
[62] *'Commission Implementing Regulation (EU) 2019/317 of 11 February 2019 laying down a performance and charging scheme in the single European sky and repealing Implementing Regulations (EU) No 390/2013 and (EU) No 391/2013.' European Commission (2019).*

Evidence suggests that NERL's operating leverage has increased since the start of RP2. Figure 28 shows three measures of operational intensity: opex to RAB, capex to RAB and capex to opex, displayed as indices, equal to 100 at the start of 2015. Two measures (opex to RAB and capex to RAB) show increases since 2015, while the ratio of capex to opex shows a slight decrease. The average value of the three indices at the end of 2018 is 120. The balance of this evidence suggests that NERL's operating leverage has increased since RP2.

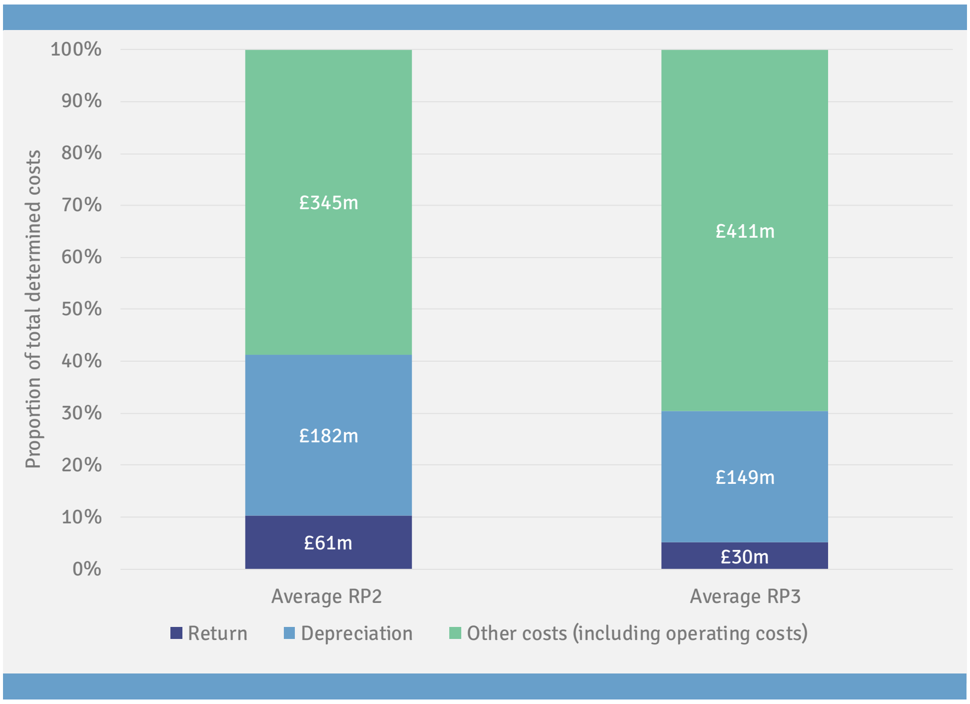
Figure 28: Operating leverage measures, indexed since 2015



Source: Economic Insight calculations, NERL regulatory accounts

Further, Figure 29 compares the composition of NERL's total determined costs at RP3 versus RP2. The proportion of revenues accounted for by allowed return and depreciation falls from over 41% of revenue to 30%. Within this, the proportion accounted for by return halves, from 10.3% to 5.1%, while depreciation's share falls from 31.0% to 25.3%.

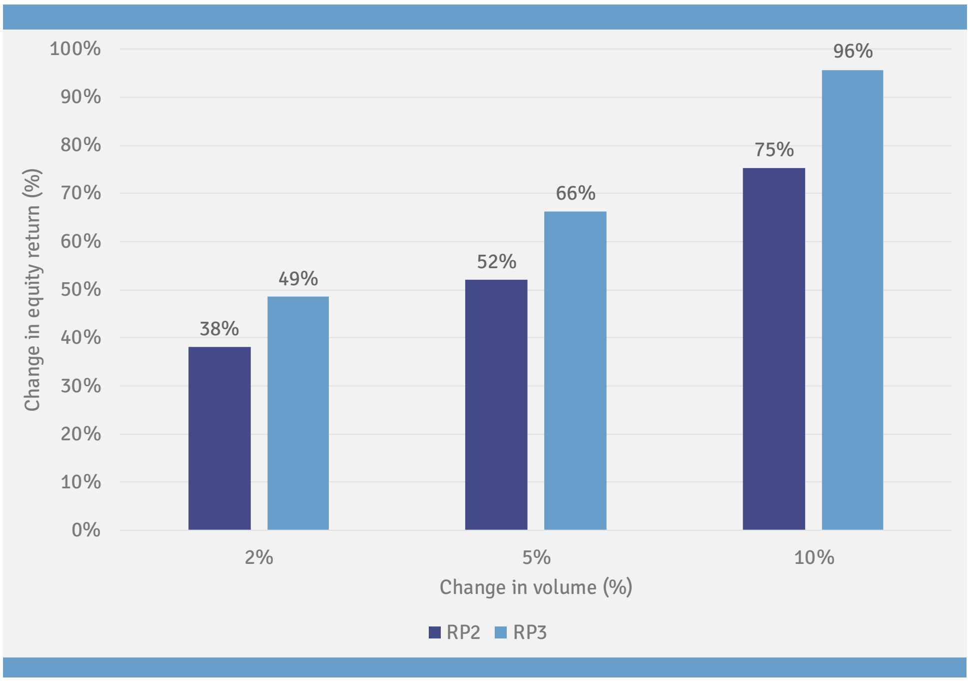
Figure 29: Composition of revenues, RP3 versus RP2



Source: Economic Insight calculations, CAA RP3 decision

In section 2.3.3 we set out an analysis of the impact of the fall in allowed return as a percentage of total revenue on the change in realised returns in response to volatility in volumes. In general, this doubled the impact on realised returns, with a 2% change in volumes leading to an 18% change in realised returns under the RP2 revenue structure, but a 36% change in realised returns under the RP3 structure. In addition, we have calculated the impact of lower allowed return as a proportion of revenue on realised *equity returns*. Figure 30 shows that there is a material increase in variation in equity returns at RP3, relative to RP2. For example, where a 10% change in volumes previously led to a 75% change in realised equity returns, the impact with the RP3 cost and revenue structure is 96%.

Figure 30: Impact of lower allowed return on changes in realised equity returns



Source: Economic Insight calculations based on CAA data

Conclusion

Table 30 summarises our assessment using the risk framework. Overall, there are good reasons to expect higher systematic risk at RP3, including but not limited to the CAA's capex proposals. Across three of the four categories in our risk framework, we have identified strong evidence that systematic risk will be higher at RP3. We have not identified any good reasons as to expect lower systematic risk, as implied by the CAA's proposals.

Table 30: Changes in risk profile since RP2

Category		Change since RP2
Revenue	*Sales price risk*	Higher
	Volume risk	Higher
Cost		Similar
Cost and revenue structure		Higher

Source: Economic Insight

It is difficult to quantify the likely impact of higher sales price and volume risk on beta. We can, however, take a similar approach to the CMA to making adjustments for cost and revenue structure and increase the 0.505 beta from RP2 in proportion with the change in allowed return and depreciation as a share of total revenue between RP2 and RP3.[63] This indicates an increase in asset beta from 0.505 to 0.64 as set out in Table 31.

[63] *While the CMA used this approach to adjust for differences between companies, there is no reason in principle why it should not be used to adjust for differences in cost and revenue structure over time.*

Table 31: Beta determined at RP2

Parameter	RP2 value
RP2 beta	0.505
Allowed return and depreciation / gearing at RP2	41.3%
Allowed return and depreciation / gearing at RP3	30.4%
Implied adjustment	26.4%
Adjusted beta	0.64

Source: Economic Insight

4.3 Overall conclusion on beta

Bringing together the evidence from our comparator analysis and temporal analysis suggests the following.

- The comparator analysis implies an asset beta range of 0.53 to 0.63, depending on the estimation period and the weight attached to Aéroports de Paris versus ENAV.

- The temporal analysis suggests a material increase in asset beta relative to RP2. Adjusting for changes in the structure of costs and revenues alone implies an increase in beta to 0.64.

In our view, this evidence supports a range of 0.53 to 0.63, with a point estimate in the upper part of this range, at 0.60. This is because we place more weight on the higher beta estimates from the comparator analysis, as we have not adjusted for the impacts of lower ENAV systematic demand risk or airport capacity constraints. The value of 0.60 is also supported by the temporal analysis, which indicates a materially higher beta than at RP2.

Reconciliation with CAA's beta estimate

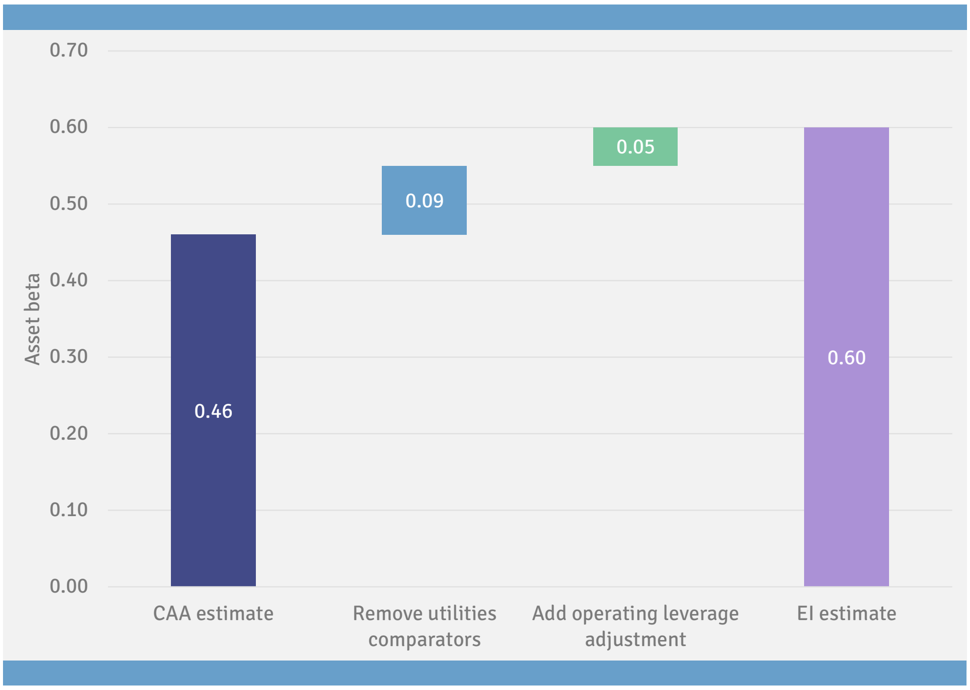
As we set out both in this report and in our cost of capital assurance review, we consider that the CAA's approach to beta incorporated several errors that led it to understate materially NERL's systematic risk. The most important of these errors are as follows:

- the CAA inappropriately included utilities companies as comparators, despite the fact that regulated networks are not exposed to volume risk and demand for utilities is less volatile than for air travel;
- the CAA did not fully reflect the important impact of operating leverage on systematic risk, despite precedent from the CMA on this matter;
- the CAA did not appropriately reflect the lower risk of some of ENAV's terminal services in its assessment; and
- for Eurozone comparators, the CAA placed too much weight on betas estimated using domestic benchmarks.

The CAA based its 0.46 asset beta point estimate on Europe Economics' analysis, with this value chosen as the lower end of a 'constraint range' based on utilities comparators (with the upper end of the constraint range based on airport comparators). Drawing these together, the 0.14 difference between our estimate and the CAA's comprises (i) approximately 0.9 from the removal of utilities comparators;

and (ii) approximately 0.05 from the application of an adjustment for operating leverage. We set this out in Figure 31.

Figure 31: Reconciliation with CAA beta analysis



Source: Economic Insight calculations

The CAA also drew on Europe Economics' analysis of ENAV's beta. Europe Economics concluded that ENAV's beta was 0.44 on a 'no adjustment' basis and 0.45 adjusted for differences in operating leverage and the risk profile of terminal services.

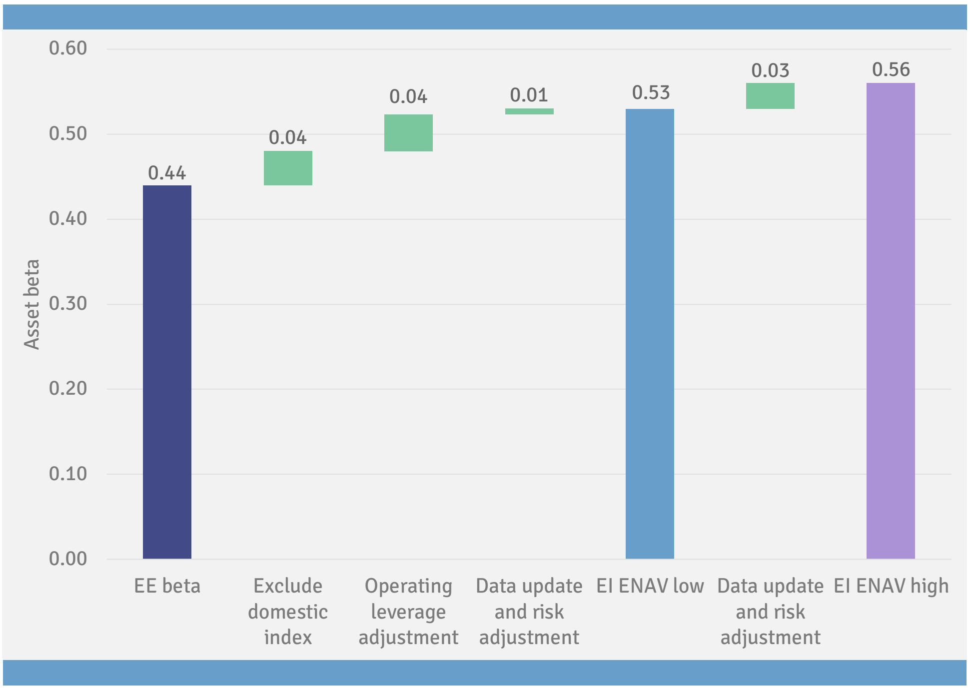
- The difference between Europe Economics' 0.44 'no adjustment' beta and our 0.53-0.56 estimated range based on ENAV comprises: (i) 0.04 from the exclusion of ENAV beta estimates based on domestic equity indices; (ii) 0.04 from the application of an adjustment for operating leverage; and (iii) 0.01 to 0.03 from updated data and the application of relative risk adjustments.[64]

- The difference between Europe Economics' 0.45 adjusted beta and our 0.53-0.56 estimate comprises: (i) 0.05 from the exclusion of ENAV beta estimates based on domestic equity indices; (ii) 0.02 from the removal of Europe Economics' downward adjustment for the relative risk of terminal services; and (iii) 0.01 to 0.03 from updated data and the application of relative risk adjustments.

We illustrate these reconciliations in Figure 32 and Figure 33.

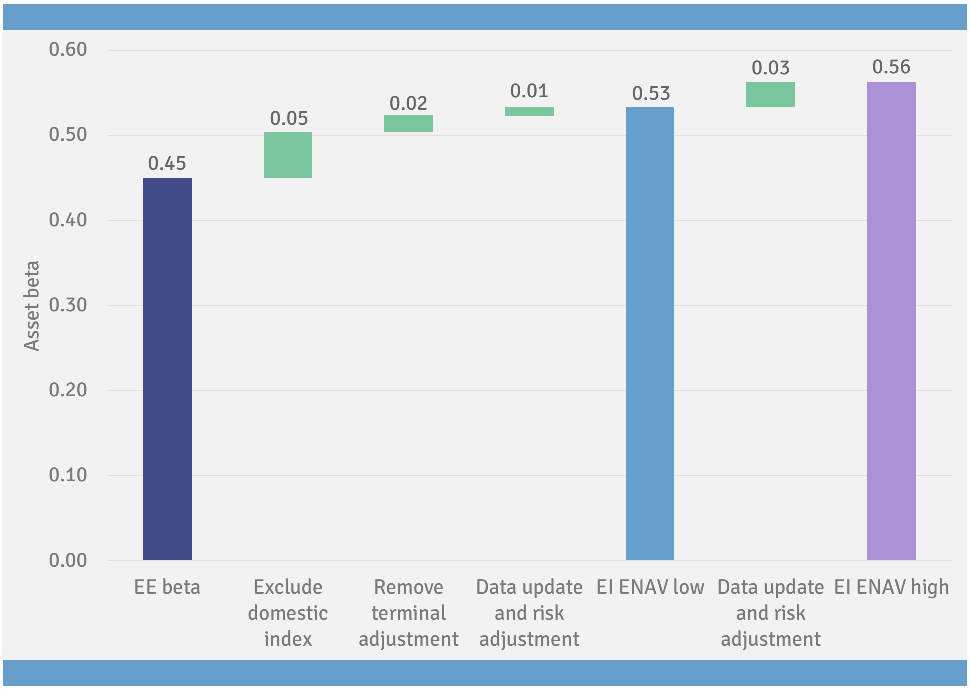
[64] *The impact of excluding domestic equity indices differs across the two reconciliations because these calculations start from slightly different beta estimates (0.44 and 0.45) and hold constant all other aspects of Europe Economics' calculations.*

Figure 32: Reconciliation with Europe Economics' 'no adjustment' ENAV beta



Source: Economic Insight calculations

Figure 33: Reconciliation with Europe Economics' adjusted ENAV beta



Source: Economic Insight calculations

5. Appendices

5.1 Regulation of listed airports

This section sets out research on the regulation applying to listed airport comparators.

5.1.1 Aéroports de Paris

Aéroports de Paris is regulated through a 5-year price cap.[65] Prices are capped through a 'base ceiling rate', which varies on a yearly pricing period basis. The base ceiling rate for each year is calculated as a fixed percentage increase from the price set in the previous year (1.25% for the price cap review beginning 2016), and further allowing for inflation (as measured by the percentage change in the consumer price index). The price cap may be adjusted based on observed passenger traffic in each pricing period. The regulator sets a predefined 'buffer zone' around the central future traffic projection made in each 5-year review. The upper and lower boundaries of this buffer zone are defined by traffic growth rates that are 50% above and below the regulator's central estimate. If traffic exceeds or falls short of the band, prices are adjusted. Specifically, 50% of the income surplus that results from the increase of passenger numbers above the upper band boundary, and 20% of the income loss that results from the decrease of passenger numbers below the lower band boundary, are offset by the price adjustments.

5.1.2 Aena

Aena is regulated through a 5-year price cap, which is set based on the recovery of expected costs[66]. This was introduced when private capital entered Aena's structure in February 2015. The Spanish Government controls 51% of Aena's share capital (through public company Enaire). The price cap is set through a 'building block' framework, whereby allowed revenue is set such that expected efficient costs can be recovered, alongside financing costs. This uses a RAB approach.

5.1.3 Auckland

Auckland Airport's aeronautical activities are subject to an information disclosure regulation.[67] These activities include: facilities to enable the landing and take-off of aircraft (i.e. runways and taxiways); terminal facilities for passengers; and aircraft maintenance facilities. Information that is required by the regulator includes:

- an "annual disclosure and monitoring of financial performance, quality (as measured by reliability measures, passenger satisfaction and operational improvement processes), capacity utilisation indicators and capital investment", and

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[65] *'Economic Regulation Agreement between the Government and Aéroports de Paris, 2016-20.'*
[66] *'Civil Airport Regulation Document 2017-2021.' Dirección General de Aviación (January 2017).*
[67] *See Auckland Airport website (https://corporate.aucklandairport.co.nz/investors/regulation)*

- "a price setting disclosure following the setting of standard aeronautical prices (every five years) which provides information on the basis for pricing and targeted returns".

The airport targets a "reasonable aeronautical return" (using a RAB approach) with prices set every 5 years and monitored by the regulator.

5.1.4 Copenhagen

Copenhagen Airport is not regulated by price cap regulation. Charges are negotiated with airlines and, in the absence of agreement, the regulator sets prices on the basis of 'reasonable returns' (though this has not so far been necessary). Denmark's aviation strategy suggests some changes to this model, though with its main features maintained.[68]

5.1.5 Frankfurt

Frankfurt Airport proposes its own charges, which are then investigated by its regulator. The charges that are subject to approval include[69]: "take-off and landing charges, including noise components and emission charges, parking charges, and passenger and security charges, as well as charges for the financing of passive noise abatement measures (noise surcharges)". Note, these regulated charges "accounted for 37.07% (previous year: 36.92%) of Fraport AG's revenue in the year under review". Changes to pricing can be proposed at any time, although in practice, this appears to occur once every couple of years. Recently, it was stated that "airport charges were increased by 1.9% as at January 1, 2017. The price adjustment was made only based on an increase in noise charges". The regulator approved this adjustment via the sole examination of this noise component[70].

5.1.6 Sydney

Sydney airport is not subject to price cap regulation, but is monitored closely on its prices, investments, costs, and quality of service[71]. The regulator prioritises "continued investment in aeronautical infrastructure", and therefore the primary reason for monitoring the airport is to ensure it does not abuse its market power[72]. A recent report by the Productivity Commission[73] regarding the regulation of Australian airports found that while the four major airports (including Sydney) carried market power, they did not systematically exercise this power to negative effect.

5.1.7 Vienna

Vienna airport is subject to a price cap that is applied to a basket of charges rather than an average per-passenger charge. It contains a basic risk adjustment mechanism, whereby the charges are adjusted on a scale that reflects the rate of growth of traffic.

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68 *See 'Aviation Strategy for Denmark': (https://www.trm.dk/en/publications/2017/aviation-strategy-for-denmark/)*
69 *'Fraport Annual Report 2018.'*
70 *See regulator's 2017 price adjustment approval (https://wirtschaft.hessen.de/verkehr/luftverkehr/reisen-arbeiten-informieren/daten-fakten/jahresbericht-zur-genehmigung-der)*
71 *'Airport monitoring report 2017-2018.' Australian Competition and Consumer Commission (February 2019).*
72 *See 'Economic Regulation of Airports.' Productivity Commission Inquiry Report (2019).*
73 *See 'Economic Regulation of Airports.' Productivity Commission Inquiry Report (2019).*

The airport's 2017 annual report[74] states: "the maximum change in the fee is calculated from the rate of inflation less 0.35-times the traffic growth. Traffic growth is calculated using the three-year average, with each twelve-month period running from 1 August to 31 July. If traffic growth is negative, the maximum fee adjustment is equal to the rate of inflation."

5.1.8 Zurich

Zurich Airport has a two-stage process for setting flight operation charges, the second of which involves the regulator[75]. In the first, the airport seeks to reach a negotiated price (for its aeronautical division) with its users. However, if this is not possible, the airport will submit a charge proposal to the regulator, which will be reviewed with necessary amendments made and the imposing of new charges. This is decision is made every 4 years[76]. Zurich Airport also has a transfer payment set by its regulator in the form of a cross-subsidisation from the commercial side (e.g. car parking, duty free shops) to its aeronautical business (30% of airport activities)[77].

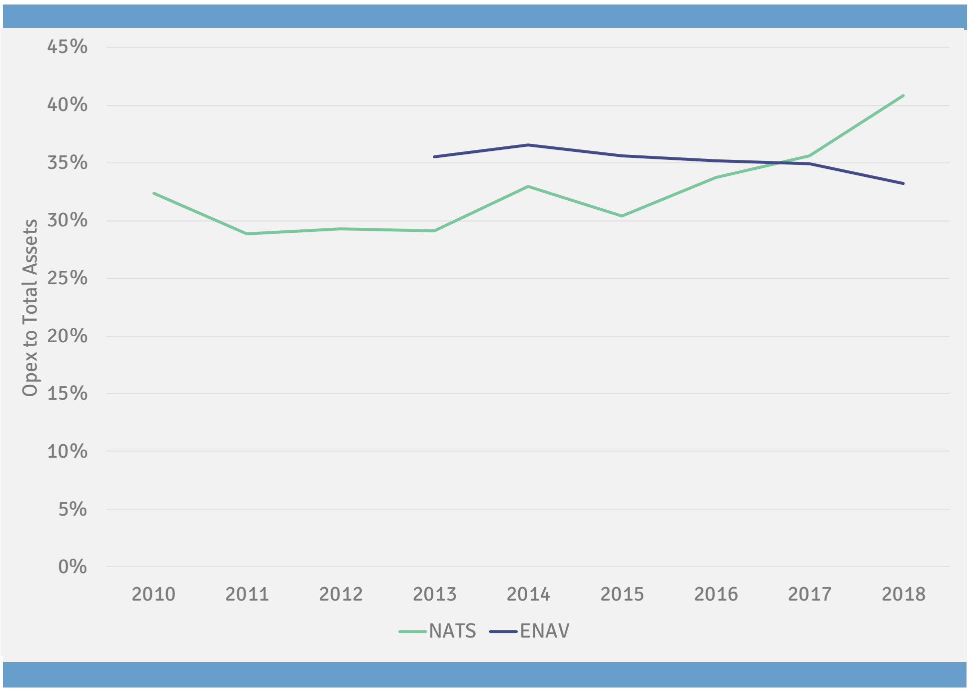
[74] *'Vienna Airport Annual Report 2017.'*
[75] *'Federal Administrative Court decides on charges at Zurich Airport.' International Law Office (October 2015).*
[76] *'Annual report of Flughafen Zurich AG 2016.'*
[77] *See https://www.zurich-airport.com/the-company/media/news-center/2019/jun/ir-20190614-flughafengebuehren?cat=IR*

5.2 Further evidence on operational intensity

5.2.1 ANSPs

Figure 34 compares ENAV and NERL with respect to the ratio of opex to total assets (opex to RAB for NERL) for the period 2010 to 2018. The figure shows that NERL's opex to total assets ratio was somewhat below ENAV's from 2013 to 2016, and somewhat higher from 2017 to 2018. Overall, however, NERL and ENAV are broadly similar across this metric.

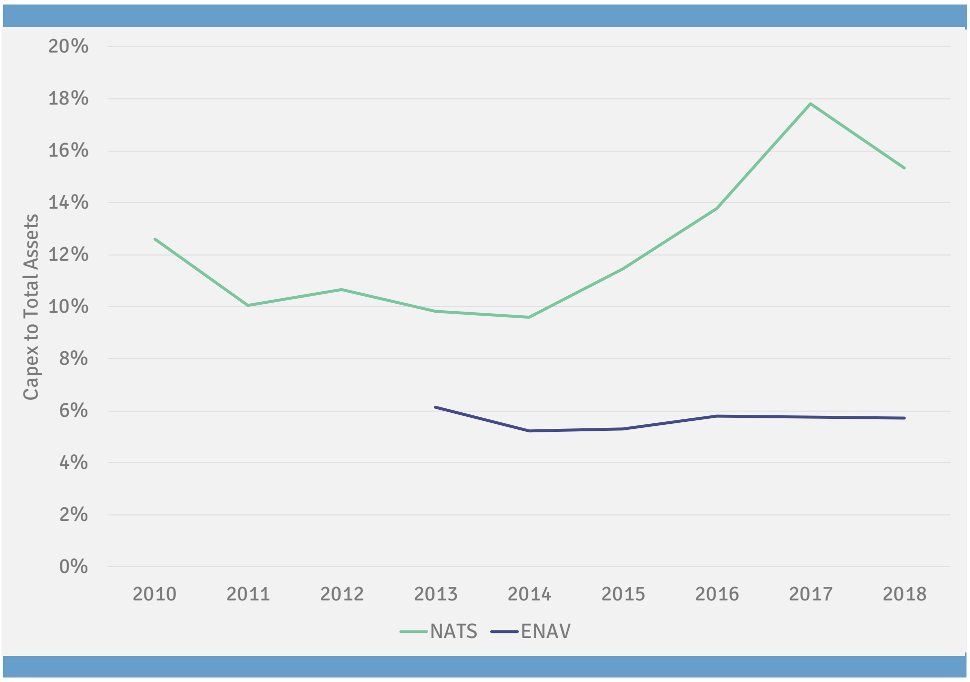
Figure 34: Opex to Total Assets (ANSPs)



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

Figure 35 compares ENAV and NERL with respect to the ratio of capex to total assets (capex to RAB for NERL) for the period 2010 to 2018. The figure shows that NERL has consistently had a higher ratio of capex to asset value. Specifically, NERL's ratio of capex to RAB has a range from just below 10% to nearly 18% since 2010, whereas ENAV's value has been around 6% over the period for which data is available. This metric therefore suggests that NERL has materially higher operational intensity than ENAV.

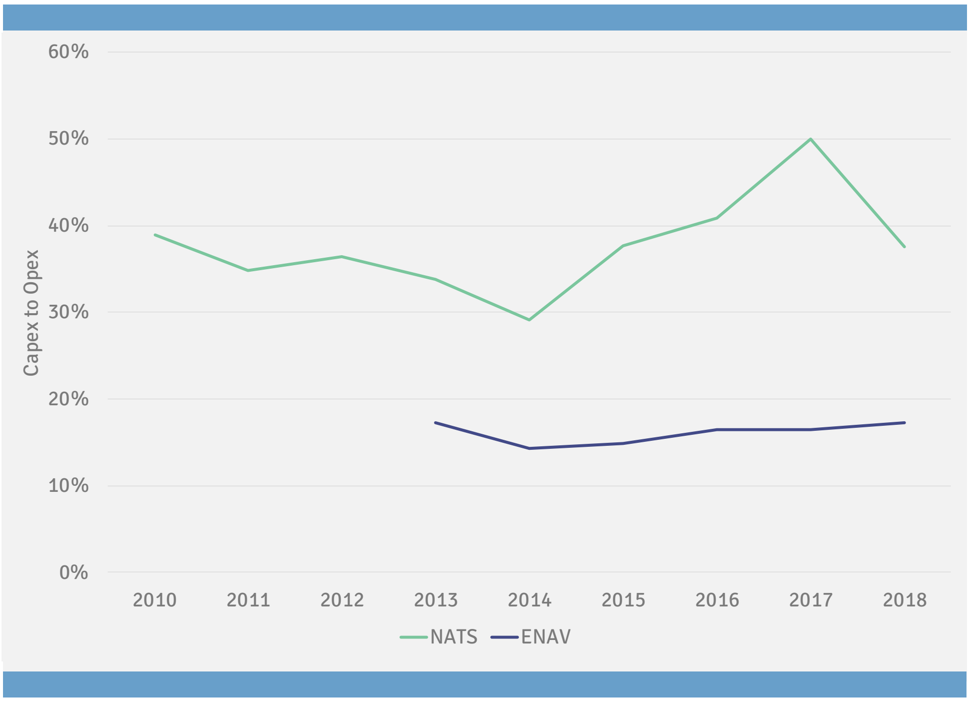
Figure 35: Capex to Total Assets (ANSPs)



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

Finally, Figure 36 compares ENAV and NERL with respect to the ratio of capex to opex. The figure shows that NERL has consistently had a higher ratio. Over the period since 2010, NERL's ratio of capex to opex has ranged from just less than 30% to around 50%, while ENAV's has consistently been below 20%. This metric therefore also suggests that NERL has materially higher operational intensity than ENAV.

Figure 36: Capex to Opex (ANSPs)

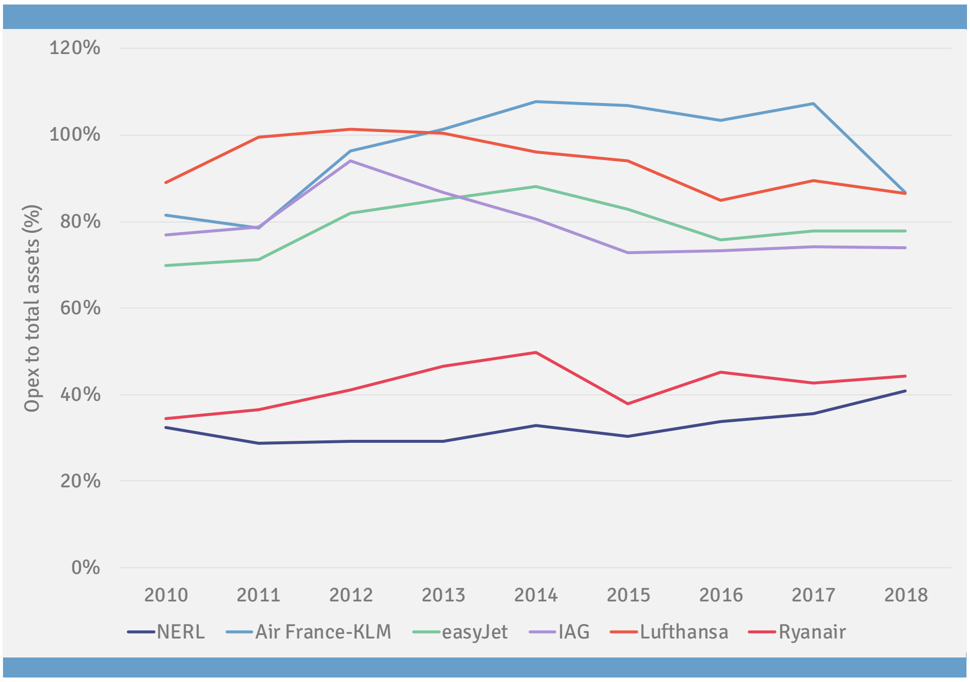


Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

5.2.2 Airlines

Figure 37 compares NERL and airline comparators with respect to the ratio of opex to total assets (opex to RAB for NERL) for 2018. The figure shows that NERL's ratio of opex to total assets is below all of the potential airline comparators (though of a similar magnitude to Ryanair), suggesting that NERL has lower operational gearing on this measure.

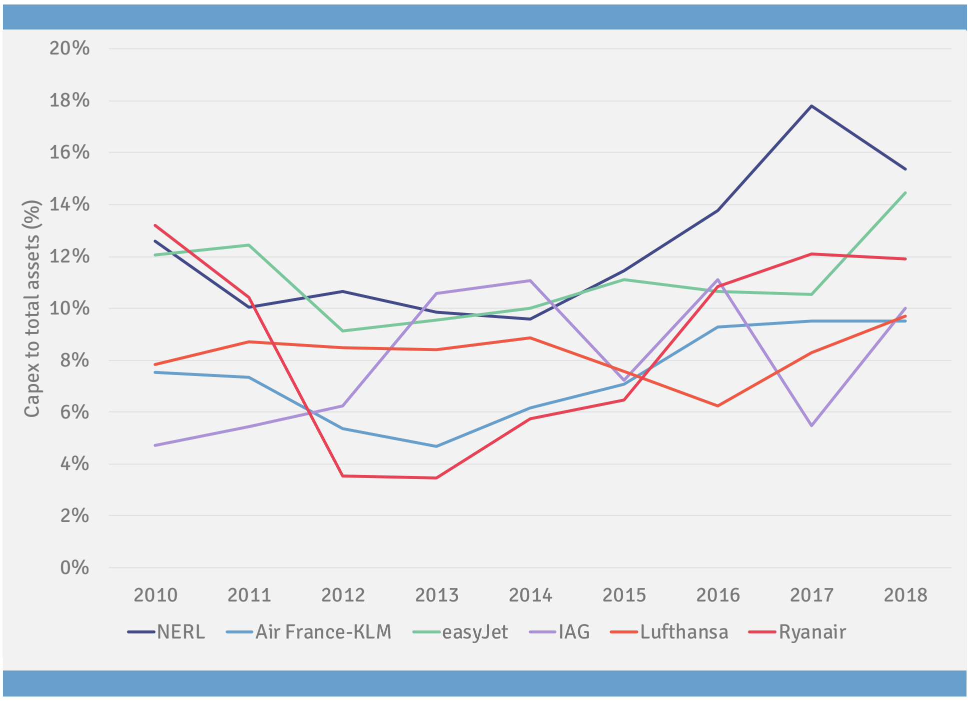
Figure 37: Opex to Total Assets (airlines)



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

Figure 38 compares NERL and the potential airline comparators with respect to the ratio of capex to total assets (capex to RAB for NERL). In contrast to the preceding measure of operational intensity, NERL's ratio of capex to total assets is higher than potential airline comparators at 15%, with figures for airlines ranging from 10% to 14%.

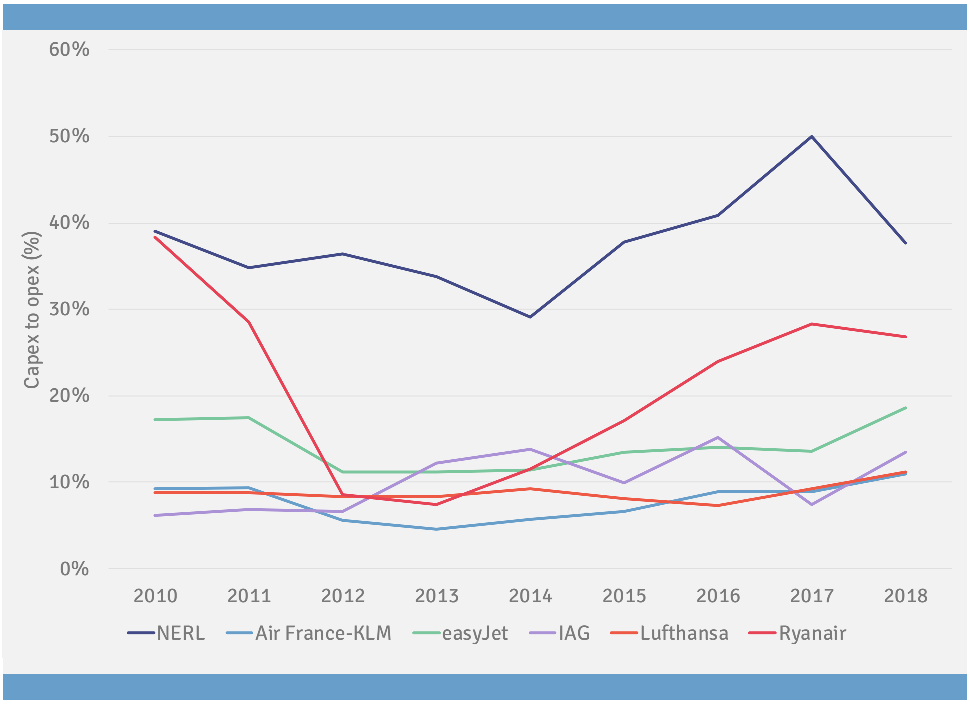
Figure 38: Capex to Total Assets (airlines)



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

Figure 39 compares NERL and the potential airline comparators with respect to the ratio of capex to opex. On this measure, NERL has materially higher operational intensity at 38%, compared to a range since 2012 of 11% to 27% for the airlines.

Figure 39: Capex to Opex (airlines)

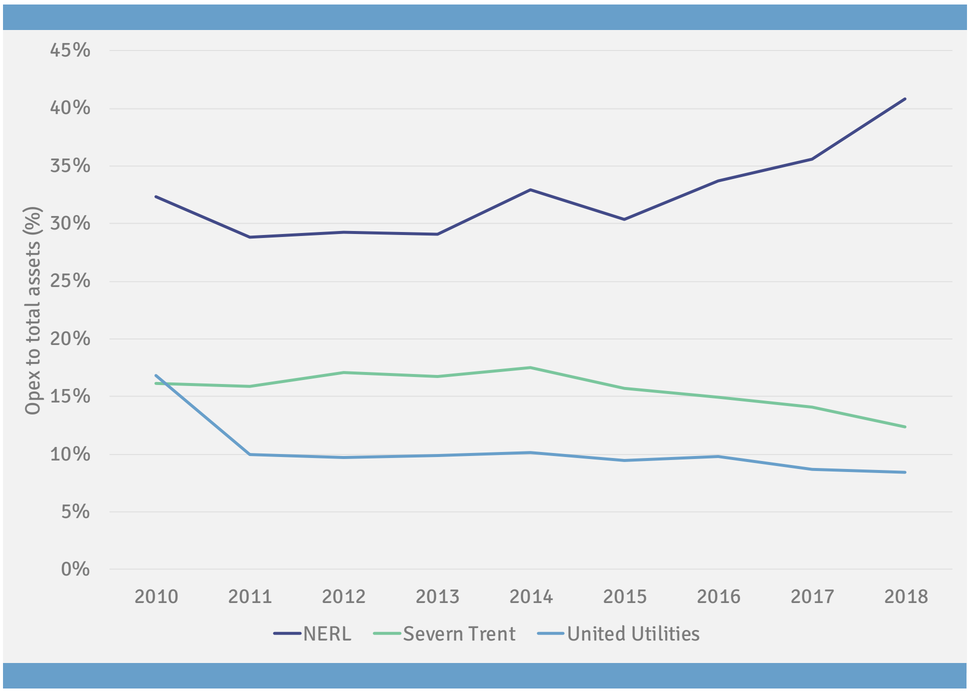


Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

5.2.3 Utilities

Figure 40 compares NERL and the potential utility comparators with respect to the ratio of opex to total assets. NERL's ratio of 41% is above the range for the network companies of 8%-17%.

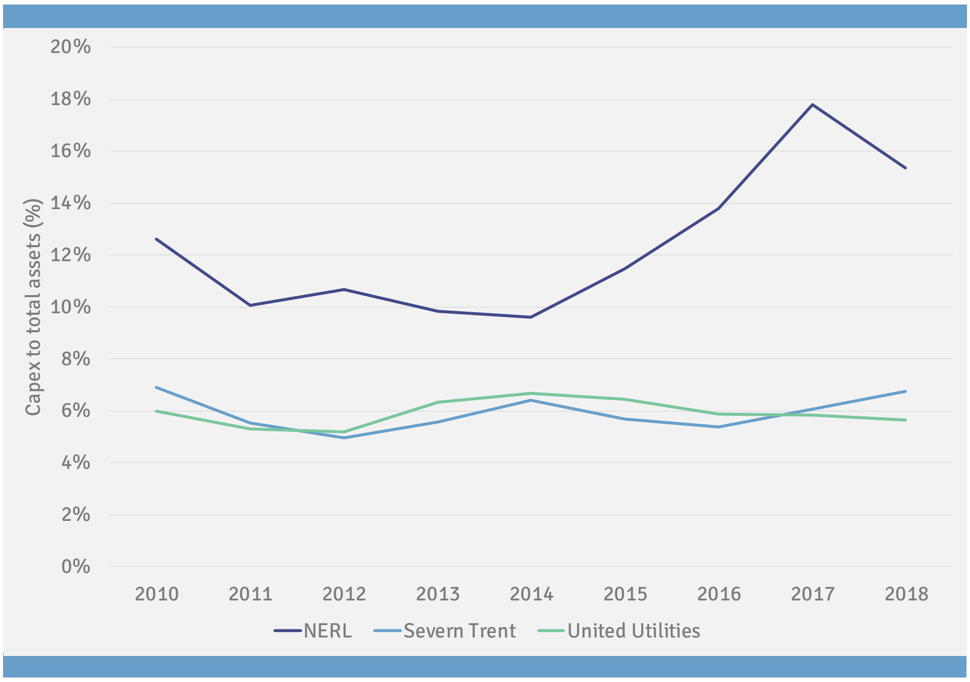
Figure 40: Opex to Total Assets (utilities)



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

Figure 41 compares NERL and the utility comparators with respect to the ratio of capex to total assets. On this measure, NERL appears to have higher operational intensity, with a ratio of 10-15% compared to values of around 6% for the water companies.

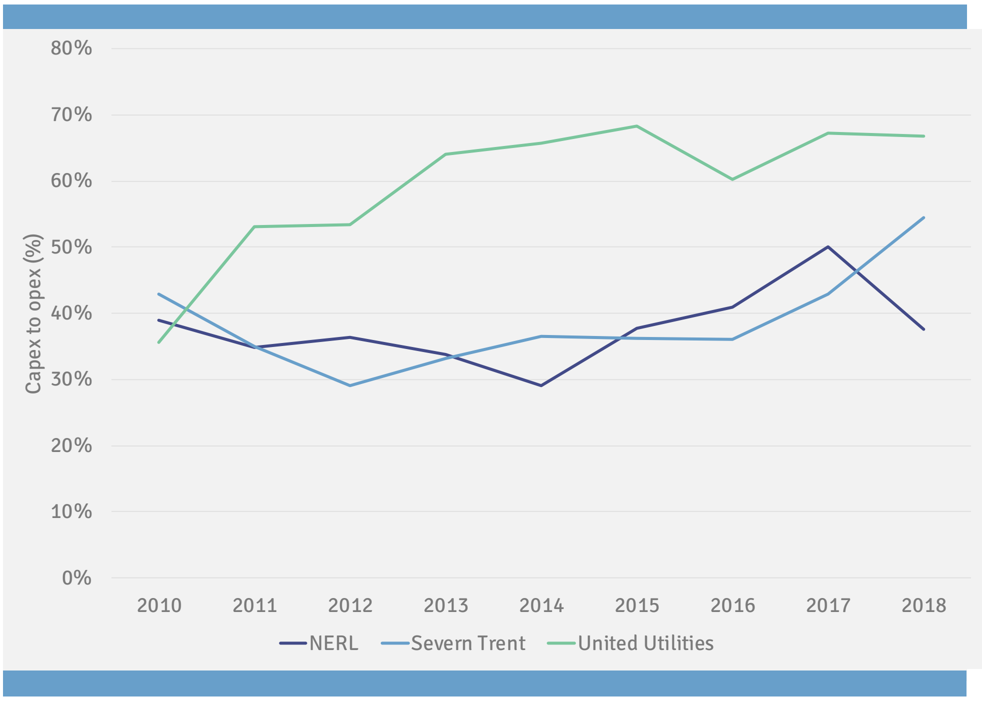
Figure 41: Capex to Total Assets (utilities)



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

Finally, Figure 42 compares NERL and the utility companies with respect to the ratio of capex to opex. The picture is mixed, with NERL's ratio lying below United Utilities', but around the same level as Severn Trent for most of the period.

Figure 42: Capex to Opex (utilities)



Source: Thomson Reuters, NERL Regulatory Accounts and Economic Insight calculations

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