Europe Economics

Advice on the application of long run incremental cost estimates for Gatwick and Stansted

Final Report

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Introduction

This report has been prepared for the Civil Aviation Authority (CAA) by Europe Economics with the assistance on airport planning and related matters of MSP Solutions.

Our terms of reference are to review the various approaches taken to the calculation of Long Run Incremental Cost (LRIC) in the aviation sector and other regulated sectors; estimate LRIC for Gatwick and Stansted; identify the advantages and disadvantages of using a LRIC based approach to inform estimates of the competitive price for Gatwick and Stansted; and identify the advantages and disadvantages of using a LRIC based approach to set price caps, in particular if used as a transition to greater competition in the aviation sector.

We make no assessment of whether or not Stansted or Gatwick has significant market power; that issue is being addressed separately by the CAA. Here we analyse the advantages and disadvantages of a LRIC approach on alternative assumptions about the extent of market power.

LRIC in regulation

For economic regulators seeking to regulate the charges or revenues of suppliers with significant market power, a way of assessing the level charges that would be expected in a normally competitive market is an essential requirement. In a normally competitive market, prices will equal costs that would be incurred by a normally efficient firm, including as part of costs a normal return on capital.[1] Estimating the long run incremental costs (LRIC) is one way of assessing these costs.

The essential feature of a LRIC based approach is that a direct attempt is made to estimate the long run costs that would be incurred by a normally efficient competitor or entrant to the market. This means that assets are valued at the current cost of acquiring an asset that would supply the services defined using modern technology (modern equivalent asset (MEA) valuations) and efficient operating methods. The advantage of this approach is less relevant in the airports sector, where entry and expansion can be, as in the case of South East England, driven less by price signals and more by government planning strategy.

In systems using LRIC, the term "increment" is often but not always applied to the part of total output whose charges are to be regulated. The increment may be all supplies to a defined market (a 'whole service' increment), or an increase or reduction ("decrement") in the volumes supplied (a 'capacity' or 'volume' increment).

The circumstances in which price controls based on LRIC are used are:

- There is significant market power, and *ex ante* regulation of charges or revenues is justified.
- There is a realistic prospect of efficient competitive entry to the market and policy-makers prefer to base expansions of capacity on competition rather than planning control and Government decision-taking. In this case whole-service increments may be preferred.
- Alternatively, there are important bottlenecks in supply (e.g. at times of peak demand), and it is important to allow suppliers to charge the full economic cost for those particular supplies so that they have appropriate signals to invest. In this case, a combined approach might be appropriate with

[1]These may also be thought of as the costs that could be avoided by not supplying the goods or services in question,

estimates of the LRIC of increases in supply at peak times being used to set charges for peak use while overall revenues are subject to a RAB-based limit to prevent excessive overall returns.

Review of LRIC in other sectors

In principle, the most accurate LRIC estimates are made through a 'bottom up' approach, in which an estimate is made of the most efficient methods that would be used by an efficient entrant to the sector, using modern technology and operating methods. This is the approach that would be taken by competitors entering an unregulated market. An alternative approach is to make a "top down" estimate, beginning with the existing assets and operating methods, and correcting them for known inefficiencies. In a top down approach, assets are re-valued on the basis of modern equivalent assets.

The bottom up approach is superior in principle, because it is less likely to assume a continuation of current possible inefficiencies. On the other hand, a large element of professional judgement is required for bottom up estimates, and there is correspondingly great scope for argument, all of which adds to the costs of regulation. Sometimes both approaches are used, and the results compared (a "hybrid" model may result from this process).

In telecommunications termination rate markets the increment is defined as the whole service which is subject to regulation. The relevant costs are considered as the difference between the costs of the operator's total services with the termination service, and the costs of the operator's total services without the termination service. These are the directly attributable, avoidable costs of the service, and in the UK there is no allocation of common costs. In the fixed access market the increment is also the avoidable cost of the whole service (in our case study, the local unbundled copper loop) but in this a case a share of costs common to other services provided by the operator is also included ("LRIC +").

In the electricity case study the increment is the additional generation, and the LRIC is made up of the necessary costs of reinforcing a branch to accommodate the increase in power flow. In the gas example, the increment is expanding the network pipeline to transport 1GWh of gas over 1km.

These examples show that where LRIC is used to set prices for a service as a whole, that service is defined as the relevant increment. This is used as a regulatory approach in order to send the right signals for investment, innovation and entry by efficient new entrants. Where a smaller increment is used (an increase in capacity) then the LRIC is used to structure the charges relating to that increment but these estimates are not then used to set overall revenue limits.[2]

Review of LRIC in the airports sector

CAA and Competition Commission work

We reviewed the work carried out by the CAA and the Competition Commission (CC) in 2008 in the context of the Stansted price control review.

The CAA had concerns about the RAB-based approach, in particular the incentives for investment, and thought that LRAIC-based regulation might provide a closer approximation to the incentives present in a competitive market. The CAA proposed a number of options, two of which were based on a LRAIC approach.

[2] LRIC is not used directly by Ofgem to regulate prices in gas and electricity markets (where a regulatory asset value, or RAV, based approach is used), but is used by electricity distribution operators (DNOs) and the electricity transmission owner (TO) to structure their charges based on either location or peak usage.

The CC's main concern with these proposals was the form of the price caps that assumed a level of competitive pressure that the CC did not believe was applicable to Stansted.[3] The CC was not opposed to LRAIC-based approaches *per se*: even under the assumption of market power at Stansted the CC considered a price cap set directly at LRAIC could be suitable in theory.

The CC did however raise a number of general concerns about setting price caps directly at LRAIC, which included difficulties in defining an appropriate increment; the need to find a suitable efficient benchmark in a heterogeneous sector; the difficulty in obtaining robust data, particularly in relation to long-term forecasts; and the need for long-term regulatory commitment to a cap set at LRAIC to enable firms to recover their costs over the long run.[4]

Our own modelling work revealed similar difficulties and we agree with the CC that the dynamic efficiency benefits of a LRIC approach are reduced by the nature of the airports sector, whereby entry and expansion is influenced more by government planning than competitive price signals.

The CC also raised the issue of uncertainty of remuneration of investment under a LRIC approach. Whilst this may be the case, a LRIC system provides better incentives for efficient investment as operators will be exposed to the risk of their assets becoming redundant if they do not take account of technological advancements or market developments.

LRIC models

To complement our theoretical review, we conducted four modelling exercises:

- A review of the CAA model used to estimate LRAIC for Stansted in 2008
- A review of a LRAIC model developed for Gatwick in 2011/12 by FTI Consulting
- The development of a LRAIC model for Stansted, based on available data
- The development of a LRAIC model for Gatwick, based on available data

The CAA model of Stansted

The CAA model considered only one increment - an increase in capacity at the time when the existing capacity at Stansted (35 million passengers per year, or mppa) becomes binding. The costs were based on Stansted plans for an additional runway and terminal facilities (SG2), and the incremental volume was assumed to be 35mppa. The LRAIC estimates based in this expansion in capacity were used to inform the competitive price level at Stansted at the time.

Our analysis on the model highlights the model's sensitivity to changes in traffic forecasts (in particular a fall in demand), and to construction periods, both which have the effect of delaying the arrival of incremental passengers and increasing the costs of the investment relative to the additional volumes.

FTI Consulting's Gatwick model

The Gatwick model developed by FTI Consulting considers three increments: a small increase in capacity for an additional eight to 10 mppa; a significant increase in capacity with a new runway and terminal for an additional 27-37mppa, and a replacement airport based on the current configuration of Gatwick.

In the context of FTI's model, the purpose of the LRAIC calculations is to provide price benchmarks against which to compare the current price cap. The assumption is made that the LRAIC estimates represent the competitive price level.

[3] Competition Commission 'Assessment of LRAIC-based price cap within the Stansted Inquiry', 2008, page 2
[4] Competition Commission 'Assessment of LRAIC-based price cap within the Stansted Inquiry', 2008

The relevance of the LRAIC of a second runway would depend on willingness to pay for the additional capacity.[5] If an airport has market power, then there is a danger in using a (higher) LRIC for the increment to set average process at the airport as a whole as the airport could inflate the costs or need for the expansion and use its market power over existing customers to extract higher prices (as in a RAB-based approach).

In our view, the relevant increment to LRIC calculations is the service or product for which prices are to be determined.[6] In the context of Gatwick Airport this is the airport as a whole — Increment 3. However, estimates should be of the costs of the most modern, efficient airport configuration, using modern equivalent asset valuations rather than the costs of replacing the existing airport.

We reviewed the inputs used in the model and the general approach. In some cases the inputs and assumptions used result in both higher (e.g. the level of capex) and lower (e.g. the way in which incremental passengers been modelled) LRAIC estimates than might have been expected.

Our sensitivity analysis also shows that this model is also sensitive to changes in capital costs and demand forecasts.

Our Stansted model

Our Stansted model incorporates four increments. These are: an increase in capacity from 25mppa to 35mppa (based on SG1 plans – 2006); a larger increase in capacity from 35mppa to 70mppa with a new runway and associated terminal facilities (based on SG2 – 2008); a small amount of investment to bring existing capacity into full utilisation (based on current plans – 2011); and a whole service increment of the whole airport. We note that as we have not conducted a full MEA valuation of a replacement airport this increment cannot be considered a 'full' LRIC estimate.[7]

Increment 1 is divided into two sub-increments, 1(a) including only those projects from SG1 that we considered necessary to increase capacity, and 1(b) including all SG1 plans.

The LRAIC per passenger are shown in the tables below.

Table 1: Stansted LRAIC costs per passenger, 2011/12 prices

	Increment 1(a) (2006)	Increment 1(b) (2006)	Increment 2 (2008)	Increment 3 (2011)	Increment 4
LRAIC (£/pax)	1.8	6.1	8.5	0.8	6.3

As the table shows, the LRAIC per additional passenger is highest for Increment 2 at £8.5 (the additional runway), followed by Increment 4 (the replacement airport) Increment 1(b) (the full SG1 investment plan) at just over £6. Increment 1(a) and Increment 3 are the smallest, at £1.8 and £0.8 respectively. This is due to the very small capital expenditure attributed to the increase in capacity from 25mppa to 35mppa.

The model results highlight the importance of the definition of the increment, in particular obtaining a realistic relationship between costs and additional volumes. The results also highlight the sensitivity of LRAIC calculations to capital expenditure estimates. Increments 1(a) and (b) are very similar save for the capital projects included, and the estimates for 1(b) are significantly higher than for 1(a).

[5] Even if there is a capacity shortage in the South East, the locational differences between the airports and planning barriers make it impossible to assume that the demand for additional capacity must equal the demand for additional capacity at Gatwick.

[6] For example in telecoms the whole termination service; in electricity, the peak capacity flows.

[7] Our approach was to index the fixed assets in Stansted's statutory accounts to COPI over the years 1991 – 2011. We have made no adjustments for efficiency.

Our Gatwick model

Our Gatwick model incorporates three increments. These are an increase in capacity to cater for an additional 10mppa with a capital cost of around £1.26bn in 2011/12 prices; a new runway and terminal facilities to cater for an additional 35mppa with a capital cost of £2.3 billion in 2011.12 prices; and a replacement cost increment for the airport as a whole using estimates of the modern equivalent value of Gatwick's existing fixed assets. The total cost is estimated at £3.74 billion, with a capacity of 35mppa. A variation of this final increment includes a lower capital expenditure of £3.23 billion.

The LRAIC per passenger are presented in the table below:

Table 2: Gatwick LRAIC model results, 2011/12 prices

	Increment 1	Increment 2	Increment 3	Increment 3(b)
LRAIC (£/pax)	16.9	17.0	10.60	8.4

We note that as we have not undertaken a full assessment of the modern equivalent value of assets that would be required to provide the whole airport (most likely entailing a new configuration) our estimates for Increment 3 cannot be considered a full LRAIC estimate.

The use of LRIC in the airports sector to assess the competitive price level

The fundamental characteristic of LRAIC is to estimate the costs that determine prices in a normally competitive market, namely the forward-looking avoidable costs of supply. The specific nature of the airports sector means entry and expansion is restricted and controlled by government planning procedures, but there could nevertheless be value in assessing the competitive price level of the airport services provided by Stansted and Gatwick.

In using LRAIC for this purpose three different types of increment may be considered:

a) Small expenditures that allow fuller utilisation of existing runways and terminal buildings.

b) Additional runways and/or terminal buildings to give a major expansion of capacity.

c) A new airport, notionally replacing Stansted or Gatwick, with similar or expanded capacity to the present planned capacity and service levels, but using modern techniques and the most efficient configuration of runways, terminals and other facilities.

Type (c) is more relevant for assessing the competitive price level, since there is established demand at each airport. In using this increment it is necessary to establish what an efficient and modern airport configuration would be like in each location; and the associated costs. Assumptions would need to be made regarding the configuration of the terminal buildings and runway(s), land values, connections to utilities and transport, construction and material costs, the quality levels (including an assumption about the main types of airline customers), associated non-regulated revenues, and operating costs. As Stansted is a relatively new airport, these problems may be less severe in its case.

The use of LRIC in the airports sector to set price caps

As above, we consider the whole airport increment the most relevant to setting prices. Using other increments could have significant disadvantages

If a whole airport increment were used, a LRIC based approach could give prices closer to those of a competitive market than prices set on the basis of an historic cost RAB. As the CC noted, this would help by "providing the appropriate signals to the market to foster efficient entry, investment and innovation."

With regard to entry, the particular circumstances of airports significantly reduce this advantage as this is driven more by government planning and less by price signals. However, setting the prices at Stansted and Gatwick at competitive market price levels would avoid distorting competition between them and other airports, and the correct signals would be given to all concerned in the related markets, helping (as the CC noted) to encourage innovation and efficient use of resources.[8]

The practical disadvantages of using LRIC (even using the whole airport increment) include its unfamiliarity and hence a risk that it would reduce regulatory certainty. It would also involve the greater uncertainty that is inherent in making assessments of the efficient levels and types of investment instead of using historic cost values of what was spent. A larger element of judgement would be involved in estimating these costs, and therefore there would be more scope for argument. The costs of the regulatory system would almost certainly be higher, and the airport owners would face greater risks, perhaps increasing their required rate of return from any future investment.

We consider the practical disadvantages of applying a LRIC methodology to airports may be reduced, and much of the value of LRIC estimates obtained, by using MEA valuations of the RAB in place of the present indexed historic cost estimates. We have made a start towards this, based on indexation of the historic costs of assets currently included in the RAB.

[8] Although it may not be apparent now, there may be many related markets that use airport price signals, including new markets relevant to innovation.

1 Introduction

This report has been prepared by Europe Economics with the assistance on airport planning and related matters of MSP Solutions.

1.1 Terms of reference

Our terms of reference are to:

- Review the various approaches taken to the calculation of Long Run Incremental Cost (LRIC) in the aviation sector (in particular the Competition Commission (CC) and CAA's work in the 2008 price control review for Stansted) and other regulated sectors namely the telecommunications, gas and electricity sectors. This includes an analysis of existing LRIC calculations for Gatwick airport.
- Estimate LRIC for Gatwick and Stansted, using available data.
- Identify the advantages and disadvantages of using a LRIC based approach to inform estimates of the competitive price for Gatwick and Stansted.
- Identify the advantages and disadvantages of using a LRIC based approach to set price caps, in particular if used as a transition to greater competition in the aviation sector.

We make no assessment of whether or not Stansted or Gatwick has significant market power; that issue is being addressed separately by the CAA. Here we analyse the advantages and disadvantages of a LRIC approach on alternative assumptions about the extent of market power.

LRIC is a method of estimating costs for regulatory purposes, not a system of regulation. There are indeed a number of different regulatory systems that incorporate elements of both a Regulatory Asset Base (RAB), which is a principal alternative to LRIC, and of a LRIC system.

We therefore begin this report with an outline of the basic reasoning underlying different systems, and define some key terms.

1.2 LRIC in regulation – basic theory and terminology

An economic regulator should not seek to regulate charges or revenues of suppliers unless the suppliers possess significant market power (SMP) and it would be better to apply *ex ante* regulation to the supplier than to rely on competition law remedies.

Where limits on charges or revenues have to be set the regulator will in general try to set such limits at the same level that would be expected if the supplier were subject to a normal degree of competitive pressure. This idea rests on the economic argument that such regulation should minimise the distortions in the economy resulting from the monopoly position, and is generally embodied in the statutory duties of UK economic regulators (and in EU legislation) through requirements to protect the interests of consumers, which include suppliers operating efficiently. Our reading is that this objective applies to the CAA under present legislation and will continue to do so under the new Act.

Similar duties apply to regulators that use LRIC and to those that use RAB-based methodologies.

Our understanding is that the same principle is basic to competition law, as applied to cases in which allegations are made of excessive charging by a firm in a dominant position (under Article 102 and

equivalent domestic legislation). Excessive charging would be regarded under competition law as charging that significantly exceeds the levels of charge that would be expected in a normally competitive market.

Thus for regulatory purposes the essential requirement is a way of assessing the level of charges that would be expected in a normally competitive market. The fact that different methods of estimating such costs are used by different regulators does not in general come from any important difference in regulatory objectives, but from differences in other circumstances.[9]

In a normally competitive market, prices will equal costs that would be incurred by a normally efficient firm, including as part of costs a normal return on capital.[10] Clearly, part of being normally competitive is having customers wishing to purchase at prices that allow a profit.

These costs will be those incurred over the long term, as otherwise the supplies would not be continued.

If all of the services provided by the supplier are to be subject to price controls then the total costs of supply need to be covered. However, if only some of the services need to be regulated, or if the regulator needs to apply separate price controls in more than one market supplied by the regulated firm, the costs that are relevant for regulation are the costs of those services (plus, where appropriate, any allocation of common costs).

The first essential step is therefore to define the goods or the services whose costs are to be estimated.

In systems using LRIC the term "increment" is usually applied to the part of total output whose charges are to be regulated.[11]

The increment may be all supplies to a defined market, as is normally the case in telecommunications regulation, or an increase or reduction ("decrement") in the volumes supplied.

Where a firm supplies more than one type of service, some of its costs may be incurred for more than one service. These are the common costs. Costs that are caused by one service and would not be incurred for other purposes are the directly attributable costs of the service.

"Pure LRIC" applied to specific services of a firm, as applied in some telecommunications regulation (e.g. for determining interconnection charges) does not include a contribution to the common costs of the firm. If some of the common costs also need to be recovered from the service in question, then the relevant costs for regulation are "LRIC +" a contribution to common costs.

If the whole of the output of the supplier is to be regulated as a single service, then there is no longer a distinction between common costs and incremental costs — all costs represent the avoidable costs of supply, and thus the approach is pure LRIC.

Where the increment is an increase or reduction in the volumes supplied (for example, adding x per cent to output) it too may be relevant for regulation. For example, estimates of this sort are used to set the charges paid by electricity generators for use of the transmission system at times of peak load. The companies calculate the costs of the additional capacity that is needed to allow the additional generator's use of the system to be accommodated. Such charges may be combined with an overall revenue target or limit calculated using RAB methodology.

[9] Statutory objectives naturally reflect different circumstances to some extent.

[10] These may also be thought of as the costs that could be avoided by not supplying the goods or services in question, because those are the costs relevant to decision-taking in a competitive market. Avoidable costs are also referred to as opportunity costs since they measure the value of opportunities that have to be foregone as a result of incurring the costs.

[11] An exception would be a system in which the cost of an alteration in quantities supplied was used to estimate the cost of all supplies.

Long run average incremental costs (LRAIC) are LRIC divided by a measure of units of output, or an average of estimates for different years. These are two sorts of average: average per passenger (or other unit of output), or average of years. Both are relevant, and they may be combined (e.g. average charge per passenger over the years X to Y).

Whatever the definition of increment, and whatever the treatment of common costs, LRIC are by definition the avoidable costs resulting from continuation in the long term of supply of a defined increment, assessed as the costs that would be incurred by an efficient supplier, measuring efficiency by normal competitive standards. They are necessarily forward-looking and incurred over a number of years, and so need to be brought to a present value by discounting costs in future years at an appropriate interest rate.

There are two main ways of assessing the levels of efficiency to be assumed: "Bottom up" and "Top down". In a bottom up estimation, engineering and business consultants estimate what an efficient business entering the market would need to do in order to supply the service in question. In a top down estimation the starting point is the level of costs currently being incurred by the business whose charges are to be regulated, and these are adjusted to exclude any recognised inefficiencies (such as assets no longer needed but remaining on the books). Either of these approaches can produce the LRIC estimates that are required and it may be useful to carry out both exercises and compare the results.[12] In both cases, reasoned judgements will be needed about future trends in productivity, real wages, and relative prices of other significant inputs and these may be informed by comparisons with other businesses ("benchmarking" exercises).

1.3 RAB

A Regulatory Asset Base (RAB), also sometimes referred to as Regulatory Asset Value (RAV), is the estimated value of the assets used to supply regulated services. The estimate may be use a number of alternative accounting conventions but is generally assumed to be based to a large extent on the historic cost (HC) of the amounts actually spent in acquiring the assets. In this sense it is necessarily a "backward looking" approach.

In order to base forward-looking price controls on a RAB, the value at the start of a regulatory period has to be combined with forecasts, and estimates made of depreciation and other costs of capital over the relevant period.

The formulae generally used for setting prices for the regulatory period (e.g. the following five or eight years) may be summarised as follows:

> RAB (incorporating both initial assets and relevant capital expenditure (capex) during the period) * rate of return allowed
>
> + forecast depreciation over the period[13]
>
> + forecast opex
>
> – forecast revenues from connected but unregulated activities (in a "single till" system)
>
> = total net costs = total revenues to be earned at assumed levels of efficiency and demand.

The business case for incurring new capital expenditure and the regulator's decision whether to accept it as a part of the cost to be remunerated through regulated charges will be based on the assessment of the costs and benefits of the investment in question over the expected lifetime of the asset. This is the case irrespective of the regulatory periods for which prices are set, or of whether LRIC or RAB methodologies

[12] When this is done, the resulting estimates are sometimes referred to as "hybrid".
[13] This involves an estimate of the asset values at the end of the period.

are used. In airports, the regulator may need to be less involved if airlines support and are willing to pay for capital projects through airport charges, or if the Government makes the decision as a strategic matter that more capacity is needed.

Where long term investments are involved, perhaps stretching over much longer periods than are used for setting charging limits, and perhaps involving over-sizing to allow for possible future growth in demand, a decision will be needed about the extent (if any) to which current charges should include the costs of capacity from which future users are expected to benefit. This issue too needs to be decided irrespective of whether LRIC or RAB-based methodologies are used (although again the issue is likely to be more marked in sectors other than airports, where dialogue between airlines and airports provides useful information, and where a move to LRIC would involve additional issues for the regulator).

In a RAB system the forecasts made for the purpose of setting price limits for a regulatory period include or imply a forecast value of RAB at the end of the period. This forecast value will be subject to adjustments according to how capex and other factors in fact develop, but a degree of regulatory certainty is provided by setting out the rules according to which RAB will be adjusted.

1.4 Differences between a RAB-based approach and a LRIC-based approach to setting price limits

Before describing the differences between a RAB-based approach and a LRIC-based approach to setting price limits, the wide variety of methods used by different regulators should be stressed. In comparing LRIC with RAB-based approach, it is important to be clear about the essential features of each approach to cost estimation, and which other regulatory issues may be common to both.[14]

Issues that are common to both RAB and LRIC based regulatory approaches include that in either case the regulator needs to decide:

- Which goods or services need to be subject to price limits
- The period for which prices should be set.
- What levels of efficiency to assume for the period of the price control, for all types of expenditure.
- What rate of return is required, taking due account of risks involved in the business, and what financing arrangements are to be assumed (or required) to ensure financeability of the business.
- What changes in input prices are to be assumed.
- Whether any cost items are to be allowed to be passed through as incurred, e.g. because they are substantially outside the regulated business' control.
- What asset lives are to be assumed for capital assets, and what time profile should be assumed for depreciation.
- The timing of recovery of costs through charges (whether charges below the regulated limits create "unused" pricing capacity that can be carried forward from one year to another, and from one regulatory period to another; and the extent to which charges can be increased to help pay for capex which will not yield benefits for consumers for some time).

The essential feature of a LRIC based approach is that a direct attempt is made to estimate the long run costs that would be incurred by a normally efficient competitor or entrant to the market. This means that assets are valued at the current cost of acquiring an asset that would supply the services defined using

[14]If one wanted to compare petrol driven cars with cars with diesel engines it would not be useful to consider differences in size, colour, make, trim, etc.

modern technology and modern equivalent asset (MEA) asset valuations. This is the case regardless of the increment defined.

The essential feature of a RAB approach is that an existing asset base is valued, and a return on it (and on any additions to it) is allowed as a cost of supply for regulatory price control purposes. As we have noted, this valuation would normally be based on the historic cost of the assets (in the case of CAA, adjusted for inflation), and this is the current baseline for the CAA's approach.[15] Where modern equivalent asset (MEA) valuations are used the differences between cost estimates based on RAB and LRIC are significantly reduced.

This last point is important:

- In a RAB approach in which existing assets are valued at depreciated historic cost (even if adjusted for inflation), price limits would reflect this, and the method can fairly be called backward-looking. A RAB approach also needs to deal with investment plans and other expected expenditures over the coming control period for which price limits are to be set, so it has a forward-looking aspect too.
- In a LRIC approach, all assets are valued at current costs; the method is essentially forward-looking.
- In a RAB approach in which asset values are updated by an inflation index a partial step has been taken to make the historic costs more relevant to current circumstances, but no has adjustments have been made to reflect the extent to which technical progress or market developments have affected what assets an efficient competitor would use.[16]
- In a RAB approach in which assets have been re-valued on an MEA basis, the costs are by definition estimates of what a competitor would use, and the method is forward – looking, as is LRIC. Indeed, the asset values would be the same in MEA and in LRIC if the increment being considered is the same, and there is therefore very little difference between the methods.[17]

1.5 The reason why RAB is sometimes preferred, and why LRIC is sometimes preferred

The reason why RAB-based methods are (in our view rightly) preferred in some circumstances and LRIC-based methods in other circumstances is not because the objectives of regulators differ: all may be essentially concerned to measure the prices that would be expected on realistic assumptions in a normally competitive market. Nor is the difference due to differences in time horizons; all regulators are likely to face the difficult problem of deciding the appropriate level of charges for a defined regulatory period which is short in comparison to some important asset lives.

The difference is that in some industries, the advantage of knowing what an efficient entrant would need to charge is very important, while in other industries such entry is less likely for example. In some cases entry by competitors may only be possible if the entrant is allowed to share use of some of the sunk assets on reasonable terms (regulated access charges). In the latter case, no useful information would be provided by estimating the replacement cost of assets which will in practice continue in use and – if competition is to be made possible – shared between competitors.

[15] The CAA corrects the RAB for general inflation.

[16] Where there have been no important technological or market developments, indexation using appropriate price indices is an efficient way of approximating an MEA value.

[17] For example, the same thought would need to go into determining what the most efficient, modern way of providing the service would be and what the cost of this would be. Examples include a new efficient airport configuration; or (from another sector) fibre as a new way of providing fixed telecommunication services. In both the LRIC and the MEA-RAB approach, the same concerns about uncertainty and forecasting exist.

A LRIC approach may result in a different valuation of assets compared with a historic RAB, leading to either capital gains or losses.

Estimates produced from applying a LRIC approach are bound to be less certain than those from a RAB, and are likely to require more resources. It is only worth incurring these costs if it is important to estimate a competitive market price, e.g. so as to provide the right signals for efficient entry.

This in a nutshell is why LRIC is applied in contexts like telecommunications, in which it is important to encourage efficient entry to the market, while historic cost RAB-based approaches are more appropriate in sectors like water or electricity transmission / distribution, in which investors must be able to achieve a reasonable return on their investment but there is less need to provide efficient signals for new entry into the network part of the value chain. For example, it would not be appropriate to allow water companies to earn a return on the replacement cost of reservoirs and underground assets; this does not reflect what investors have actually paid to acquire these assets (due partly to the capital value discount at privatisation), and such assets do not need to be replaced in their entirety either.

1.6 What in general are the circumstances in which LRIC should be used?

It follows from the above that the circumstances in which price controls based on LRIC should be used are:

- There is significant market power, and *ex ante* regulation of charges or revenues is justified.
- There is a realistic prospect of efficient competitive entry to the market, and policy-makers prefer to base expansions of capacity on competition rather than planning control and Government strategic decision-taking. In this case, whole-service LRIC estimates may be preferred.[18]
- Alternatively, there is no realistic prospect of competition in supplying (some of the) essential services but there are important bottlenecks in supply e.g. at times of peak demand and it is important to allow suppliers to charge the full economic cost for those particular supplies so that they have appropriate incentives to invest. In this case, a combined approach might be appropriate with estimates of the LRIC of increases in supply at peak times or for specific extensions to the service and overall revenues subject to a RAB-based limit to ensure the regulated business can continue to finance its activities without excessive overall returns.

The circumstances in which price control based on a historic cost-based RAB-based approach on its own would be preferable are:

- There is significant market power, and *ex ante* regulation is justified.
- There is no realistic prospect of efficient competition and therefore no need for efficient price signals for entry in supply of the main assets concerned, and no justification for providing the investors with more than a reasonable return on their original investment.
- There is no need for regulation of the structure of charges (beyond that required by competition law or other regulations, for example the Airport Charges Directive for aviation).

Where there is no SMP or justification for *ex ante* regulation of charges or revenues, neither RAB nor LRIC calculations are needed, unless the regulator wished to maintain a monitoring role or there were an *ex post* competition law issue to be resolved.

1.6.1 The particular circumstances of airports

The relevant features of the airport sector must be considered when assessing the relevance of LRIC. Two key features of airports regulation are particularly relevant to the possible use of LRIC-based approaches.

[18] Or the near-equivalent MEA-based RAB estimates.

- The political environment in which airports operate, where airport planning and expansion is controlled by the government, means that competitive entry is restricted and will not necessarily respond to price signals.
- In each periodic review, the CAA assesses the designated airports' proposed investment plans focusing on the justification for the expenditure expected within the next price control period (with the exception of a few longer-term projects) as this is the period in which price controls are set. Some external validation of capital projects is made against longer term airport master plans. When taking forward capital projects the CAA takes account of the views of airlines, for example through constructive engagement and the needs of passengers.

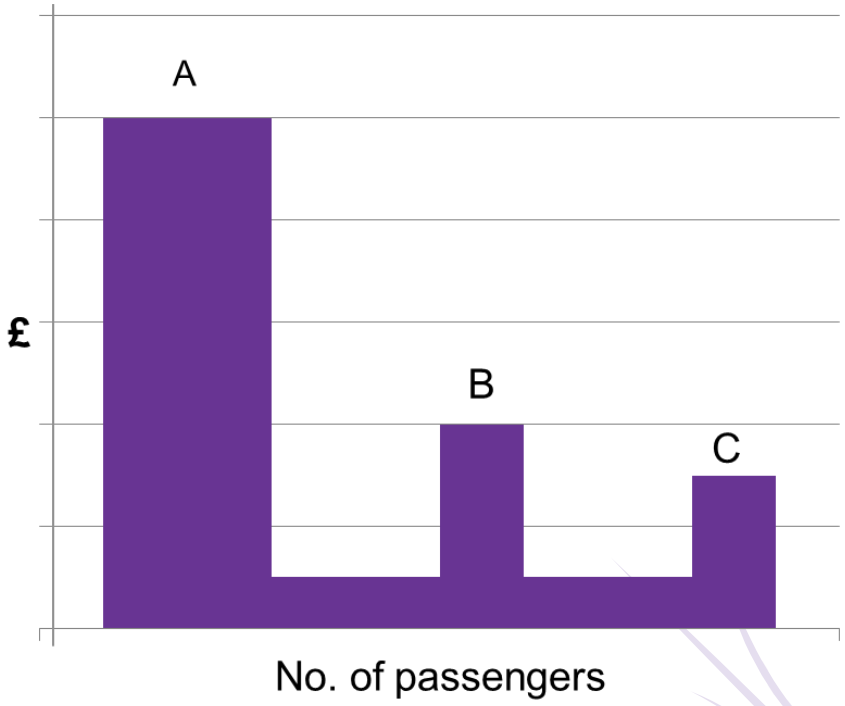
1.6.2 Is LRIC likely to be useful in airport price controls?

LRIC of additions to capacity

If the CAA needs to set a price limit for airport services as a whole, it is unlikely that a LRIC estimate of a change in airport capacity or throughput would be helpful. This is because the costs of increasing capacity are 'lumpy', and over a wide range of additions to passenger numbers the fixed cost of airport services is high in relation to the marginal costs of serving additional passengers, and even when volumes require some additional capital expenditure this may still be well below the average cost.

If volumes to be served were such as to require an additional runway and terminal the cost might be higher than the average cost, but there is no reason to assume it would be the same.[19]

Figure 1.1: Marginal costs of increasing passenger numbers (stylised picture)



In the above figure the fixed airport costs are represented by the left hand block A; the marginal costs of increasing customer numbers are for some increments just operating costs; there are from time to time requirements for additional investment, represented by the smaller peaks, B and C. The costs of additions

[19] If there were evidence that airlines were willing to pay the cost of a new runway etc., and this were higher than the current level of price limits, this would imply that current limits were below market levels. Such evidence would need to be robustly ascertained.

to capacity would be very variable, and most unlikely to be useful as estimates of average costs, which is what are needed to regulate the average airport charges.

The LRIC of these additions to capacity may however be valuable in structuring the charges for the additions alone, such a peak capacity charges.

LRIC of airport service as a whole

Estimates of LRIC for airport services as a whole speak directly to the cost of providing these services, and so are potentially relevant to setting airport charges. The present RAB based system also provides estimates of the costs of providing airport services as a whole, so the question is: which are the better estimates.

A historic-cost based system such as RAB shows how much the airport spent in acquiring its assets; and assuming a reasonable rate of return is allowed, together with realistic allowances for depreciation and operating expenditure, this should justify the investments and allow the airport owners to finance the business. It is a familiar system, and those involved understand what is involved.

A LRIC- based estimate would show what the costs would be if there were a normal degree of competition in providing the services of the airport. A larger element of judgement would be involved in estimating these costs, and there would be more scope for argument. The costs of the regulatory system would almost certainly be higher as a result, and the airport owners would face greater risks, perhaps increasing their required rate of return from any future investment.

However there are several potential advantages of setting price limits at the level that would result from competition:

- Any potential entrant which was able to improve on the regulated price levels would have an incentive to do so; efficient investment would in theory be encouraged. However, little if any weight can be attached to this advantage in the case of Stansted and Gatwick, since any major additions to airport capacity in the South East of England will be decided by Government, on strategic / planning grounds.
- The owners of Stansted and Gatwick would face greater risks if their investment plans proved inefficient. There would be no incentive to add unnecessarily to capital expenditure in order to increase the RAB.
- Other airports would be competing against Stansted and Gatwick on a more normal basis.
- Better pricing signals would be given to those who might be the sources of possible innovation, including to airlines in planning routes etc..
- The overall allocation of resources in the economy would perhaps be improved.

Whether or not the potential advantages would justify the departure from the present RAB-based system would depend on the balance of these advantages and disadvantages. If there is no need to provide efficient signals to possible entrants, the potential advantages are greatly reduced, and the balance of arguments is more likely to favour staying with a simpler (and therefore more economical) RAB-based method.

The rest of the report presents evidence and analysis to extend the commentary on the use of LRIC in the airports sector. This includes a review of the use of LRIC in the aviation sector and other regulated sectors, and the development of LRIC models for Stansted and Gatwick. The final sections provides our detailed conclusions on the use of LRIC in the airports sector, including a summary of what a LRIC based approach might look like at Stansted and Gatwick.

2 Review of LRIC Calculations in Other Sectors

2.1 Introduction

We reviewed the use of LRIC in a number of cases in the telecommunications, electricity and gas sectors and present a summary across four dimensions:

- Definition of the increment
- Modelling approach
- Regulatory use
- Advantages and disadvantages.[20]

In the telecommunications sector Ofcom uses LRIC to inform the likely level of efficient costs in the context of its price-cap regulation of mobile termination rates (MTRs).[21] LRIC is also used in a slightly different form in the regulation of fixed access charges.

In the electricity sector, LRIC is used by distribution network operators (DNOs) to structure their charges to extra high voltage (EHV) customers within the EHV Distribution Charging Methodology (EDCM). The Transmission Owner (TO) uses a charging methodology known as the Investment Cost Reflective Pricing (ICRP) model. This differs from a LRIC approach in that the extent of utilisation of the existing network capacity is not considered.[22]

In the gas sector, the transmission network owner makes use of the LRIC approach in calculating its charges within its overall revenue cap, through the use of the long-run marginal cost in its transportation model. In both the gas and electricity markets, Ofgem's overarching approach to regulation is RAB-based (the term used is a regulatory asset value, or RAV). LRIC methodologies are only used in some sectors for the structure of charges.

2.2 Definition of the increment

In the regulation of mobile telecommunications termination rates, the relevant increment is the whole termination service.

In the electricity distribution network operators (DNO) charging model for extra high voltage (EHV) customers, the relevant increment is a small increase in demand or generation at the node, the costs of serving which include necessary costs of reinforcing a branch to accommodate the increase in power flow.

The gas transmission operator (TO)'s transportation model calculates the long-run marginal costs (LRMCs) of transporting gas from each entry point to the relevant off-take point, via a reference node. The cost of

[20] Full reviews are provided in the Appendix.

[21] This is in line with the Recommendation of the European Commission: 'Commission Recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU,' 7 May 2009

[22] In the ICRP model the charges depend on the distance the electricity has to travel (MWkm), with no recognition of the degree of network utilisation, such that any additional power is assumed to require immediate network reinforcement.

the increment is the unit cost of expanding the network pipeline to transport 1GWh over 1km (also known as the expansion constant).

2.3 Modelling approach

2.3.1 Relevant costs of the increment

The relevant costs considered in the LRIC calculations for mobile termination markets (MTR) are those directly attributable to the MTR service. Ofcom defines the LRIC used here as 'pure LRIC'; incremental costs are the difference between the costs of the operator's total services with the termination service, and the costs of the operator's total services without the termination service. This is the avoidable cost methodology. The costs considered in Ofcom's approach are based on the costs of a hypothetical efficient national operator. Forward-looking costs are based on the efficient current costs to a new entrant using modern equivalent assets and making efficient technological choices.[23][24] In this case no allowance is made for the recovery of operators' common costs.

Ofcom defines the LRIC used in the setting of charges in access networks as 'LRIC+' which enables operators to recover a share of fixed common costs attributable to the increment. The incremental costs of the service are considered as a proportion of the total costs of all services provided by the operator, often allocated in a top-down way. This is also sometimes known as a 'fully allocated cost' (FAC) allocation methodology.[25] The costs considered are those of the incumbent, and Ofcom applies a current cost accounting (CCA) approach to valuing the assets (i.e. considering the costs an efficient entrant would incur).

In both the electricity and gas markets, LRIC calculations are used by the companies to structure their charges within the overall RAV-based methodology used by Ofgem to set limits to the expected overall levels of revenue. As Ofgem does not directly regulate charges using the LRIC calculations, the companies are responsible for constructing their LRIC models, and therefore the data used come from the companies' own accounts and other information (as opposed to a hypothetical entrant).

The relevant costs in the electricity distribution sector LRIC calculations are the incremental costs of reinforcing a branch of the network in response to an increase in power flows. These are calculated as the difference in the cost of reinforcing a branch under base conditions and under conditions in which there were additional power flows. The costs of the investment are based on modern equivalent asset costs.[26]

The relevant costs to the gas TO's LRIC calculation are the unit costs measured as the costs of pipeline to transport 1GWh over 1km. These investment costs are also based on modern equivalent asset costs.

2.3.2 Type of models used

[23] Ofcom adjusts its choice of parameters for efficient costs and technology choices following consultation with market participants.

[24] This is consistent with the EC Recommendation which states that assets which are valued in historic cost terms should be re-valued in current cost terms so as to reflect the costs of an efficient operator employing modern technology, as in a competitive market operators would compete on the basis of current costs and would not be compensated for costs that have been inefficiently incurred.

[25] Ofcom 'Charge control review for LLU and WLR services – Statement' 7 March 2012, page 12

[26] Energy Networks Association 'Schedule 17 – EHV Charging Methodology (FCP Model) www.energynetworks.org/modx/assets/files/electricity/regulation/EDCM/7%20EDCM%20Deliverables/Appendix%201a-1d.zip

For mobile termination rates (MTRs) Ofcom calculates the costs using a bottom-up economic/engineering model of an efficient network. Ofcom calibrates parts of the model against data obtained from national mobile communications providers, to ensure that its model of a hypothetical efficient operator reasonably matches the average infrastructure deployment of the national operators. In its modelling for fixed access networks, Ofcom makes assumptions about the wholesale services that are provided by the incumbent (BT) and uses data from BT along with its own assumptions to estimate the assets required and costs involved in providing these services.

The gas transmission operator (TO) adopts a bottom-up modelling approach that uses a number of inputs (such as demand forecasts, and the expansion constant) to estimate the capacity prices to cover the additional cost in increased usage.

2.3.3 Time period over which LRIC is calculated

Ofcom's model for MTR costs calculates the network costs for the period 1990/91 to 2039/40 with a perpetuity-based terminal value thereafter. MTR charges are set over a four-year period with scope for the model to be recalibrated after this with more up-to-date data. Ofcom raises the concern that a four-year period in the mobile telecommunication sector may be too long given the rapid pace of technological change. A shorter control period would enable Ofcom to rebase the model more often and thus have more accurate efficient costs, but would remove some of the certainty to regulated firms given by a longer control period. Ofcom has addressed the potential problem of forecasting error over the time period of the model by considering a range of parameters for sensitive variables and using conservative assumptions to reduce the risk of under-recovery of costs.[27][28]

The EDCM LRIC model used by the electricity DNOs uses an annuity period of 40 years.

2.4 Use in regulatory decisions

2.4.1 Ofcom

In markets where it believes regulation is required, Ofcom's approach in common with that of other UK economic regulatory authorities is to use price cap regulation rather than cost-plus charges limits. In some cases, such as the MTR market, Ofcom will come to a view on the likely level of efficient costs (using LRIC in this case) to inform the price cap.

In the MTR market, Ofcom uses LRIC as the cost standard against which to benchmark the charge controls for the four national four national mobile communication providers,[29] set over the four-year control period.[30]

The MTR charges are constructed as a yearly cap on mobile call termination (in pence per minute). The cap is set on a four-year glide path from the regulated charges at the end of the current control period to the efficient unit cost level at the end of the period (the pure LRIC benchmark). Ofcom sets the nominal

[27] Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011, Chapter 9

[28] Ofcom mentions in particular that data traffic on mobile networks has grown significantly ahead of forecasts. An under-forecast of traffic is said to be less important when using pure LRIC compared with LRIC+ as with the former common costs are not allocated to call termination, so that the level of permitted charges is lower, and so in consequence are changes result from differences in demand. Ofcom states this as an advantage of pure LRIC, rather than a reason for using pure LRIC.

[29] The four national mobile communications providers are H3G, Everything Everywhere, O2 and Vodafone

[30] Ofcom sets the same charge control for all four operators, regardless of the technology or platform that is used to provide call termination services.

maximum charge in the first year, and for the remaining three years the charge is calculated on an RPI-X basis. The X is the yearly percentage change required to equalise unit charges and unit costs at the end of the price control period.

In the fixed access network (such as copper LLU), Ofcom places a charges control in the form of an RPI-X price cap, using the fully allocated cost (FAC) method of cost allocation and a CCA approach to valuing assets.[31] Ofcom also makes use of an RAV valuation of pre-1997 assets to prevent over-recovery of the costs of the older assets.[32] As described in its final statement on valuing BT's copper access network (2005)[33] Ofcom was concerned that as a result of a change from historical cost accounting to current cost accounting in 1997 for BTs network assets, and due to insufficient competition in the access network, BT's charges to competitors for the use of its access network would result in over-recovery of the costs of its copper network assets. To address this concern it introduced a historic cost RAV to represent the remaining value of pre-August 1997 copper network assets.[34]

The use of LRIC reflects in part the number of operators in the market and the possibility of competition from new entrants for the provision of the services in question. Ofcom found that all 32 individual mobile communications providers providing mobile voice call termination services on their individual networks had significant market power (SMP),[35] but given the possibility of market entry and the use of alternative technologies, benchmarking costs on an efficient hypothetical entrant is a way of promoting efficient production and competition. In fixed access networks, however, the legacy networks operated by the single incumbent are still providing the main services, and thus cost benchmarking approach based on the FAC approach using the incumbent's data (with some adjustments for efficiencies) is more appropriate.

2.4.2 Ofgem

Ofgem regulates both electricity and gas markets within the RIIO framework.[36] The DNO revenue controls implemented by Ofgem mainly use a regulatory asset value (RAV) approach in which the RAV is constructed from an estimate of the initial market value of the licensee's regulated asset base at privatisation, subsequent additions to this at cost and annual depreciation. Charges limits are set on the basis that licensees should be able to earn revenues that cover depreciation and a return on the capital investment.[37] Within their predicted revenue cap, DNOs are then required to set their own prices for access to the network.

Ofgem also uses a RAV-approach to set total revenue allowances for gas transmission, and does not make use of LRIC for this purpose. However, the gas TO structures its charges on the basis of its transportation model, which uses a LRIC approach by considering the long-run marginal costs of investment in the transmission system caused by an incremental increase in demand or supply.[38]

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[31] Ofcom 'Charge control review for LLU and WLR services – Statement' 7 March 2012, page 12

[32] See Ofcom 'Valuing BT's copper access network - Final statement' Issued 18 August, and Ofcom 'Charge control review for LLU and WLR services – Statement' 7 March 2012, page 14

[33] Ofcom 'Valuing BT's copper access network - Final statement' Issued 18 August 2005

[34] As the RAV adjustment includes HCA cost elements for pre-1997 assets, its inclusion in Ofcom's cost model means that the costs used are not 'pure' CCA.

[35] Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011

[36] RIIO stands for Revenue = Incentives + Innovation + Outputs.

[37] Ofgem 'Electricity Distribution Price Control Review Final Proposals' 7 December 2009 www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/DPCR5/Documents1/FP_1_Core%20document%20SS%20FINAL.pdf

[38] It is not clear why LRIC is not used by Ofgem to set overall revenue charges, but we assume the rationale for LRIC

2.5 Advantages and disadvantages of LRIC

2.5.1 Ofcom

In the context of the MTR market Ofcom considers pure LRIC the most appropriate cost-benchmarking methodology to promote efficient production and minimise potential competitive distortions. The disadvantage of LRIC+ in this context (as was used in previous price control periods) was that the allowance for an allocation of common costs resulted in what Ofcom concluded was over-recovery by mobile operators, leading to excessive pricing and competitive concerns.[39]

In the context of fixed access networks, Ofcom considers that the CCA FAC approach provides a robust and transparent basis for the regulation of wholesale access charges. It has the advantage of being a well understood concept and has been the cost basis for previous charge control obligations imposed by Ofcom. Furthermore, CCA FAC uses data which can be reconciled to the regulatory financial statements, which are published by BT and independently audited.[40] Ofcom also considers that the CCA FAC is a suitable cost basis to prevent excessive levels of charges being levied by BT (Openreach). It also ensures that the delivery of regulated services is sustainable by enabling Openreach to recover all relevant and efficiently incurred costs.

One recent example of a disadvantage with LRIC in the fixed access market was the high volatility and subsequent drop in copper prices in 2008. When determining its price control, Ofcom used the latest valuation available.[41] Post 1997 copper is valued on a CCA FCM basis. Any swings in copper prices will have an impact both on estimated costs both through the change in asset values and also through holding gains (price increases will result in holding gains which will push down costs; price decreases will push up costs).

2.5.2 Ofgem

In the context of electricity distribution, Ofgem no longer requires DNOs to make use of LRIC within their EDCM models. In its 2012 decision to no longer require DNOs to use the LRIC or FCP approach, Ofgem considered that LRIC/FCP charges may not be cost reflective due to inappropriate growth assumptions used in both methodologies, such as the one per cent assumption of distributed generation growth across all areas in the LRIC model and the potential volatility of the charges generated from the models.[42]

The major concern about the use of LRIC is the potential volatility of the charges. One DNO in its response to the 2011 consultation on the matter has found the methodology extremely volatile and it can produce very high or very low prices depending on the capacity level of the network or the rate of underlying load growth. LRIC could also lead to charging volatility if there is a significant change in loading capacity in a particular part of the network.[43] In addition, LRIC can generate reinforcement charges in cases where no real reinforcement is required.

[39] Commission Recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU, 7 May 2009

[40] Ofcom 'Charge control review for LLU and WLR services – Statement' 7 March 2012, page 14

[41] Ofcom 'Charge control review for LLU and WLR services' 31 March 2011,

[42] Ofgem letter "Distribution use of system charging – decision and further guidance on higher voltage generation charging" 2 Feb 2012

[43] SSE response: Next steps in delivering the electricity distribution structure of charges project, 11 December 2008

Other arguments include the failure of LRIC in taking account of all relevant reinforcement costs drivers, especially the fault level costs.[44]

In the context of the electricity TO, Ofgem commissioned a piece of work in 2008 to review the network charging methodologies used for transmission and distribution networks.[45] The main benefit of LRIC was found to be the lack of any requirement to reinforce the system for new demand, as generation was encouraged to locate at highly loaded areas.[46]

Ofgem considered moving away from the ICRP approach to a LRIC model in its 2012 Significant Code Review (SCR),[47] but concluded that LRIC was less attractive than the ICRP approach due to its potential to increase the volatility and complexity of charges levied on users. The application of a LRIC model at transmission level would impose the full cost of an enhancement of transmission capacity on a single user, potentially leading to this increase in volatility and complexity. Since investments in the electricity network tend to be 'lumpy' and therefore typically leave some spare capacity, entry by one user would be likely to make it easier for other users; yet this was not taken into account in the cost allocation. Research undertaken on behalf of Ofgem suggested that this effect could be reduced by sharing the transmission charges between the two users based on the ratio of their relative capacities once the second one enters.[48]

Another issue identified with the LRIC model was the sensitivity of the power flow analysis to the assumptions made for demand growth, for the generators that will have access to the system in the future and for how generator power will be dispatched. This power flow analysis guides the timing for reinforcements made on any one branch. This problem was seen to be more significant for the transmission network than the distributional network since the distribution network has a radial structure and (presently) relatively little embedded generation whilst the transmission network has many degrees of freedom, all of which are uncertain.[49]

A third issue identified was that the model focussed on breach of branch capacity limits when considering when reinforcements would be triggered. This makes the method very sensitive to small changes when the limit is approached. However, Ofgem's research report suggested that this problem could be reduced by averaging nodal charges across pre-specified zones.[50]

Although the issues of moving to a LRIC approach were not seen to be insurmountable, Ofgem felt that consideration of this methodology did not represent the most appropriate means of considering the issues that were the main priority of the current SCR.[51]

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[44] Ofgem decision document 'Delivering the electricity distribution structure of charges project' 1 October 2008

[45] Dr Furong Li (2008) "Network Charging Methodologies for Transmission and Distribution Networks" University of Bath www.supergen-networks.org.uk/filebyid/204/Furong%20Li.pdf

[46] Dr Furong Li (2008) "Network Charging Methodologies for Transmission and Distribution Networks" University of Bath www.supergen-networks.org.uk/filebyid/204/Furong%20Li.pdf

47 Ofgem 'Electricity transmission charging arrangements: Significant Code Review conclusions' 4 May 2012 www.ofgem.gov.uk/Networks/Trans/PT/Documents1/TransmiT%20SCR%20conclusion%20document.pdf

[48] Bell, Keith, Green, Richard, Kockar, Ivana, Ault, Graham and McDonald, Jim (2011) "Project TransmiT: Academic review of transmission charging arrangements" Produced on behalf of Ofgemwww.ofgem.gov.uk/Networks/Trans/PT/WF/Documents1/E.ON_comments_transmission_charging_arrangements.pdf

[49] Bell, Keith, Green, Richard, Kockar, Ivana, Ault, Graham and McDonald, Jim (2011) "Project TransmiT: Academic review of transmission charging arrangements" Produced on behalf of Ofgem www.ofgem.gov.uk/Networks/Trans/PT/WF/Documents1/E.ON_comments_transmission_charging_arrangements.pdf

[50] Bell, Keith, Green, Richard, Kockar, Ivana, Ault, Graham and McDonald, Jim (2011) "Project TransmiT: Academic review of transmission charging arrangements" Produced on behalf of Ofgem www.ofgem.gov.uk/Networks/Trans/PT/WF/Documents1/E.ON_comments_transmission_charging_arrangements.pdf

[51] Ofgem 'Electricity transmission charging arrangements: Significant Code Review conclusions' 4 May 2012 www.ofgem.gov.uk/Networks/Trans/PT/Documents1/TransmiT%20SCR%20conclusion%20document.pdf

3 Use of LRIC in the Airports Sector

3.1 Introduction

We now review the Competition Commission (CC) and CAA work for Stansted price control review 2008, including the review of options to set Stansted price caps based on LRAIC.

3.1.1 Background

In its reference to the CC in 2008, the CAA identified a number of challenges unique to Stansted to be considered when determining the appropriate form of price control in Q5. These included:

- greater market uncertainties than is usual at designated airports;
- the scale of the investment envisaged by the airport relative to the airport's existing asset base and the potential distortions to decision-making that could result from inappropriate regulation;
- the likelihood that Stansted's historic RAB did not reflect the replacement cost of its existing assets, due to the regulatory policies applied to the airport in the past, including the mixed history of regulation on the basis of a system of BAA London airports and as an individual, stand-alone airport; and
- sharp disagreement between airport and airlines as to what investment is required and by when.[52]

The CAA also had reasons to believe that a RAB-based price cap might give the wrong incentives for economically efficient investment. On one hand, airports might have an incentive to over-invest if inclusion of new assets in the RAB meant they would earn a higher return than they deserved. On the other, the CAA also considered that incumbent airlines might oppose an efficient expansion if it was not in their interests.[53] For this reason, the CAA considered that LRAIC-based regulation might provide a closer approximation to the incentives present in a competitive market than the RAB-based price cap currently in use.

In light of these considerations, and of the competitive pressures it considered Stansted to face, the CAA proposed six regulatory options to the CC, all of which were intended to address the challenges posed by Stansted, in particular the need for future investment.[54] Two options of the options were based on a LRAIC approach:

- A market-led price cap (MLPC), whereby the price cap would be set with reference to forward-looking measures of LRAIC. This would be at the lowest level consistent with not distorting investment incentives or competition between airports. The CAA proposed this would be at a level just above LRAIC due to estimation uncertainties, to avoid a LRAIC price that is too low and therefore discourages efficient expansion.
- A precautionary price cap (PPC), whereby the price cap would be set by reference to forward-looking measures of cost, just below the level at which prices might be viewed as excessive under general

[52] Competition Commission 'Stansted Airport Ltd: Q5 price control review' October 2008

[53] CAA 'Price control proposals for Stansted Airport. Supporting paper I: Illustration of airport and airline incentives', December 2008.

[54] This implies that at the time, the CAA would have been more interested in a LRAIC calculation that focused on expanding capacity, such as an additional runway, rather than a 'whole service' increment that could have informed the competitive price level of the airport as a whole, not necessarily with an allowance for investment.

competition law. This can also be thought of as a measure of the highest price that might be seen in a competitive market, even in the short run.[55]

The CAA's proposals were based in part on the argument that Stansted faced sufficient competitive pressure to warrant only 'safe-guard' price caps, as both options assumed that competition would help to ensure prices reflected those that would be expected in a well-functioning market (with the PPC relying more heavily on this assumption). At that time, new runways were being considered at Heathrow as well as Stansted.

The CC's main concern with these proposals was the form of the price caps that assumed a level of competitive pressure that the CC did not believe was applicable to Stansted.[56]

- MPLC – if the cap is set above the real LRAIC and competitive constraints are limited, this could lead to over-recovery, harming passengers and possibly resulting in inefficiently high levels of investment.
- PPC – this requires a view on what constitutes an 'excessive price.' Price fluctuations are necessary to recover long-run costs, the implication being that the price at any one time could be substantially above LRAIC (here meaning the average of years rather than per passenger) and not be considered 'excessive'. If the airport is not subject to sufficient competitive constraints, it could price up to the 'peak fluctuation' and would not be constrained to reducing this even when demand fell.

As our work does not involve an assessment on the extent of market power at either airport, we focus on the CC's concerns that are related to applying LRAIC more generally.

3.1.1.1 CC's practical concerns with LRAIC

The CC was not opposed to LRAIC-based approaches *per se*: even under the assumption of market power at Stansted the CC considered a price cap set directly at LRAIC could be suitable in theory:

> "Correctly applied, LRAIC-based model would be expected to result in prices closer to the long-run competitive level, providing the appropriate signals to the market to foster efficient entry, investment and innovation."

Competition Commission 'Assessment of LRAIC-based price cap within the Stansted Inquiry', 2008[57]

However, the CC did raise practical concerns about setting price caps directly at LRAIC. Some of these difficulties were exacerbated by the perceived lack of competitive constraint facing Stansted.

The 'practical' concerns of the CC can be summarised as follows:

- Establishing an efficient benchmark. The CC considered that in order to establish a sufficiently accurate of LRAIC for the purposes of setting a price cap, an efficient benchmark must be established for the required capacity expansion, and that this may not be possible given the unique circumstances of each airport. The CAA thought it would be sufficient to rely on consultancy services to provide a robust estimate of the incremental costs at Stansted. The LRIC estimate could then be used to help establish an appropriate price cap, even as part of a wider evidence base. It also thought that the ability of the airlines to agree charges at Stansted reduced the need for precision.
- Data requirements. The CC was concerned about the need for precision in a LRAIC estimate given Stansted's market power. Costs and demand forecasts over the life of assets are likely to be subject to

[55] Competition Commission 'Stansted Airport Ltd: Q5 price control review' October 2008
[56] Competition Commission 'Assessment of LRAIC-based price cap within the Stansted Inquiry', 2008, page 2
[57] This is a more detailed working paper on the issues raised in the Competition Commission's 'Stansted Airport Limited Q5 price control review' 23 October 2008, pages 24-27

high forecasting error.[58] The CAA again thought that the level of competitive constraints present at that time were such that LRAIC would not need to be estimated with high precision.

- Timescales. The CC stated that it was not practical to conduct the modelling and consultation exercises that would be necessary to calculate the LRAIC estimate, citing the long time it took Ofcom to develop the economic / engineering model for mobile termination rates and fixed access.
- Regulatory commitment. The CC stated (and the CAA agreed) that it cannot give legally binding commitment to how price caps will be set in the future. As a LRIC approach is intended to deliver long-term signals, regulatory commitment is important. Whilst such commitment is also an issue in a RAB-based approach, it could be argued that this latter approach has an 'established' credibility due to its historic use.

3.1.1.2 Comment:

The importance of these practical concerns with setting price caps based on LRAIC depends on whether the airport concerned does have SMP such that uncertainties in the LRAIC estimate could result in over-recovery (or under- recovery within a control period).

Our own modelling of Stansted LRAIC, and our review of FTI Consulting's model for Gatwick, highlight the difficulties in assessing the accurate costs of long-term investments. In particular:

- When the increment concerned is a 'whole service' or a replacement cost increment, assessing the investments required for a modern efficient airport (in the case of Gatwick most likely based on a different configuration to the existing one) is very uncertain.
- When the increment is an addition to existing capacity that will be incurred far into the future, estimates of future capital costs, operating costs and demand forecasts will be very uncertain.

In comparison with the current approach taken by the CAA whereby investment costs are largely only assessed for the next price control period (provided they move towards the long-term plans laid out in the master plans), these practical difficulties that are based on the long-term nature of LRIC represent a significant challenge.

We do note that the fact that RAB-based price limits are set for short periods does not in theory mean that regulators using this approach can disregard long term issues. If – say - a major new sewer is needed in London, the costs and the benefits will stretch over far longer than the period used for Ofwat's RAB-based determinations of price limits. In any sector where long term investments may be justified, the regulator cannot escape taking a view of their justification (by definition, over the expected lifetime of the investment) and, once this is done, on the separate issue of how much of the capital costs should be recoverable in charges over the next period for which charges are to be set. However, in airports, the involvement of airlines and the government may give CAA sufficient assurance of the justification for major investment in new capacity.

In terms of regulatory commitment, if prices are set at an annual average LRAIC[59] then the airport and airlines would need a commitment to these prices over the long term to avoid under (over) recovery during periods of low (high) available capacity. However, a LRAIC-based approach does not require prices to be set as such — having established the NPV of the amount to be recovered in charges, the path of prices during the control period can then be decided.[60]

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[58] Indeed, the LRAIC models developed by the CAA, FTI and Europe Economics (for this report) are all very sensitive to changes in passenger demand and the capacity of the increments.

[59] As noted earlier, two sorts of averaging may be involved. The LRIC is the cost of providing a defined increment; if this cost is expressed as an average per unit of output (or per passenger) this is termed LRAIC; if this is expressed as an annual charge, this is a second type of averaging.

[60] There have been cased in which regulators have wanted to see a significant reduction in charges in the first year of a control period – a 'P0 cut'- and others in which a smooth transition has been preferred.

3.1.2 Other comments by the CC on LRAIC

The CC highlighted the value of considering the expected price path in a competitive market— as spare capacity is used and the time for the next investment approaches the LRIC price estimate would increase; post-investment the LRIC could be relatively low as there would potentially be spare capacity. LRAIC is averaged over the units of output the increment produces, so that if the average over the period were used as to set the price limit in each year this would in effect smooth the LRIC over the life of the asset, which might not be desirable or indeed feasible.[61]

The CC raised the point that LRAIC is not the only methodology for approximating the long-run competitive price: it thought that both the replacement cost and RAB approaches attempt to estimate the competitive price in different ways. Considering a new airport, the LRAIC and RAB approaches would be expected to result in the same net present value, if correctly applied. [62]

In addition to its practical concerns about the use of LRAIC, the CC raised more conceptual issues about a LRAIC-based regulatory approach. We summarise these below, with some comments in the light of the previous discussion:

CC Observation

> Under a LRAIC approach (as with a RAB-based approach) an operator would have an incentive to reduce costs between price reviews and keep the savings. However, under the LRAIC approach it is not clear that these savings would be passed onto consumers as the LRAIC-based price cap may not be adjusted to actual spend by the operator at each review.

Comment

Assuming that the LRAIC based price is estimated anew at each review and is based on modern equivalent asset values for the service as a whole, the costs estimated as being necessarily incurred by an efficient entrant would be informed by the savings made by the operator during the recent period so that under either system there is a combination of incentives for the operator to out-perform and a mechanism by which consumers benefit in subsequent periods. The theory underlying this is that it mimics how a competitive market works: an efficiency gain by one supplier will increase its profitability for a while, after which competition will erode the advantage, to the benefit of consumers.

If a LRIC estimate were made of additions to capacity (which was an option the CC may have had in mind, but which we would not recommend) the variability between estimates would make it less clear that efficiency gains would be passed appropriately to customers.

CC Observation

> The dynamic efficiency benefits of a LRAIC-based approach (which incentivises operators to invest in new assets and innovation at an optimal rate and point in time) is potentially undermined by the lack of rivals with expansion plans that would be expected to affect the price at Stansted, and no prospect of new airport entry in the South-East.

Comment

This remains true, although there is currently a new policy debate about where airport capacity should be created. As highlighted earlier in the document, the airports sector has other barriers to competitive entry

[61] This would reflect a possible (probably mistaken) regulatory decision distinct from the decision whether or not to use LRIC to estimate costs.

[62] Competition Commission 'Assessment of LRAIC-based price cap within the Stansted Inquiry', 2008, page 6

besides incorrect price signals (namely the restrictions on planning and expansion) which suggests limited value to the dynamic efficiency benefits of LRIC.

CC Observation

> Future investment may not be easily remunerated if it was not included in the 'increment' when the price cap was set.

Comment

Under either system, any airport considering expansion would need a realistic degree of certainty about how the costs would be treated for regulatory purposes. A historic cost – based RAB system offers greater certainty, since once an investment cost has been approved for inclusion in the RAB it will be part of the calculation for future price limits. There is no guarantee that the investment costs will be recovered, if volumes are below expectation during a price control period or the airport is unable to charge up to the cap, but the investor will not be exposed to the risk of capital losses if technological advance means that its assets would be redundant in a competitive situation. On the other side of the coin, the LRIC system therefore provides better incentives for efficient investment as operators will be exposed to the risk of their assets becoming redundant if they do not take account of technological advance or market developments.

CC Observation

> There is increased risk to the airport operator of fixing prices so far into the future, with the potential for large cash flow fluctuations if price cap cannot be fully adjusted in each regulatory period. This may deter airports from expansion investment.

Comment

- The CC here makes an assumption about how a price control based on costs assessed through LRIC would operate with which we disagree. Under either system, the regulator would be expected to make clear arrangements for re-setting and up-dating at the start of a new control period. There is no need for prices to be set for longer than the control period under either system, nor any need for different degrees of pre-financing.

  Under both systems based on LRIC and those using a RAB, the investment costs to be reflected in charges comprise a) those relating to the assets that are currently in place or to their MEA, and b) investment planned for the coming control period. The assets to be remunerated may be similar; the difference is that a RAB values them at historic cost (probably indexed for general inflation) while a LRIC approach values them by reference to modern equivalent assets, as would happen in a competitive market. The use of LRIC as a cost methodology does not imply that prices need to be set at the same level over the entire forecast period; provision could be made to adjust prices to avoid large cash surpluses in one period when no investment is done, and potential under-recovery in another period where significant investment takes place.

CC Observation

> A LRAIC-based cap may not sufficiently reimburse quality improvements (although this could be overcome by calculating the low-level specification of the increment and allowing the airport and airlines to negotiate any additional quality improvements).

Comment

There is no difference between the systems with regard to the regulatory treatment of quality issues.

CC Observation

> The CC recommended defining the appropriate increment for setting price caps at Stansted as the entire airport (cost of a new green-field airport) or SG2 as a proxy of the cost of building and operating a new airport and then apply this cap to all assets at Stansted, existing and new.[63]

Comment

This is broadly in line with our view of the most appropriate increment, although using a new runway and terminal as a proxy for the whole airport would depend on evidence that customers are willing to pay for the additional capacity. The regulator would also need to take a view on the capacity and quality requirements of the additional runway.

3.1.2.1 Comment

We agree with the CC's observation that the differences between a LRIC and a RAB-based system are greatly reduced if the RAB is re-estimated at MEA values, since such asset valuation is at the heart of the LRIC system.

There are then the following key issues in relation to the use of LRIC in the airports sector:

- Should historic cost or MEA / LRIC values be used to assess the value of assets on which the airport should be allowed, if market conditions permit, to earn a return?
- Given that MEA values are not currently used, what level of certainty can be attached to MEAV estimates, in particular when considering a hypothetical new airport?
- If MEA or LRIC values are to be used, should they be of the airport as a whole or of an addition to its capacity?
- What level of certainty can be attached to long-term forecasts of capital expenditure, operating expenditure and demand for investments that will take place some way into the future?
- The central role of government with respect to the planning of airports in and around London.

3.1.3 Review of CAA's LRAIC modelling work in 2008

In its January 2008 consultation to airlines the CAA presented the results of an illustrative LRAIC model, using a stylised version of the Stansted Generation 2 investment plan (SG2).[64] The main purpose of this exercise was to inform airport users how this methodology might be employed in the future to inform how price caps are set, in particular if they are market-led or precautionary. This is the model reviewed below.

In its price determination, the CAA finally adopted a 'dual approach' to set its price cap.[65] It was partly informed by a RAB-based approach, which was also the recommended approach by the CC.[66] In addition, the CAA considered in its decision the price in a competitive market, informed by a number of measures of forward-looking average cost, including some LRAIC estimates for Stansted performed by ASA consultants, based on the capital investment plan for SG2.[67]

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[63] Competition Commission 'Assessment of LRAIC-based price cap within the Stansted Inquiry', 2008, page 12

[64] CAA 'Price control review – consultation on the framework and options for the economic regulation of Stansted. See the following webpage for a link to the indicative model: http://www.caa.co.uk/default.aspx?catid=78&pagetype=90&pageid=12275
Airport', January 2008.

[65] CAA 'Economic Regulation of Stansted Airport 2009-2014: CAA Decision', March 2009.

[66] Competition Commission 'Stansted Airport Ltd - Q5 price control review', October 2008.

[67] Competition Commission 'Stansted Airport Ltd - Q5 price control review. Appendix B - Competition at Stansted', October 2008.

We reviewed the CAA's approach to LRAIC modelling as undertaken for Stansted price control, based on the indicative model used for the January 2008 consultation (the version available to the public). We note that the final figures used in the December 2008 proposals[68] are slightly different, but the fundamental structure of the model remains the same.

3.1.3.1 Information sources

The CAA model attempts to be only an illustrative exercise and, therefore, inputs used are high-level estimates. The capital expenditure range is informed by BAA investment plans and a comparison to similarly sized expansions at other major European and UK airports.[69] No sources are mentioned for the cost of capital, asset lives and traffic forecasts.

3.1.3.2 Definition of the increment

CAA considers only one increment in its model. It considers an increase in capacity at the precise moment when the initial capacity at Stansted Airport (assumed to be 35mppa) becomes binding. The duration of the increment corresponds to the asset life of the new capital. The increment contemplates expanding capacity from 35 to 70 mppa, which is consistent with the SG2 plans under consideration at the time that include an additional terminal and a new runway. In addition, the CAA extended the work by the Competition Commission that estimated the LRAIC of a replacement airport.[70]

In its reference to the CC, the CAA suggested that LRAIC-based pricing removes the link between actual investment and the charge to airlines, removing the need for the regulator to make decisions about the timing and specification of specific investment project. As a result this may be expected to reduce the risk of regulatory gaming.[71] However, the approach taken by the CAA in its modelling– considering LRAIC calculations using the operator's data relating to a specific project – does not necessarily remove this problem.

3.1.3.3 General inputs and assumptions

The model includes the following general inputs. The CAA modelled three scenarios in its January 2008 version, all with different values of these inputs. We describe here the values used in the central scenario.

- Discount rate, assumed to be equal to the cost of capital – 8 per cent.[72] (We note that the final discount rate used in the December 2008 proposals was 7.1 per cent). [73]
- Capital investment is modelled at a high level, taking into account only the amount of its present value - £2 billion.

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[68] CAA 'Stansted Airport CAA price control proposals, December 2008 http://www.caa.co.uk/docs/5/ergdocs/081209StanstedProposals.pdf

[69] CAA 'Price control review - consultation on the framework and options for the economic regulation of Stansted Airport. Annex C: Cost of new entry and expansion', January 2008.

[70] CAA 'Economic Regulation of Stansted Airport 2009-2014: CAA Decision', March 2009, paragraph 4.9: "In support of these views, the CAA referred to a number of measures of forward-looking average cost. In particular, the CAA referred to the two estimates presented by the Competition Commission: an estimate of long-run average incremental cost (LRAIC) based on the results of the work of its consultants, ASA, of £7.80 per passenger; and an estimate of average replacement cost of £6.60 per passenger (both in 2008 prices). The CAA reviewed these estimates and produced updated estimates of these values of £6.70 and £6.30. However, the CAA argued that these estimates were likely to represent a conservative estimate of average incremental costs, in part due to the use of the current average cost of capital, rather than the cost of capital that would apply to an incremental project."

[71] CAA reference to the Competition Commission for Stansted Airport, April 2008

[72] The January 2008 model considers three possible values for the discount rate: 7, 8 and 9 per cent. The choice of 8 per cent being the 'central scenario' is "not intended to indicate the CAA's views on the appropriate cost of capital or asset life for Stansted Airport" (CAA 'Price control review - consultation on the framework and options for the economic regulation of Stansted Airport', January 2008, footnote 95.). This value also differs from the cost of capital of 7.1% used in the 'building block' calculation for the price determination published in March 2009.

[73] CAA 'Stansted Airport CAA price control proposals, December 2008, paragraph 5.58

- Asset life. As the model takes the total value of the capital investment, there is no distinction made on the asset lives for different assets. Therefore, a single asset life is assigned to the full investment – 35 years.
- Passenger long-run growth rate. Traffic is assumed to be at full capacity in the initial period of the analysis and subsequently grows at a constant rate – 4 per cent[74]

3.1.3.4 Modelling decisions

The CAA's model, like all models is sensitive to both the values of the inputs and to the modelling approach. In addition to the input assumptions, several explicit and implicit modelling decisions are made:

- The model does not contemplate construction or pre-construction periods. Long construction periods increase the value of LRAIC, since the capital investment has to be made in the initial periods while the benefit (i.e. the incremental passengers) only materialise when the new capacity is available. This effect is more pronounced as the discount rate increases. In our sensitivity analysis below we consider the possibility of construction periods of 3 and 5 years.
- Timing of capital investment is assumed to be perfect. That is, the incremental capacity becomes available in the same period when it is needed. The LRIC estimates are sensitive to mistiming, in particular when the investment is made earlier than necessary. Not only the discounted value of initial investments become large relative to the discounted value of benefits, but also some periods of useful asset life are wasted.
- The model assumes no phasing in of the investment. In other words, all incremental capacity becomes immediately available, even though much of it will not be needed for several years. If the investment were to be broken down into output phases, the present value of the capital cost could decrease, although spreading capital expenditure over more than one year before the capacity is required is likely to increase the present value.
- It is assumed that capital does not need to be maintained, potentially underestimating the estimate of LRIC.
- Similarly, the model does not consider operating expenses and non-regulated revenue (or implicitly assumes these offset each other). This simplifying assumption could result in a lower-than-actual LRIC estimate if operating expense were greater than non-regulated revenue.

3.1.3.5 Sensitivity analysis

The CAA's model and accompanying document[75] consider three scenarios with different values of the four main inputs. The scenarios considered in the model are:

- Discount rates of 7, 8 and 9 per cent.
- Capital investment could take the present values: £1.5bn, £2bn and £2.5bn.
- Passenger growth rates of 4 and 6 per cent.
- Asset lives of 25, 35 and 45 years.[76]

In addition to those described above, the following sensitivities can be explored:

- Construction period. We consider the effect of having construction periods of three and five years before the capacity becomes available. In effect, this exercise discounts the present value of incremental passengers into the future by three or five periods, respectively.[77]

[74] The average passenger traffic growth in the 2003-2008 period was 5.93%. Source: CAA, UK Airport Statistics: 2008 - annual

[75] CAA 'Price control review - consultation on the framework and options for the economic regulation of Stansted Airport. Chapter 10. Option 4: Market-led approach', January 2008.

[76] This sensitivity was not reported on the document but included in some analysis supplied by the CAA.

- We consider the possibility of having the investment projects being finalised too early. In our sensitivity analysis, incremental capacity becomes available two years earlier than necessary.[78] This variation has two effects on the LRIC calculation: first, the incremental passengers have to be discounted two periods into the future and second, the period in which the investment is efficiently used is two years shorter.
- It is likely that operating expenditure would differ from non-regulated revenues.[79] The effect on LRIC, however, would be similar having a higher present value of capital investments. We could reinterpret the sensitivity analysis that increases the PV of Capex by a certain amount as having Opex exceeding Revenue by that same amount.
- We consider the possibility of differences between the realised and the planned capacity expansion. We consider incremental capacities of 30 and 40mppa.
- Lower passenger forecasts. In consideration of [✂][80] which provides a central forecast of [✂] per cent growth for the period until 2024/25, we conduct a sensitivity analysis of having a lower growth rate than the one used in the CAA's model. We estimate the LRIC for a passenger long-run growth rate of 2 per cent, in addition to the scenarios of 4 and 6 per cent included in CAA's estimates.

3.1.3.6 Summary of results of the sensitivity analysis

Table 3.1 contains the results for the sensitivity analyses mentioned above, both those conducted by the CAA and those by Europe Economics.

The central scenario is based on the CAA's model that we reviewed (the 2008 version) and results in a LRAIC of £10 per pax. We note that the final value included in the March 2009 decision was lower, at £6.70.[81] However, the purpose of this exercise is to test the sensitivity of the CAA's model, the fundamental structure of which remained the same even though the input values changed.

[77] The construction of Heathrow Terminal 5 spanned 5.5 years, from September 2002 to March 2008 (Source: Mott MacDonald http://www.terminal5.mottmac.com/aboutus/) and the construction of phase 1 of Terminal 2 is planned for 4 years of construction (2010-2014) plus one year of demolition and site clearing (Source: http://www.heathrowairport.com/about-us/rebuilding-heathrow/heathrow%27s-new-terminal-2/timeline).

[78] This could be the case if high, rather than central, traffic forecasts are used to bring forward capacity construction.

[79] For example, in 2011 the total adjusted operating expenditure was £147.8 million while non-aeronautical revenues were £107.6 million. Source: Stansted Annual Accounts: http://www.baa.com/investor-centre/document-centre/annual-accounts

[80] [✂]

[81] CAA 'Economic Regulation of Stansted Airport 2009-2014: CAA Decision', March 2009, paragraph 4.9. The CAA referred to the two estimates presented by the Competition Commission: an estimate of long-run average incremental cost (LRAIC) of £7.80 per passenger; and an estimate of average replacement cost of £6.60 per passenger (both in 2008 prices). The CAA reviewed these estimates and produced updated estimates of these values of £6.70 and £6.30.

Table 3.1: Sensitivity analysis 2008 prices[82]

		LRAIC change	% change
Central scenario		10.0	
Cost of capital (Central: 8%)			
	7%	-1.5	-14.7%
	9%	+1. 6	16.4%
PV Capex (Central: £2000bn)			
	1500	-2.5	-25.0%
	2500	+2. 5	25.0%
Asset life (Central: 35 years)			
	25	+2.	20.6%
	45	-0.8	-7.3%
Passenger growth rate (Central: 4%)			
	2%	+8. 8	87.9%
	6%	-2. 10	-20.8%
Construction period (Central: 0 years)			
	3	+1. 9	19.2%
	5	+3. 9	39.1%
Incremental capacity (Central: 35mppa)			
	30	+. 7	7.3%
	40	-0.6	-5.4%
Timing (Central: on time)			
	2 years early	+1. 3	13.4%

It can be seen from the table above that, with two exceptions, the sensitivity analysis leads to changes in the LRAIC estimates of up to 25 per cent. The LRAIC estimates are most sensitive to increases in passenger growth rates (88 per cent change with a passenger growth rate of two per cent) and longer construction periods (39 per cent change with a construction period of five years). The substantial increase in LRAIC under a low passenger traffic growth scenario is a consequence of the modelling approach. While assuming a two per cent passenger growth rate in the long run is not completely unreasonable, a more realistic capital expenditure plan would defer the later phases of the expansion. In this case, the LRAIC estimate would decrease significantly.

The results are least sensitive to different levels of incremental capacity, and to longer asset lives, The sensitivity to different specifications of the discount rate is moderate (a change of one percentage point leads to a change in LRAIC estimates between 14 and 17 per cent).

[82] The model from CAA that we reviewed is indicative and therefore prices are not expressed in a specific base year. The results for the LRAIC model presented in the December 2008 proposals and March 2009 Decision, however, are expressed in 2008 prices.

Compared to the sensitivities performed for the models of FTI for Gatwick and Europe Economics for Stansted, the CAA model is very sensitive to a decrease in the passenger growth forecast. On the other hand, the LRAIC calculation from CAA's modelling is not as sensitive as Europe Economics' model to making capacity available too early. The possible source of this discrepancy is the simplifications made in CAA's model regarding the construction period and the absence of capital maintenance.

3.2 Review of LRAIC calculations for Gatwick

3.2.1 Introduction

Our understanding is that Gatwick commissioned the model by FTI Consulting to contribute to the CAA's assessment of market power at Gatwick Airport. Gatwick intended to inform the debate on market power and the competitive price level.[83] Gatwick did not intend the model results to address the question of how LRAIC could be used to set price caps.

The main purpose of this review is to analyse the underlying assumptions and theoretical underpinning of the model and assess the sensitivity of the calculations to changes in key assumptions. Whilst we comment, where relevant, on the values of some of the inputs, our remit is not to undertake a technical audit of the investment plans.

This sections presents a summary of our review- please see the Appendix for the full version.

3.2.1.1 Information sources

Information used for this critique includes:

- FTI Consulting's draft LRAIC model for Gatwick Airport ("draft for CAA December 2011"). This model is the main subject of our review.
- FTI Consulting's presentation of the model to the CAA workshop.[84]
- FTI's reconciled LRAIC model for Gatwick ("2 November 2012"). This model reconciles the differences between the original model and a model developed by FTI Consulting using the approach the CAA used in 2008 in the Stansted price review.[85]
- FTI Consulting's report on the reconciled models which attempts to address comments raised by the CAA on the original model.[86]
- Gatwick Airport's Master Plan (July 2012) and Capital Investment Plan (August 2012). These contain information about Gatwick's expenditure plans, the levels of increased capacity that could be achieved and traffic forecasts. However the Plan does not provide detailed data on capital investment to enable straightforward reconciliation with the data included in FTI Consulting's model.

[83] CAA 'Gatwick - Market Power Assessments Non-confidential Version: The CAA's Initial Views', February 2012

[84] FTI Consulting 'LRAIC for Gatwick Airport: Presentation to CAA workshop' 7 December 2011

[85] The key differences between the two models is that FTI Consulting's own approach considered in more detail the phasing of capital expenditure, and the profile at which new passengers would take up the newly available capacity. The traffic forecast used by FTI is based on the one elaborated by Gatwick in 2011. Due to the decrease in traffic since 2008, the forecasted growth by FTI/Gatwick is lower than the one used by CAA in 2008,

[86] FTI Consulting 'Long run average incremental cost of airport capacity – an update for Gatwick Airport Limited' 2 November 2012

3.2.2 Review of FTI Consulting's Approach

3.2.2.1 Definition of the increment

FTI Consulting uses the following increments in its model:

Increment 1 – small increase in capacity

A series of capital projects which would have the combined effect of providing capacity for an additional eight to 10 million passengers per annum ("mppa") by around 2025 (from 35mppa to 43-45mppa). Based on actual plans provided by Gatwick, with a capital cost of around £1.3bn in 2013/14 prices. The projects include those directly related to capacity enhancement (around 70 per cent of cost), as well as those related to quality improvements which enhance capacity (around 30 per cent).[87] The length of the forecast period is 25 years for Increment 1, from the end of the capital expenditure in 2018/19 until 2043/44.

Increment 2 – additional runway

This estimates the costs of constructing a new terminal, a second runway and associated other infrastructure. The additional new capacity would be between 27 mppa and 37mppa (from 43mppa to 70-80 mppa). The cost estimates for this project are indicative, and range from £3bn to £5bn in 2013/14 prices.[88] The forecast period is until 2058/59, 35 years after the new capacity enters service in 2023/24.

Increment 3 – replacement airport

This estimates the replacement cost of a new airport under three scenarios: on a similarly located greenfield site (both with and without the cost of acquiring the land) and on the basis of replacing the airport on its existing site (brownfield).[89] The costs are indicative and range from £6.5bn to £8.3bn in 2013/14 prices. These costs vary according to a number of underlying assumptions, including the resale value of the current land. The present value of these capital expenditure programs falls between £5 and £5.9 billion. In light of the value of Gatwick's RAB (£2.2 billion) and total fixed assets (£2 billion) at the end of March 2012, we find these estimations notably high (even though the total fixed assets do not account for inflation). Under all of these scenarios, FTI assumes that the new airport would accommodate 45 mppa upon opening, consistent with the capacity of Gatwick Airport after the projects considered in Increment 1. For Increment 3 the airport enters service in 2020/21 or 2023/24 depending on the scenario. The forecast period is 35 years after the capacity enters service.

Although the costs of the new airport are very indicative, an implicit assumption of the model is that the replacement airport would be of similar configuration to the existing one, allowing for a slight increase in capacity similar to Increment 1.[90] This is unlikely to be the approach that would be taken in a bottom up LRIC assessment, since the present configuration at Gatwick has built up over a number of years and could be improved.

The LRAIC figures for the three increments are summarised in the table below.

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[87] The capital costs quoted here represent the model's central estimate. Options exist for excluding quality-related investments, or including other types of investment such as asset replacement.

[88] This is based upon the CAA's estimate of the cost of delivering similar additional capacity at Stansted (£2.5bn), adjusted for inflation and allowing some additional headroom for the likely higher costs of undertaking such a project at Gatwick, particularly with respect to the cost of acquiring the necessary additional land.

[89] 'Brownfield' site assumes the land is set up for an airport, including connections to utilities and transport, and all planning permission and land acquisition costs. 'Greenfield' site assumes the use of new land not currently set up for an airport. Costs therefore include land acquisition and planning, and connects to utility and transport services.

[90] We base our reading on this on FTI's description of the Increment in its presentation "we assume a replacement airport is built on a brownfield site with the same characteristics as Gatwick's current site": FTI Consulting 'LRAIC for Gatwick Airport: Presentation to CAA workshop' 7 December 2011 and on the discussion about the historical development of Gatwick in FTI Consulting 'Long run average incremental cost of airport capacity – an update for Gatwick Airport Limited' 2 November 2012, page 23-24

Table 3.2: Summary of FTI Consulting's model increments

Increment	Description	Incremental passengers	Capital costs (2013/14)	£/passenger
Current average price	2011/12 level in 2013/14 prices[91]			9
Increment 1	Indicative capital programme	8 – 10 mppa	£1.3bn	10 – 11
Increment 2	Additional runway	27 – 37 mppa	£3bn - £5bn	14-28
Increment 3a	New airport: relocation	45mppa	£8.3bn	20
Increment 3b	New airport: relocation net of sale value	45mppa	£7.3bn	17
Increment 3c	New airport: brownfield site	45mppa	£6.5bn	15

Source: FTI Consulting 'LRAIC for Gatwick Airport: Presentation to CAA workshop' 7 December 2011

3.2.2.2 Most relevant increment

In the context of FTI's model, the purpose of the LRAIC calculations is to provide price benchmarks against which to compare the current price cap. The assumption is made that the LRAIC estimates represent the competitive price level.

In our view, the relevant increment to LRIC calculations is the service or product for which prices are to be determined.[92] In the context of Gatwick Airport this is at present the airport as a whole — Increment 3. However, estimates should be of the costs of the most modern, efficient airport configuration, using modern equivalent asset valuations rather than the costs of replacing the existing airport. MEA valuations would reduce the estimates.

Although the model does not go into detail about the design of the new airport in Increment 3, it is implied that the costs are associated with reconstructing Gatwick as it is today (with some additional capacity), including airport services not related to passenger capacity and keeping the same airport structure. In our view, Gatwick airport could be more efficiently configured, for example by having a 'toast-rack' of terminal buildings between two runways. If only one runway was built to begin with, the terminals would still be placed such that a second runway could be built on the other side.

It may be argued that the historic development of Gatwick has resulted in its current configuration and therefore a replacement cost that replicates this is appropriate. However, a LRIC based on replacement costs must reflect modern costs; in a competitive market, the current level of Gatwick prices would be constrained by the price that a new entrant could charge – this would be based on the costs of the most efficient airport configuration.

If the resulting LRIC estimate is below the current cap at Gatwick, this could imply that the assets have been earning too high a return. If the resulting estimate is above the current cap, this could support the view that prices at Gatwick are below the competitive price level.[93] It may also be reasonable to use these

[91] This is the value reported by FTI. The price cap according to the price determination (including RPI-0.5% for the one year extension of Q5) would be £8.79 per passenger in 2012/14 prices, assuming that the future annual inflation (according to RPI) is 3 per cent.

[92] For example in telecoms the whole termination service; in electricity, the peak capacity flows.

[93] It would also be important to consider additional evidence such as the level of airport charges at comparable or competitive airports

LRAIC estimates to help to set per-passenger prices at the airport as a whole as this is the directly reflected by the increment.

We should however here repeat the caveat attached to the estimates presented: they are based on cost of projects provided by the airports, and have not been audited for cost-effectiveness. In particular the replacement costs for Gatwick are higher by an order of magnitude than the current fixed assets.

The other increments

The relevance of the LRAIC of a second runway would depend on willingness to pay for the additional capacity.[94]

If an airport has market power, then there is a danger in using a (higher) LRIC for the increment to set average process at the airport as a whole as the airport could inflate the costs or need for the expansion and use its market power over existing customers to extract higher prices (as in a RAB-based approach).

3.2.2.3 Inputs and data

The data used in the model vary in detail across the three increments. We describe and comment briefly on the inputs used for the three increments.

Increment 1 - small increase in capacity.

The data are relatively detailed as they represent actual investment plans of Gatwick Airport Ltd. (GAL), although the plans not been reviewed by an independent body. The data specify the fraction of each cost item that is allocated to an increase in available capacity, quality enhancements or asset maintenance. FTI Consulting assumes a weighted average asset life for the new assets of 23 years.[95] Capital maintenance is three per cent of additional capex and begins 10 years after construction is completed.[96] Operating expenditure and non-aeronautical revenue have been hard-coded into the model and therefore we cannot assess how they were derived.

Increment 2 – additional runway

Data for Increment 2 are less detailed than those used for Increment 1, and are based on costs developed for Stansted on the building of a second runway.[97] Whilst this increment may be more appropriate for the calculation of LRAIC for setting price limits, the high-level nature of the data means that the results should be treated with more caution.

We have the following additional comments to make on the data used for Increment 2. Some of these comments also apply to Increment 3:

- Capital expenditure. Whilst the costs associated with an additional runway at Gatwick are indicative, they are nevertheless based on high estimates of a similar capacity increase at Stansted (approximately £2.5 billion). Updated figures based on analysis by the Competition Commission are available (ranging

[94] Even if there is a capacity shortage in the South East, the locational differences between the airports and planning barriers make it impossible to assume that the demand for additional capacity must equal the demand for additional capacity at Gatwick.

[95] It is our view that asset lives could be significantly longer than this – at least 35 years (the Annual Report gives a range of 20 to 60 years as the depreciation period).

[96] In our view a figure of 3 per cent is very high. It is likely that maintenance will be needed at an earlier stage, at a lower proportion of capital expenditure in the early years. See further comments in the Appendix.

[97] CAA reference to the Competition Commission for Stansted Airport: Supporting paper III Advice to CAA on BAA's Capital Investment Plans at Stansted Airport, May 2008

from £1.6 to £1.8 billion) which, if used as a base by FTI Consulting, would significantly reduce the indicative costs of the additional runway.[98]

  - Asset lives. FTI Consulting assumes the combined asset life of the new capacity is 35 years. In our view this is reasonable, although a longer asset life might also be appropriate (up to 50 years).

- Operational expenditure. Opex is assumed to be equal to non-aeronautical revenue and therefore not modelled for Increment 2 or Increment 3. Our view is that opex and non-aeronautical revenue should be modelled separately as these are likely to be different: for example, opex at Gatwick in 2011/12 was approximately £287 million and non-aeronautical revenue approximately £166 million.[99] If revenue and opex had each been modelled as a function of passenger growth it would have been relatively straightforward to include these in the model.[100]

Increment 3 – new airport

FTI Consulting uses information from GAL, BAA/Stansted and its own assumptions to estimate the capital costs of building a replacement airport under the three scenarios. The present value of the capital expenditure in these scenarios is £5.9bn, £4.99bn and £5.4bnbn respectively. The level of detail for Increment 3 data is significantly less than the other options, although many of the underlying assumptions are the same.

3.2.2.4 Modelling decisions

Models are sensitive to both the values of the inputs and to the modelling approach. In the appendix we discuss some of key elements of FTI Consulting's approach, including the nature of capital investment, the timing of revenue, opex and capital investment, the treatment of incremental passengers and inflation of capital expenditure.

3.2.2.5 Sensitivity analysis

We conduct sensitivity analysis on key assumptions and inputs. We do not analyse any detailed changes to the modelling approach – our model for Gatwick will include the modelling decisions that we consider more appropriate. The Appendix contains full details of our sensitivity analysis, including tables.

The results of the sensitivity analysis show that the LRAIC calculations are very sensitive to changes in capital costs and demand forecasts. In particular, if the assumed long-run traffic growth rate is reduced to 2 per cent, then the LRAIC estimate increases by 15 per cent for Increment 2. The change in demand forecasts does not affect Increment 3 as this assumes a constant increment of 45mppa. Changes of approximately one percentage point in the discount rate have a moderate effect, leading to variations in the LRAIC estimate between 9 and 16 per cent. The calculations are also sensitive to the assumed maximum capacity of the investments and hence the number of incremental passengers in each in increment. The assumed asset life, on the other hand, does not affect the estimates by so much. An increase in the assumed the lives of assets to 30 and 45 years leads to a decrease in the calculations of only between 4 and 6 per cent.

FTI Consulting conducted further sensitivity analysis in response to queries by the CAA, using a simplified model. The full results are presented in the appendix. The main differences between the full and simplified model are a consequence on different assumptions regarding the initial volume of passengers and the date

[98] The original CAA reference to the Competition Commission included costs of approximately £2.5 billion. These were subsequently reduced significantly by the Competition Commission and its consultants to between £1.6 and £1.8 billion. See ASA and Competition Commission: 'Review of the master plan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008.

[99] Operating costs exclude depreciation, and non-aeronautical revenue consists of retail and car parking revenue. See Gatwick Airport Limited Report and Financial Statements for the year ended 31 March 2011, page 15

[100] Additionally, the traffic would affect operating expenditure and revenue differently, typically leading to different estimations for each of these categories.

when the expansion becomes operational. Each of these assumptions accounts for differences of between £6 and £14 per passenger in the LRAIC estimate.

Table 3.3: FTI Consulting's sensitivity analysis

	Option 1		Option 2		Option 3		
(£/pax)	Low	High	Low	High	A	B	C
FTI Consulting estimate of LRAIC using CAA approach	**12**	**14**	**15**	**25**	**10**	**9**	**9**
Impact of adding incremental volume on day 1			-7	-11			
Impact of asset life ending in 2043/44	1	1					
Impact of using a growth forecast instead of the average growth rate	-1	-1					
Impact of pre-day 1 incremental passenger volume	-3	-3					
Impact of using a 3% instead of a 2% growth rate			-1				
Impact of future operational start date			7	14	10	8	6
FTI Consulting estimate of LRAIC using the FTI Consulting approach (Dec 2011)	**10**	**11**	**14**	**28**	**20**	**17**	**15**

Note: FTI Consulting's sensitivity analysis was conducted on the results of their simpler model (CAA approach); the results of their original model are shown as a cross-reference.
Source: FTI Consulting (2012) 'Long Run Average Incremental Cost of airport capacity – an update for Gatwick Airport Limited, page 19

3.3 Summary

The LRAIC calculations are sensitive to both inputs and the modelling approach taken. If these estimates were to be used to help to set price caps, careful scrutiny of inputs would be needed (in particular capital costs). The greater the detail of the input data, the more accurate the modelling approach is likely to be; for example, the timing of investments and relationship between opex and revenue and passenger numbers would be better informed. The modelling of incremental passenger flows, however, may be more subject to discretion, for example deciding whether incremental passengers can be counted whilst investments are still being made.[101]

[101] We consider that incremental passengers should be counted only when the baseline capacity is reached and the increment (or the corresponding phase) is ready. However, FTI's approach includes passengers as incremental as long as they exceed current traffic levels (not capacity levels), independently of the date when the capital investment is finalised.

4 LRIC Estimates for Stansted

4.1 Introduction

This model is intended to illustrate the LRAIC per passenger of different capacity increments for Stansted Airport. The increments chosen relate to capacity expansions that have either been proposed in the past or are currently being considered by Stansted. Our purpose is not to conclude what the most appropriate expansion at Stansted would be, and therefore we do not undertake a detailed audit of the proposed capital projects, nor comment on the likelihood of these occurring. Before price limits were set on the basis of a LRIC calculation, the input assumptions would need to be subject to greater scrutiny.

In some instances a level of judgement is required in deciding which data are most appropriate to use for the modelling. For this Europe Economics has drawn on the technical expertise of our external advisor from MSP solutions (an aviation consultancy).

We present a summary of our modelling process here. Please see the Appendix for a full description.

4.2 Model structure

Our long run average incremental cost calculation is of the form:

$$\text{LRAIC} = \frac{\text{Sum of the present value of net costs forecast over the investment horizon}}{\text{Sum of the present value of number of passengers over the investment horizon}}$$

The present value (PV) of net cost is (capital expenditure + operating expenditure –non-regulated expenditure) over the investment period, discounted at the assumed cost of capital. The PV of passengers is the additional number of passengers related to the investment over the investment period, discounted at the same rate.

4.3 Demand forecasts

Stansted traffic forecasts until 2018/19 are based on the Memorandum of Information submitted by Stansted to the CAA.[102] These forecasts assume a starting point based on forecasts of overall traffic growth [✂].[103] These forecasts have been revised to include consideration of incentive-led growth at Stansted. The timescale is extended to 2020/21 using forecasts from Stansted's draft Strategic Business Plan 2011 assumptions.[104] We assume that the incentive-led growth will tail off after the Information Memorandum forecast period. To reflect this, we assume the central average long-run growth will converge to [✂]'s central scenario after the end of the Information Memorandum forecast period. Instead of a sudden transition to [✂]'s lower growth scenario, we assume that the decrease in the growth rate occurs smoothly over a five year period.

[102] Stansted Airport, 'Information Memorandum' October 2012
[103] [✂]
[104] Stansted Airport 'Draft Strategic Business Plan 2011'

Table 4.1: Stansted Passenger Forecasts

	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Passenger (m)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Growth		[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Long-term annual growth rate beyond 2020/21		[✂]							

Notes: 1. Forecasts until 2018/2019 from Stansted Airport, 'Information Memorandum' October 2012, adjusted to spread over financial year. Forecasts for 2019/2020 onwards from Stansted Airport 'Draft Strategic Business Plan 2011'. Long-term growth beyond 2020/21 based on average of central forecast estimate (2012/13 – 2023/24) from [✂]

The central forecast estimates [✂] are more conservative [✂] as they do not assume any discount-driven growth. We conduct sensitivity analyses on our model using these more conservative figures.

4.4 Definition of increments

Our LRAIC model for Stansted covers three increments based on expansion plans published at different times by Stansted, but with some adjustments which will be explained, and a fourth which would represent the services provided by the airport as a whole combined with the current expansion plans.

The plans were, in chronological order:

- Increment One - based on SG1 plans in 2006, updated to current prices (2011/12). These plans would provide an increase in airport capacity to 35mppa from current assumed maximum capacity of 25mppa.[105] The additional number of passengers that can be attributed to the investment is uncertain, as Stansted has implied that the proposed investments were designed to bring the full capacity of 35mppa into full use but include some spending for purposes other than capacity increase. We divide this increment into two options: Increment 1(a) excludes projects not clearly related to capacity expansion; Increment 1(b) includes all projects in the SG1 plans.
- Increment Two – based on SG2 plans from 2008, also updated to current prices (2011/12). These plans would provide a further increase in airport capacity with additional runway and terminal facilities to 70mppa. They are additional to Increment One (i.e. assume baseline capacity at 35mppa). There is a clearly attributable link between the investment and the additional 35mppa.

  (These plans were not implemented, although some projects were carried out from those in SG1 and SG2).
- Increment Three – based on current plans (2011), representing remaining investment projects needed after capacity reaches 25mppa in order to utilise maximum terminal capacity of 35mppa.
- Increment Four: - a whole service increment for Stansted Airport, representing the modern equivalent asset value (MEAV) of Stansted airport at the existing site. The increment is based on the value of the tangible fixed assets as seen in Stansted's statutory accounts (1999 – 2011) indexed to account for inflation, and the current investment plans (represented by Increment 3) The capacity of the airport will be 35mppa. The method used to estimate the cost of this increment is to apply appropriate inflation indices to the different types of asset in which Stansted has invested; this is a "top down" approach to LRIC. In a bottom up approach, there would be estimates from airport planners and engineers on which to base the assumptions of the airport assets in their most efficient configuration, but such information is not available. The bottom up approach would be preferable in principle, although it would involve a greater need for judgement to be applied, and therefore offer more scope for disagreement.

[105] Estimating current levels of capacity is not straightforward, since the numbers of passengers landed depends in the turn-round times achieved by different airlines and on airlines' willingness to use off-peak times of day.

- The table below summarises the main elements of the four increments. Further detail about the capital expenditure is provided in the Appendix.

Table 4.2: Description of Increments

	Increment 1(a) (2006)	Increment 1(b) (2006)	Increment 2 (2008)	Increment 3 (2011)	Increment 4
Baseline capacity	25mppa	As 1(a)	35mppa	25mppa	
Capacity on completion of plan	35mppa	As 1(a)	70mppa	35mppa	35mppa
Incremental capacity	10mppa	As 1(a)	35mppa	10mppa	35mppa
Capital expenditure (£m at 2011/12 prices)	231.8	595.3	1,798	[✂]	2,285
Forecast period (years)	35	35	50	35	50
Information source	Capital projects in SG1 plans (2006)	Capital projects in SG1 plans (2006)	Capital projects in SG2 plans (2008)	Capital projects in draft Strategic Business plans (2011)	Tangible fixed assets in Stansted's Financial Statements (1999 – 2011) plus Increment 3
Investment projects included	Projects clearly relating to relevant capacity increase	All projects	All projects	Projects identified by Stansted as necessary for completing capacity increase	The MEAV (as indexed) of existing assets plus projects identified by Stansted as necessary for completing capacity increase

Notes: 1. Projects for Increment 1 selected from Scott Wilson assessment of Stansted Airport CIP in 'CAA reference to the Competition Commission for Stansted Airport, Supporting paper II: Advice to CAA on BAA's Capital Investment Plan at Stansted Airport, April 2008. Relevant projects selected from airline and ASA commentary in Competition Commission 'Stansted Airport Limited: Q5 price control review, October 2008, Appendix F'.
2. Projects for Increment 2 taken from ASA and Competition Commission: 'Review of the master plan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008. We used ASA's 'minimum cost' estimates.
3. Projects for Increment 3 selected from Stansted [✂]. Increment 4 is based on the fixed assets found in Stansted's statutory accounts (1999 – 2011) indexed to account for inflation (using COPI)

4.5 Inputs and assumptions

The model inputs and assumptions are similar across increments, with the exception of capital expenditure. We first discuss the capital expenditure associated with each increment, and then present the other inputs and assumptions.

4.5.1 Capital investment

Increments 1(a) and 1(b)

The capital projects included in Increment 1(a) and 1(b) are taken from Stansted's investment plans for SG1 adjusted for efficiency, as they appear in the CAA's reference to the Competition Commission.[106] Whilst our remit for this work does not include a technical audit of the capital plans, we have reviewed the

[106] 'CAA reference to the Competition Commission for Stansted Airport, Supporting paper II: Advice to CAA on BAA's Capital Investment Plan at Stansted Airport, April 2008

projects listed and assessed the extent to which they can be considered to add to capacity. Increment 1(a) only includes those we consider capacity enhancing – a total of a total of £231.8 million in 2011/12 prices. Increment 1(b) includes all projects – a total of £595.3 million in 2011/12 prices.

Increment 2

The capital projects included in Increment 2 originate from Stansted Airport but were revised by the Competition Commission and its consultants in the Q5 price control review.[107] As Increment 2 is a discrete set of investments for an additional runway and terminal facilities, we consider all capital projects relevant, although this might be an overestimate as some of the investment is likely to lead to higher service quality for example in terms of airport ambience.[108] Implicit in the SG2 plans is some allowance for full-service airlines. However, for the purposes of the modelling exercise we take the necessary projects at face value. We have nevertheless excluded the allowance for "risk" so as to include what we assume was intended to be the central cost estimates for each project. The full capital cost is £1.8 billion in 2011/12 prices– see the Appendix for the full list of project.

Increment 3

The projects for Increment 3 are selected from Stansted's response to the CAA's request for information on the costs and timings for investment necessary for completing the expansion to 35mppa.[109] The table below presents the capital projects considered relevant by Stansted. These are a sub-section of the projects included in Stansted's draft Strategic Business Plans 2011.[110] Total capital cost is £ [✂] million in 2011/12 prices, see Appendix for more details.

These investment projects are those necessary to complete the expansion of Stansted and therefore do not represent the entire capital expenditure that has been necessary to move Stansted to a maximum capacity of 35mppa. For example, the terminal building can already accommodate 35mppa; these investments are just the remaining ones needed to enable the airfield to accommodate this increase in passenger numbers. Therefore any LRAIC estimate using only these capital projects will be very low, as the full additional 10mppa is being attributed to only a proportion of the expenditure. This highlights the importance of the definition of the increment to LRAIC calculations.

In addition, as we have already noted, estimating the existing maximum capacity at Stansted without these investments is not a straightforward matter. Capacity depends in part on the type of airlines using the airport (with different turnaround times) and therefore existing capacity may be somewhere between 25mppa and 30mppa. For the purposes of our modelling exercises we have assumed that the baseline maximum capacity before these investments is 25mppa, based on Stansted's response to the CAA that these investments would be needed after demand reaches 25mppa. Some investments are phased in once capacity is at 30mppa.

Increment Four

This increment represents the replacement costs of Stansted Airport at the existing site. We note that for a potentially more accurate bottom up LRIC calculation to be conducted the modern equivalent asset values for the most up-to-date and efficient airport configuration should be used. However, even with this approach any proposed airport configuration would be a matter for professional judgement, which could vary between experts and be a matter for argument. As this information is not available to us we estimate

[107] Competition Commission and ASA Consulting 'Review of the Masterplan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008.
[108] For example, this can be seen following the investment in Heathrow Terminal 5 which has higher customer satisfaction rating than other terminals at Heathrow.
[109] Stansted [✂]
[110] Stansted: Draft Strategic Business Plan: Planning for the future - a consultation, August 2011

an indicative cost based on adjustments to the current asset base at Stansted by inflating the costs of assets by the construction price index increases since the time each asset was purchased, using the "top down" approach. We include estimated MEA values of the existing assets on this basis as well as the final investments needed to bring the capacity to 35mppa (as represented by Increment 3). We consider only those assets directly related to the airport (excluding, for example, office buildings and land held for development). We assume the airport is constructed over a five-year period from 2011/12, to be ready in 2016/17. When it opens we assume that the traffic level will be high enough to have the airport operate at full capacity throughout the increment duration (35mppa). [111]

We emphasise that the replacement costs are based on indices and indicative and subject to uncertainty regarding the true modern equivalent asset values.

We do not make any downward adjustments for efficiency gains. We use available data on existing assets from the Financial Statements available in Stansted's Annual Reports from 1999 – 2011. In order to arrive at an approximation of the MEA values for the existing assets relevant to the airport we consider the following:

- Current configuration — we assume the current configuration represents the modern efficient equivalent given that the airport is relatively new and well-designed, and in the absence of information about an alternative configuration or specification.
- Efficient capacity — we assume that the capacity of the current airport (after final investments) is needed and would be replicated in a replacement airport.
- We consider the following asset categories directly relevant to the airport:[112]
  - Investment properties (in 2011 the majority of assets in this category were directly related to the airport (such as car parks and the airfield). Approximately seven per cent relate to offices and industrial which we do not consider directly relevant and so exclude.[113]
  - Terminal complexes
  - Airfields
  - Plant equipment and other assets
  - We do not include 'land held for development' as this is entered into investment properties once it comes into use; or 'group occupied properties/other land and buildings' as this appears to relate to buildings for the BAA Group as a whole and not directly to the airport.
  - Neither do we include 'assets in the course of construction' as these are added to the other relevant asset groups when complete. The exception is 'assets under construction' in 2011 which should be included in the asset base but which would not yet have been allocated to a specific asset group.
- We assume that the disposals reflected in the final values of the assets were made at fair value and represent the removal of unwanted assets from the total value which should not be included in a MEA valuation (such as the removal of planning costs associated with the redundant second runway plan).
- The 'investment properties' are valued each year and as such the final value in 2011 represents the modern equivalent value.[114]

[111] In our sensitivity analysis, we consider the alternative in which traffic would be equivalent to the forecasted levels at Stansted in 2016/17 (21 mppa).

[112] These asset categories are taken from the latest financial statement: Stansted Airport Limited 'Annual report and financial statements for the year ended 31 December 2011', page 28

[113] See the CAA 'Mid-quinquennium review – Stansted RAB' May 2012, page 8

[114] See Stansted Airport Limited 'Annual report and financial statements for the year ended 31 December 2011', page 29

- The terminal, airfields and plant and equipment are valued at historic cost and not updated for inflation. We adjust for inflation in the following ways:
  - For terminals and airfield we use COPI; for plant equipment and other assets we use RPI in the absence of another index.[115] If a more specific index for equipment assets were available this may affect the MEA values.
  - We take the asset value at 1999 as the base value for each category and update it to 2011 prices. We first inflate the 1999 value on the assumption that this was the same value in 1991 when the airport came into use.[116]
  - For each asset category we update the additions to the assets in each year by the correct index (COPI or RPI) for that year. These are net of disposals for that year.

We note that if the value of the land upon which the buildings and airfield are based is not reflected in the value of these assets, then the total MEA value of the replacement airport would be higher. We also note that there are no assets dedicated to the provision of utilities or transport in the financial statements. Again, if these values are not reflected in the available assets then the total MEA value of the replacement airport would be higher.

The table with the detailed updated asset values is presented in the Appendix.

We assume an average asset life of 50 years for the replacement airport.[117] Other general assumptions on the relationship between operating costs and non-regulated revenues, and passenger numbers; maintenance; demand forecasts and cost of capital are the same as the other increments.

The table below summarises our other key inputs and assumptions. More details are contained in the Appendix.

[115] The other possible indexes are Producer index and Consumer index, neither of which seemed significantly preferable.

[116] We note that this may overstate the value of the asset base in 1999 as additions to the base are likely to have been made between 1991 and 1999 and should not be subject to inflation for the whole period. However, in the absence of data from 1991 we consider this the best way to account for inflation. Further, it may be likely that no substantial investment was made in the first few years of the airport coming into operation.

[117] Our sensitivity analysis on assets lives (40 and 50 years) does not result in a significant change in the LRAIC calculations

Table 4.3: Model Inputs

	Central estimate	Source
Cost of capital	7.1%	[✂]
Maintenance cost (proportion of capex)	0.58%	Maintenance as proportion of cost-value assets (£9.9m/£1,695.2m), Stansted Airport Limited Annual Report 2011, pages 4 and 28
Maintenance timing	To begin 5 years after expenditure	
Forecast period	Weighted average asset life (between 35 and 50 years)	Europe Economics' judgement
Operating costs (elasticity of passenger growth)	0.44	Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, p57
Non-regulated revenues (£/pax)	[✂]	Stansted Baseline Business Plan, 31 May 2012 p36.
Fixed revenue for Increment 4 (to account for all airport revenue, not just that which varies with passenger traffic)	£28m in 2011/12	
Inflation		ONS, CPI And RPI Reference Tables, Table 20: RPI all items index: 1947 to 2012, August 2012 BIS, Construction Output Price Indices, Table 1: Output Price Index for New Construction (2010), - September 2012.
- Retail revenues	RPI	
- Capital expenditure	COPI	

4.6 Costs per passenger

The LRAIC per passenger are shown in the tables below.

Table 4.4: LRAIC model results, 2011/12 prices: key components

	Increment 1(a) (2006)	Increment 1(b) (2006)	Increment 2 (2008)	Increment 3 (2011)	Increment 4
PV capex (£m)	150.4	386.4	482.6	[✂]	2,097.8
PV opex (£m)	192.5	192.5	180.5	192.5	2,131.0
PV non-regulated revenue (£m)	247.5	247.5	232.1	247.5	1,952.43
PV pax (m)	54.0	54.0	50.6	54.0	362.5

Note: present values are all discounted back to the same point (2011/12) and therefore very large values that are incurred further into the future (such as Increment 2) appear of similar magnitude to smaller values incurred earlier. **Table 4.2** presents the undiscounted costs for comparison.

Table 4.5: LRAIC costs per passenger, 2011/12 prices

	Increment 1(a) (2006)	Increment 1(b) (2006)	Increment 2 (2008)	Increment 3 (2011)	Increment 4
LRAIC (£/pax)	1.8	6.1	8.5	0.8	6.3

As the table shows, the LRAIC per additional passenger is highest for Increment 2 at £8.5 (the additional runway), followed by Increment 4 (the replacement airport) and Increment 1(b) (the full SG1 investment plan) at just over £6. Increment 1(a) and Increment 3 are the smallest, at £1.8 and £0.8 respectively. This is due to the very small capital expenditure attributed to the increase in capacity from 25mppa to 35mppa.[118]

We note that for increment 1(a) and Increment 3 the operating costs and non-regulated revenues are greater than the capital expenditure. This is because these two variables are entirely dependent on passenger traffic and not capital expenditure. The definition of the increments is such that a relatively small capital expenditure is related to a large incremental increase in passengers.

The LRAIC for Increment 4 is lower than for Increment 2 despite the capital costs being higher. This is because the incremental number of passengers for Increment 4 is higher (as represented by the total number of airport users when the airport opens, rather than just the additional passengers over and above current capacity as in Increment 2).

We also note that the LRAIC for Increment 4 is lower than the current RAB-based price cap. As this increment considers the whole airport, the same assets, operating expenditure and estimates for unregulated revenues are used (of course, some differences will exist due to the different levels of accuracy of our calculations compared with those conducted for a price control). The main area of difference is the value of the assets, as we have attempted to represent modern equivalent values by using a more relevant inflation index than the RPI, which CAA uses to inflate the RAB. However, as we have made no downward adjustments for efficiency, and as COPI increased by more than RPI over the period since Stansted was built, one would expect our LRAIC estimate to be higher than the RAB-based figure. The key difference, therefore, lies in the treatment of incremental passengers in our model. We have assumed that the new airport, when built, opens to its full capacity of 35mppa, whereas a RAB-based approach today would only include current traffic, making the average cost higher.

The model results highlight the importance of the definition of the increment, in particular obtaining a realistic relationship between costs and additional volumes. The results also highlight the sensitivity of LRAIC calculations to capital expenditure estimates. Increments 1(a) and (b) are very similar save for the capital projects included, and the estimates for 1(b) are significantly higher than for 1(a).

4.7 Sensitivity analyses

The LRAIC calculations are sensitive to changes in a number of key variables. The table below shows the sensitivities considered.

[118] [✂]

Table 4.6: Description of sensitivities considered

Discount rate	We consider two alternative scenarios using 6 and 8 per cent as the discount rate.
Traffic	Our sensitivity analysis uses two alternative demand forecasts from Increments 1-3. First, we consider [✂]'s central scenario and we assume that the long run growth rate is average for their forecast period, which covers Q6 and Q7.[119] Second, we use Stansted's Information Memorandum forecasts and we assume that the long run growth rate is this average growth rate in the forecast period.[120] For Increment 4, our sensitivity analysis uses the same traffic forecast as for the other Increments, such that the new airport opens to the relevant passenger throughput for that year, and not to immediate full capacity.
Non-regulated Revenue	We consider two scenarios, in which the non-regulated revenue has been over- and underestimated by 10 per cent from the level in our central estimate.
Capex	We consider two scenarios, in which the non-regulated revenue has been over- and under-estimated by 15 per cent. This percentage increase is in line with BAA's risk factor of about 15 per cent for SG2.
COPI over RPI	We consider the possibility of a change in relative prices, in which construction becomes more expensive relative to other goods. This would be reflected by having annual inflation measured by COPI 1 per cent higher than inflation measured by RPI.
Pax-elasticity Opex	In addition to Steer Davies Gleave's central estimation, we consider two scenarios in which the pax-elasticity of Opex is 0.3 and 0.6. The first scenario coincides with the lower end of the Competition Commission's estimation of this elasticity in 2002.[121]
Timing	In our model, the timing of increment is assumed to be perfect: new capacity expansions open right when they become necessary according to the demand forecast. Our sensitivity analysis considers two possibilities: that the increments are build two years too early (-2) or two years too late (2).
Construction time	For Increment 4 we assume a central construction time of 5 years, and conduct sensitivity around 3 and 10 years.
Inflation for 1991-1999 assets for Increment 4	Our central scenario assumes the 1991 asset base when the airport opened was the same value as the value in the 1999 financial statements (in the absence of other data), and we inflate the 1999 value accordingly. We conduct sensitivity on the alternative: assuming the 1999 value is the correct value for 1999 and do not inflate this.

The full results of the sensitivity analysis are included in the Appendix. We discuss briefly the results of the sensitivity analysis across the five increments.

- Discount rate: a higher discount rate makes the future less valuable relative to the present. Therefore, the benefits of long term investments are smaller compared to their initial cost and the LRAIC increases. The elasticity of LRAIC estimates to changes in the discount rate is relatively high: a one percentage point change in the discount factor changes the LRAIC estimates by between 15 – 30 per cent.

[119] [✂]
[120] See the Appendix for a chart to illustrate different forecasts
[121] Competition Commission 'Stansted Airport Limited: Q5 price control review, October 2008, Appendix H'.

- The model is very sensitive to traffic forecasts, as this affects the number of incremental passengers and the timing of capacity investments. Using the STN IM as a long run forecast increases the long-term traffic growth rate from [✂] per cent to [✂] per cent, leading to a decrease in LRAIC between 6.8 and 32.9 per cent across the four increments. Our second sensitivity analysis, [✂], decreases the volume of traffic in the short run. For Increments 1 and 3, LRAIC estimates increase significantly, due to a fall in the PV of incremental passengers and less-than proportionate fall in the present value of capital costs. However, since Increment 2 takes place significantly later, the change in the timing of investments resulting from the traffic forecast change decreases the present value of capital expenditure by a larger proportion than the other components of the LRAIC calculation, leading to a decrease in the LRAIC estimate.
- Non-regulated revenue: as expected, the sensitivity analysis shows that a change in the amount of non-regulated revenues has the largest effect on Increments 1a and 3, where such revenue is very large in relation to capital expenditure. For Increments 1b and 2, the change in LRAIC is less than 10 per cent from the central estimate.
- Capital expenditure: the LRAIC estimates are very sensitive to variations in capital expenditure, leading to changes between 16.8 and 36.3 per cent across the increments. The elasticity of the changes is also significant – for a percentage change in capital expenditure, the LRAIC figure changes by more than a per cent (between 1.1 and 2.4 per cent across the increments).
- COPI over RPI: our sensitivity analysis shows that a persistent increase of construction prices over average retail prices has a large impact on LRAIC. An increase of COPI of 1 per cent over RPI will have the largest effect on projects with large capital expenditure and those that occur far into the future. [122] This can be seen for example on the effect on the Increment 2 LRAIC, which is over 20 per cent greater than the central estimate.
- Pax-opex elasticity: the difference between the Competition Commission and Steer Davies Gleave estimates has a large effect of our LRAIC calculations. The lower Competition Commission estimate results in a decrease in LRAIC of between 13 and 150 per cent. The Increments where opex forms a large proportion of the overall costs are the most sensitive to changes in the opex-elasticity.
- Timing: our analysis shows that the LRAIC estimates are not greatly affected if the increments occur later than necessary. However, the change in LRAIC caused by making capacity available too early can be significant. The construction of an increment two years too early results in a change of between 18 and 40 per cent across the increments. We consider this a relevant scenario, since airport expansions are planned several years in advance and it is not unlikely that they might be based on traffic forecasts that exceed realised demand.
- The sensitivity analysis shows that the Increment Four calculations are less sensitive to changes in input variables than the other increments. This is most likely to be due to the simplifying assumptions about construction (we do not assume any phasing of construction, and it is not reliant on passenger traffic to signal the need for construction). The elasticity of change with respect to capex is the largest, which is in line with the other increments, highlighting the significance of investment costs to LRAIC estimates.
- For Increment Four our central assumption on the timing of the airport is that it is built today (ready by 2016/17) and opens at full capacity (35mppa). Given the current traffic forecasts at Stansted, this is unlikely to happen. If the building of the airport was delayed until traffic had reached 35mppa (in approximately 2030/31), the LRAIC estimate would increase by approximately 19 per cent to £7.48, as the PV of incremental passengers would be significantly lower. The same outcome would occur if we assumed that the new airport was opened in 2016/17 but opened to the passenger throughput based on current traffic forecasts. The latter situation might imply that the airport was overcapitalised for the

[122] This alternative scenario considers a scenario slightly in excess of the RPI+0.75 per cent recommended by the Competition Commission, but well below RPI+2 per cent, as proposed by BAA. (Competition Commission 'Stansted Airport Limited: Q5 price control review, October 2008', paragraphs 8.118-8.124.)

current traffic, although the expectation of future growth could justify the building of the airport now.[123]

[123] Indeed, this is an advantage of LRAIC calculations, in that they show the effects of building capacity before it is needed. The entrant airport operator's decision on when to build would be informed in part by such calculations.

5 Estimates for Gatwick

5.1 Introduction

This model is intended to illustrate the LRAIC per passenger of different capacity increments for Gatwick Airport, insofar as this is possible using currently available data. The increments chosen relate to capacity expansions that are included in Gatwick's investment plan, based on benchmarking expansion costs from other airports and on the airport's statutory financial statements. Our purpose is not to conclude what the most appropriate expansion at Gatwick would be, and therefore we do not undertake a detailed audit of the proposed capital projects, nor comment on the likelihood of these occurring. Nor is any technical appraisal available of the layout and facilities that would most efficiently supply the levels of service provided by Gatwick.

In some instances a level of judgement is required in deciding which data are most appropriate to use for the modelling. For this Europe Economics has drawn on the technical expertise of our advisor from MSP solutions.

5.2 Model structure

We follow the same model structure as used for our Stansted model. The long run average incremental cost calculation is of the form:

$$\text{LRAIC} = \frac{\text{Sum of the present value of net costs forecast over the investment horizon}}{\text{Sum of the present value of number of passengers over the investment horizon}}$$

The present value (PV) of net cost is (capital expenditure + operating expenditure –non-regulated revenue) over the investment period, discounted at the assumed cost of capital. The PV of passengers is the additional number of passengers related to the investment over the investment period, discounted at the same rate.

5.3 Demand forecasts

Gatwick annual traffic forecasts until 2019/20 are based on the Initial Business Plan To 2020 prepared by Gatwick,[124] which in turn is based on the demand forecast prepared by SH&E.[125] The long-run traffic growth rate, as predicted by SH&E in its base scenario is 1.5 per cent. We project traffic for the remainder of the increment period using this rate as our central scenario.[126] [✂].[127]

[124] Gatwick Airport, 'Initial Business Plan to 2020', April 2012.
[125] This report was prepared in February 2012 and it can be found in Appendix B of Gatwick Airport, 'Initial Business Plan to 2020', April 2012,
[126] We note that this is a low growth rate and that has an impact of the LRAIC estimates. We conduct sensitivities using higher growth rates.
[127] [✂]

Table 5.1: Gatwick Passenger Forecasts

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Passenger (m)	33.7	34.3	35.2	35.7	36	36.4	36.8	37.2	38.1
Growth		1.8%	2.6%	1.4%	0.8%	1.1%	1.1%	1.1%	2.4%
Average long run growth		1.5%							

Note: Forecasts from Gatwick Airport, 'Initial Business Plan to 2020', April 2012.

5.4 Definition of increments

Our model for Gatwick covers three increments. These are described briefly below, with more detail about the inputs in the subsequent sections.

Increment 1 – small increase in capacity

A series of capital projects which would have the combined effect of providing capacity for an additional 10 million passengers per annum by around 2025 (from 35mppa to 45mppa). This is based on actual plans provided by Gatwick, with a capital cost of around £1.26bn in 2011/12 prices. The projects include those directly related to capacity enhancement (around 70 per cent of the total cost), as well as those related to quality improvements which enhance capacity (around 30 per cent).[128] The length of the forecast period is 35 years, from the end of the capital expenditure in 2018/19 until 2043/44.

Increment 2 – additional runway

This estimates the costs of constructing a new terminal, a second runway and associated other infrastructure. The additional new capacity would be 35mppa (increase from 45mppa to 70mppa). The cost estimates for this project are indicative, based on SG2 expansion costs at Stansted Airport of £1.8bn in 2011/12 prices.[129] We add an uplift of £471m to take account of higher land costs at Gatwick.[130] The forecast period is 50 years after the new capacity enters service.

Increment 3 – replacement airport

This increment represents a replacement cost airport built on a site with comparable land value.[131] For a proper LRAIC calculation the costs should reflect modern equivalent asset values and should be based on the most efficient way of providing the existing service. This is likely to imply a different configuration to the current one at Gatwick Airport. As information is not available to us on the nature of this new configuration, we estimate the modern equivalent value of Gatwick's existing fixed assets by inflating their historic cost using the COPI index for relevant assets, and RPI for others. The total cost is estimated at £3.74bn. The capacity of the new airport would be 35mppa. The forecast period is 50 years after the capacity enters service. As these capital costs are based on Gatwick's current assets, which may be higher than a more efficiently configured airport, we include a sub-increment that benchmarks the capital costs on the replacement cost of Stansted used in our model in Section 4, using an uplift for higher land costs. This is shown as Increment 3(b) in the table below.

The figures for the three increments are summarised in the table below.

[128] The capital costs quoted here represent the model's central estimate. Options exist for excluding quality-related investments, or including other types of investment such as asset replacement.

[129] Based on the Competition Commission's analysis in 2008: Competition Commission and ASA Consulting 'Review of the Masterplan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008

[130] Based on half of the land acquisition cost for the whole replacement airport quoted by Gatwick Airport in FTI Consulting's estimate, £942m in 2011/12 prices.

[131] We assume that the value of the land and the connections to utilities and transport are included in the existing asset values for the airport.

Table 5.2: Summary of Increment Description

	Increment 1	Increment 2	Increment 3	Increment 3(b)
Description	Indicative capital programme	Additional runway	New airport	New airport
Incremental passengers	10mppa	35mppa	35mppa	35mppa
Capital costs (2011/12)	£1.26bn	£2.27bn	£3.74bn	£3.23bn
Forecast period	35	50	50	50
Capex information source	Gatwick's Investment plans as used in FTI Consulting's LRAIC model	Benchmark of Stansted's second runway (SG2)	Indexation of existing fixed asset base	Benchmarked against Stansted replacement cost

5.4.1 Modelling of increments

The capital projects for Increment 1 are modelled according to how they have been planned by Gatwick, with different projects occurring at different times. As the costs for Increment 2 and 3 are more indicative, we model these investments as a single expenditure, spread out equally over a set construction period.[132] In our central scenario, increments are timed to become operational in the same period where the additional capacity is necessary to satisfy the forecasted demand.

In our model, all investment takes place at the same time. In reality it is likely that some investments would be phased to make additional capacity available in smaller increments. However, this approach requires a more detailed capital expenditure plan than is available.[133]

We also assume that the additional capacity (and corresponding incremental passengers) is only available once the whole investment plan is complete.

All prices are expressed in the current period (2011/12 in our model), and all present values are discounted back to this period. We have used the Output Price Index for New Construction (COPI) to deflate future capital expenditures to constant 2011/12 prices and the Retail Price Index (RPI) for non-regulated sources of revenue and equipment. Maintenance costs start after a given number of years after the increment has been finalised and are assumed to be a percentage of the capital expenditure.

5.5 Inputs and assumptions

The model inputs and assumptions are largely similar across increments, the main difference being capital expenditure. We first discuss the capital expenditure associated with each increment, and then present the other inputs and assumptions.

5.5.1 Capital investment

Increment 1

[132] In our central scenario, construction requires five years. Our sensitivity analysis considers alternatively construction times of three and 10 years.

[133] If investments are phased over time then the resulting LRAIC estimate is likely to be lower, as the present value of the capital expenditure would be lower for those investments incurred further into the future. This point particularly affects our results for Increment 2.

The data for Increment 1 are obtained from FTI Consulting's model provided by Gatwick Airport as representing 'best prevailing best estimate' of the costs of its preferred projects for developing the airport in line with customer demands and expectations.[134] These data are relatively detailed as they represent actual investment plans of Gatwick Airport Ltd. (GAL).

The capital investment items are categorised as 'capacity enhancement'; 'quality improvement'; 'other non-capacity enhancement' and 'asset maintenance'. In the base case of the model, capacity enhancement projects are included along with an allocation of certain quality improvement projects (at a ratio of approximately 70:30 of the increment costs). In our view it is appropriate to allocate some quality improvements to capacity expansion as these would enhance the utilisation of the existing assets. We have reviewed the allocations used in the model and regard them as reasonable. However, some of the 'capacity enhancement' projects included could be considered unnecessary, and we conduct sensitivities around a lower capital expenditure. The table of all the capital projects is presented in the Appendix.

Increment 2

The capital investment for Increment 2 is based on the costs of the second runway at Stansted Airport. The original costs were provided by BAA, but were revised by the Competition Commission and its consultants in the Q5 price control review.[135] In our model for Stansted we included all the investment costs with the exception of the allowance for risk, which gave a total cost of approximately £1.8 billion in 2011/12 prices. For the Gatwick model we add an uplift of £471m to take account of higher land costs at Gatwick.[136] The full cost of this increment is therefore £2.27 billion in 2011/12 prices.

Increment 3

This increment represents the replacement costs of Gatwick Airport at a site equivalent to the existing one. We include an estimate of the MEA values of the existing assets, and consider only those assets directly related to the airport (excluding, for example, office buildings and land held for development). We do not include Gatwick Airport's current investment plan (used in Increment 1) and therefore the capacity of the replacement airport is 35mppa. We assume the airport is constructed over a five-year period from 2011/12, to be ready in 2016/17. According to the traffic forecast used in the model (from SH&E), the traffic level will be high enough to have the airport operate at full capacity from the date at which it becomes operational.[137]

We emphasise that the replacement costs are indicative and subject to uncertainty regarding the true modern equivalent asset values. We use available data on existing assets from the Financial Statements available in Gatwick's Annual Reports from 1999/00 – 2011/12, bringing them to 2011/12 prices by applying the increases in the COPI for the relevant period for each asset purchased since 1999. For pre-1999 assets, we base our estimates on the financial accounts presented by BAA for its Q3 price control period on 1996, which were reported under a replacement cost basis.[138]

In order to arrive at an approximation of the MEA values for the existing assets relevant to the airport we consider the following:

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[134] We note that the plans have not been reviewed by an independent body, such as the Airports Operating Committee.

[135] Competition Commission and ASA Consulting 'Review of the masterplan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008.

[136] Based on half of the land acquisition cost for the whole replacement airport quoted by Gatwick Airport in FTI Consulting's model, £942m in 2011/12 prices.

[137] [✂]

[138] BAA plc, 'A report on the economic regulation of the London airports companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd)', June 1996

- Current configuration — we note that the current configuration of Gatwick is unlikely to represent the modern efficient way of providing the same services. Therefore our estimate needs to be considered in the appropriate context.
- Efficient capacity — we assume that the capacity of the current airport is needed and would be replicated in a replacement airport.
- We consider the following asset categories directly relevant to the airport:[139]
  - Investment properties: we assume that in 2011/12 all assets in this category were directly related to the airport (such as car parks and the airfield).
  - Terminal complexes
  - Airfields
  - Plant equipment and other assets
  - We do not include 'land held for development' as this is entered into investment properties once it comes into use; or 'group occupied properties/other land and buildings' as this appears not to relate directly to the airport.
  - Neither do we include 'assets in the course of construction' as these are added to the other relevant asset groups when complete. The exception is 'assets under construction' in 2011/12 which should be included in the asset base but which would not yet have been allocated to a specific asset group.
- We assume that the disposals reflected in the final values of the assets were made at fair value and represent the removal of unwanted assets from the total value which should not be included in a MEA valuation (such as the removal of planning costs associated with the redundant second runway plan).
- The 'investment properties' are valued each year and as such the final value in 2011/12 represents the modern equivalent value.[140]
- The terminal, airfields and plant and equipment are valued in the accounts at historic cost and not updated for inflation. We adjust for inflation in the following ways:
  - For terminals and airfield we use COPI; for plant equipment and other assets we use RPI in the absence of another index.[141] If a more specific index for equipment assets were available this may affect the MEA values.
  - We update the prices of asset additions between 1996 and 1999 assuming that the price base is 1995/96.
  - For each asset category we update the additions to the assets in each year by the correct index (COPI or RPI) for that year. These are net of disposals for that year.

We note that if the value of the land upon which the buildings and airfield are based is not reflected in the value of these assets, then the total MEA value of the replacement airport would be higher. We also note that there are no assets dedicated to the provision of utilities or transport in the financial statements. Again, if these values are not reflected in the available assets then the total MEA value of the replacement airport would be higher.

The table detailing the replacement costs values is presented in the Appendix.

[139] These asset categories are taken from the latest financial statement: Gatwick Airport Limited 'Directors' Report and Financial Statements for the year ended 31 March 2012', page 54

[140] See Gatwick Airport Limited 'Directors' Report and Financial Statements for the year ended 31 March 2012', page 55

[141] The other possible indexes are Producer index and Consumer index, neither of which seemed significantly preferable.

For Increment 3(b) we benchmark the costs against the replacement cost for Stansted that we estimated in Section 4: £2.3 billion. We uplift this to account for higher land values at Gatwick –£942.6 million as used in FTI Consulting's mode for Gatwick Airport, in 2011/12 prices. This results in a total of £3.3 billion.

5.5.2 Operating expenditure

Incremental operating expenditure is calculated as a proportion of passenger growth: a one per cent increase in passenger traffic results in a 0.44 per cent increase in operating expenditure.[142] As the largest element of operating expenditure at Gatwick Airport in 2010/11 was staff, it is possible that the figure could be higher due to increased security demands in recent years. We include this in our sensitivity analysis by considering a higher elasticity.

The initial operating expenditure at the start of the modelling period is £280.9 million, which was the value at the end of 2011/12 excluding exceptional costs.[143] For increments 1 and 2, we include only the incremental opex using the elasticity specified above. As Increment 3 relates to the whole airport, we include a baseline opex as represented by the initial operating expenditure at the beginning of the period, and incremental opex using the elasticity for the additional passengers over and above those reflected in the 2011/12 value. For Increment 3(b) we use the initial opex figure from the Stansted replacement cost model (£144.6 million) as the airport structure is based on Stansted. However, as this opex is related to passenger numbers, in our model we adjust the initial Stansted figure to account for higher passenger numbers at Gatwick. We assume that this opex figure reflects the configuration of Stansted.

5.5.3 Non-regulated revenue

We distinguish between the fixed and variable (i.e. related to passenger traffic) components of non-regulated revenue. We regard property revenue as fixed, since it does not depend on passenger traffic. This category amounts to £34.3 million in 2011/12 and it is relevant to Increment 3 only, as it is part of the total airport revenues. Variable revenues are included in all increments, and include retail, car parks and other non-regulated revenues. Our model uses the values for 2011/12 as reported in Gatwick's regulatory accounts for 31 March 2012. We model variable revenue linearly, with each incremental passenger representing £5.76 of additional revenue.

For Increment 3(b) we again use the non-regulated revenue for Stansted as our replacement cost airport is based on a configuration similar to Stansted. [✂]

5.5.4 Summary of general inputs and assumptions

The table below summarises our key inputs and assumptions.

[142] Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, p57. The figure is based on an econometric exercise that related operating expenditure to passenger traffic for a panel of airports. While this report as a whole was developed for Stansted airport, the nature of the benchmarking exercise makes it applicable to other airports as well.
[143] Gatwick Airport Limited 'Regulatory Accounts for year ended 31 March 2012'

Table 5.3: Model Inputs

	Central estimate	Source
Cost of capital	6.5%	Cost of capital at Q5 price control. CAA, 'Economic Regulation of Heathrow and Gatwick Airports: 2008-2013', 11 March 2008, page 121.
Maintenance cost (proportion of capex)	1.2%	Maintenance as proportion of cost-value assets (£35.2m/£2017m), Gatwick Airport Limited Directors' Report and Financial Statements for the year ended 31 March 2012, pages 19 and 54.
Maintenance timing	To begin 5 years after expenditure	
Asset lives	35 years for Increment 1 50 years for Increments 2 and 3	Europe Economics' judgement
Operating costs (elasticity of passenger growth)	0.44	Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, p57
Non-regulated revenues (£/pax)	5.76	Gatwick Airport, Regulatory Accounts 31 March 2012
Inflation - Retail revenues - Capital expenditure	 RPI COPI	ONS, CPI And RPI Reference Tables, Table 20: RPI all items index: 1947 to 2012, August 2012 BIS, Construction Output Price Indices, Table 1: Output Price Index for New Construction (2010), - September 2012.

5.6 Costs per passenger

The estimated LRAIC per passenger are shown in the tables below.

Table 5.4: LRAIC model results, 2011/12 prices: key components

	Increment 1	Increment 2	Increment 3	Increment 3(b)
PV capex (£m)	1,069.96	924.52	3,675.98	3,173.86
PV opex (£m)	206.85	177.40	3,269.67	2,354.71
PV non-regulated revenue (£m)	325.01	278.74	2,701.09	2,155.80
PV pax (mppa)	56.4	48.4	400.6	400.6

Note: present values are all discounted back to the same point (2011/12) and therefore very large values that are incurred further into the future (such as Increment 2) appear of similar magnitude to smaller values incurred earlier.

Table 5.5: LRAIC model results, 2011/12 prices: cost per additional passenger

	Increment 1	Increment 2	Increment 3	Increment 3(b)
LRAIC (£/pax)	16.9	17.0	10.60	8.4

As seen in the table above, the LRAIC estimates are highest for Increments 1 and 2 at approximately £17 per pax in 2011/12 prices. The LRAIC estimate for Increment 3 is noticeably lower, at £10.6 in 2011/12 prices. This is primarily due to the larger number of incremental passengers, as all 35mppa are considered incremental. Increment 3(b) is lower still, entirely due to the reduced capital expenditure. The estimates for Increments 1 and 2 are not very different; although Increment 1 has lower capital expenditure it also includes fewer incremental passengers.

5.7 Sensitivity analyses

The LRAIC calculations are sensitive to changes in a number of key variables. The table below shows the sensitivities considered.

Table 5.6: Description of sensitivities considered

Discount rate	We consider two alternative scenarios using 6 and 7 per cent as the discount rate.
Traffic	Our sensitivity analysis uses alternative long run growth rates for passenger demand. We consider scenarios with 2.1 and 2.5 per cent growth [✂].
Non-regulated Revenue	We consider two scenarios, in which the non-regulated revenue has been over- and underestimated by 10 per cent from the level in our central estimate.
Capex	We consider two scenarios. The first is an increase in capex of 15%, in line with BAA's risk factor SG2. The second applying a 15% reduction in the costs for Increments. For increment 3(b) we consider a further scenario, whereby the additional value of the land is half the original value.
COPI over RPI	We consider the possibility of a change in relative prices, in which construction becomes more expensive relative to other goods. This would be reflected by having annual inflation measured by COPI 1 per cent higher than inflation measured by RPI.
Pax-elasticity Opex	In addition to Steer Davies Gleave's central estimation, we consider two scenarios in which the pax-elasticity of Opex is 0.3 and 0.6. The first scenario coincides with the lower end of the Competition Commission's estimation of this elasticity in 2002.[144]
Timing	In our model, the timing of increment is assumed to be perfect: new capacity expansions open right when they become necessary according to the demand forecast. For Increment 2 our sensitivity analysis considers two possibilities: that the increments are build two years too early (-2) or two years too late (2).
Capacity delivered	This variation allows for the possibility that the capacity delivered by the increment is different than projected. We consider alternative scenarios where

[144] Competition Commission 'Stansted Airport Limited: Q5 price control review, October 2008, Appendix H'.

	the capacity delivered is 5 mppa lower as well as 5 and 10 mppa higher than expected.[145]
Catch-up rate	Our central scenario for Increment 1 assumes no 'catch-up' of demand from the time when the original airport capacity is reached to the time when the capacity expansion is complete (i.e. passenger traffic does not jump to the level that it would have been had the capacity constraint not kicked in). Alternatively, we consider two scenarios with 50 and 100 per cent catch-up. The chart in the Appendix illustrates this.

We note the following points about our sensitivity analysis:

- The LRAIC estimates are particularly sensitive to the discount rate and the long-run passenger growth rate. For the discount rate, a variation of half percentage point can lead to changes in the estimate up to 14.5 per cent, as it is the case for Increment 2. An increase in the long-run growth rate from 1.5 to 2.5 per cent would lead to a substantial decrease in the LRAIC, up to 37 per cent for Increment 2 (from £16 to £10). An exception to this is Increment 3. Since current passenger traffic is currently almost at capacity, the replacement airport would operate at full capacity irrespective of the long-run growth rate.
- Increment 1 currently assumes no 'catch up' in passenger traffic from when the airport reaches full capacity of 35mppa to when the new capacity is ready. If we assume 100 per cent catch up (i.e. on the opening of the new capacity, traffic jumps to the level that would have existed had the original airport capacity not become binding) then the LRAIC estimate falls significantly, by 19 per cent.
- We have assumed that the replacement cost of current fixed assets at Gatwick would enable the construction of an airport with capacity for 35 mppa. If the capacity delivered with Gatwick's current configuration was instead 40 or 45 mppa, the LRAIC would decrease substantially by 15.6 and 27.8 per cent, respectively.
- If the additional value of the land used for Increment 3(b) was half of the original value, the LRAIC estimate would decrease from approximately £8 per pax to £7 per pax.

5.7.1 Reconciliation with FTI Consulting modelling

The capital expenditure data we use for Increment 1 is the same as that used in the LRAIC model for Gatwick prepared by FTI consulting. Our LRAIC estimate for this increment is £16.88 per passenger, whilst FTI's estimate is £10.02 per passenger. The LRAIC estimates are broken down in the following table:

[145] We note that, under the current assumptions, the replacement airport (Increment 3) would be at full capacity (35mppa) throughout the exercise. If the capacity delivered were higher (40 or 45mppa), as it is assumed in this alternative scenario, the construction of the airport would be delayed until there is enough traffic to operate the new airport at full capacity from the first period.

Table 5.7: Europe Economics and FTI Consulting LRAIC estimates for Increment 1

	Europe Economics (2011/12 prices)	FTI Consulting (2013/14 prices)	FTI Consulting (2011/12 prices)
PV capex (£m)	1,069.96	1,235.7	1,164.7
PV opex (£m)	206.85	181.6	171.2
PV non-regulated revenue (£m)	325.01	373.1	351.7
PV pax (mppa)	56.4	104.24	104.24
LRAIC estimate (£/pax)	16.88	10.02	9.44

As it can be appreciated from Table 5.7 the main differences in assumptions and our modelling approach relate to the traffic volume. The table below summaries the key differences.

Table 5.8: Difference in assumptions related to passenger traffic in Europe Economics and FTI models

	Europe Economics (central scenario)	FTI Consulting
Discount rate	6.5%	7%
Baseline capacity (mppa)	35	33.275
Long run passenger growth rate	1.5%	2%
Forecast period[146] (years)	35	31
Increment operational	2018/19	2012/13
Incremental passengers counted	When the new capacity is operational	When capital expenditure on the new capacity begins

In addition, our model assumes that when capacity is constrained, all excess demand is foregone. The consequences of our approach would be mitigated by assuming a catch-up rate of 100 per cent.

Table 5.7 shows further differences in Capex, Opex and Non-regulated revenue. The main difference in Capex is due to assumptions related to capital maintenance. We assume a maintenance cost of 1.2 per cent of capital starting 5 years after the investment is complete while FTI assumes a cost of 3 per cent starting 10 years after the increment is operational. Differences in Opex and Non-regulated revenue could be attributed to our modelling approach, in which considers opex as an elasticity of passenger growth, and revenue linearly related to incremental passengers, rather than FTI Consulting's hard-coded figures.

We conduct a number of sensitivities to illustrate how our results would change if we used assumptions and inputs similar to FTI Consulting. These are shown in the table below.

[146] This is the number of years for which incremental passengers are considered.

Table 5.9: Variations of LRAIC estimates for Increment 1 using different inputs and assumptions

	PV Capex	PV Opex	PV Revenue	PV Pax	LRAIC
Original EE values	£1,069.96m	£ £206.85m	£ £325.01m	56.40	16.88
EE with FTI Opex & Revenue figures	£1,069.96m	£183.30m	£380.67m	56.40	15.47
EE with FTI pax forecast	£1,069.96m	£ £244.25m	£ £383.77m	66.60	13.97
EE with FTI pax, 100% catch-up and 33.275mppa capacity	£1,069.96m	£ £351.77m	£ £552.72m	95.91	9.06
EE with FTI Opex, Revenue & pax, 100% catch-up and 33.275mppa capacity	£1,069.96m	£183.30m	£380.67m	95.91	9.10

We note that there are further differences between FTI Consulting's modelling approach and ours that would require us to adopt a different model structure in order to incorporate. In particular the way in which FTI Consulting has modelled the incremental passengers during the time at which the airport is technically at full capacity reduces their estimates even further.

There are also differences between the results of our model and FTI Consulting's for Increments 2 and 3. These can be explained by the different capital expenditure values used and the modelling decisions regarding investment timing (FTI Consulting assumes difference phasing of investment that affects the PV of the total capital costs); passenger numbers (FTI Consulting assumes a 'demand kick' following the building of the new runway; and assume that the new airport would open to a peak capacity of 45mppa); and other inputs (for example, FTI Consulting assumes that operating expenditure and non-regulated revenues cancel each other out and do not model these).

Our LRAIC for Increment 2 is higher than FTI Consulting's lowest estimate of £14 per pax (although its highest estimate is £28 per pax), even though we used lower capital values. This can largely be explained by the traffic forecasts used – if we use the same forecasts as FTI Consulting our LRAIC estimate for Increment 2 declines from £17 to £13.5. It would further reduce if we were to incorporate a demand kick that increased passenger numbers after the building of the second runway.

6 Summary and Conclusions

6.1 Introduction

This section draws on the previous parts of the report to identify the advantages and disadvantages of using a LRIC-based approach to assess the competitive price level at Gatwick and Stansted airports, and of using a LRIC–based approach to set price caps, in particular as a transition to a more competitive airports sector. We provide our conclusions on both these points. To illustrate these conclusions we present a summary of what a regulatory regime based on a LRIC approach might look like in the airports sector.

We have assumed throughout that if an airport has no SMP or if price regulation had not been found to be necessary for other reasons (e.g. reliance on competition law was thought likely to be more cost-effective) then neither LRIC nor any other form of cost-based economic regulation would be employed.

We imply no views on whether or not the CAA needs to regulate prices at Gatwick or Stansted, but consider the relative merits of RAB-based and LRIC-based methods under different assumptions of the degree of market power that the airports might possess.

6.2 The advantages and disadvantages of using a LRIC-based approach in order to assess the competitive price level at Gatwick and Stansted airports

As the Competition Commission put it:

> "Correctly applied, LRAIC-based model would be expected to result in prices closer to the long-run competitive level, providing the appropriate signals to the market to foster efficient entry, investment and innovation."[147]

We agree with this (which is also in line with the CAA's approach), noting that correctly applied LRAIC would only include the costs of services for which there is a reasonable expectation of demand at cost-reflective prices. The fundamental characteristic of LRAIC is to estimate the costs that determine prices in a normally competitive market, which are the forward-looking avoidable costs of supply.

The specific nature of the airports sector in the South East of England means that entry and expansion is restricted and controlled by government planning procedures, and this substantially reduces the importance of setting regulated prices to approximate those that would be found in a competitive market, but there could nevertheless be value in assessing the competitive price level of the airport services provided by Stansted and Gatwick.

6.2.1 What increment to use

In using LRAIC for this purpose three different types of increment may be considered:

d) Small expenditures that allow fuller utilisation of existing runways and terminal buildings.

[147] Competition Commission 'Assessment of LRAIC-based price cap within the Stansted Inquiry', 2008. This is a more detailed working paper on the issues raised in the Competition Commission's 'Stansted Airport Limited Q5 price control review' 23 October 2008, pages 24-27

e) Additional runways and/or terminal buildings to give a major expansion of capacity.

f) A new airport, notionally replacing Stansted or Gatwick, with similar or expanded capacity to the present planned capacity and service levels, but using modern techniques and the most efficient configuration of runways, terminals and other facilities.

Type (a) is not relevant to the competitive level of charges for the airport as a whole. As discussed in the report, in LRIC calculations we consider the relevant increment to be the service or product for which prices are to be determined. A small increment such as this can have the advantage of being 'realistic' if it is based on detailed investment plans. However, it would not be appropriate to assess the competitive price level of, or base prices for, the whole airport on such a small increment as a small increase in capacity would also not necessarily convey any information about the competitive price of the airport as a whole. The best use for an increment based on a small increase in capacity would be to convey price signals of peak capacity, or to set the structure of charges for this additional capacity. In the current airports regulation this does not appear to be a likely use.

Type (b) would be relevant provided that there is evidence that there are willing customers for the additional capacity and services at the price needed to cover costs.[148] The LRAIC of an additional runway/ terminal might then act as a proxy for the competitive prices for the whole airport. However, the nature of the runway would still be influenced by the operator and may still not reflect a true efficient and modern configuration. If the investment is due to take place some way into the future additional uncertainty is attached to the input values. Further, given the nature of the airport sector, a large expansion such as an additional runway would not occur on the basis of price and profit signals alone, but would be heavily influenced by the government planning environment (and we note that there are no current plans, approved by the government and supported by the airlines, for new runways at either airport). The potential for Type (b) LRIC in establishing efficient 'market signals' is therefore significantly undermined.

Type (c) is more relevant for assessing the competitive price level, since there is established demand at each airport. Whether or not the calculations should include any additional capacity would depend on whether there is evidence that customers would be willing to pay for it. In using this increment it is necessary to establish what an efficient and modern airport configuration would be like in each location; and the associated costs. Assumptions would need to be made regarding the configuration of the terminal buildings and runway(s), land values, connections to utilities and transport, construction and material costs, the quality levels (including an assumption about the main types of airline customers), associated non-regulated revenues, and operating costs. In all these cases, a LRIC estimate would be based on an assessment of the costs that would have to be incurred by an efficient entrant, using modern assets to provide the services of the airport. As Stansted is a relatively new airport, these problems may be less severe in its case.

In the absence of any major new expansion plans, the LRIC estimates would differ from those made using a historic cost measure of the RAB chiefly because of differences between the historic cost of the existing assets and the cost of modern equivalent assets. A good approximation for a LRAIC cost would be to make an MEA revaluation of the assets needed to provide the service levels currently planned at each of the airports, applying the appropriate cost of capital and adding forecasts of efficient levels of operating costs etc. as in the present RAB-based methodology. (We have provided an indicative estimate of a MEA asset base for Stansted of approximately £2.3bn in 2011/12 prices, based on the indexation of the current fixed asset base.)[149]

[148] If an airport has market power, then there is a danger that it could inflate the costs or need for the expansion and use its market power over existing customers to extract higher prices.

[149] This is based on a review of Stansted's statutory accounts and adjustments to the fixed asset base. See the Appendix for the Replacement Cost increment of our Stansted model for more detail.

In moving from an historic cost base RAB to an estimate of the competitive levels of pricing, there is in one sense a loss of accuracy: the historic cost of assets can presumably be shown exactly, from auditable sources, whilst the likely current cost of providing a competitive service necessarily relies on judgement.

6.3 The advantages and disadvantages of using a LRIC-based approach in order to set price caps, in particular as a transition to a more competitive airports sector

As already noted, the prior questions of whether either airport has SMP and whether *ex ante* price or revenue limits are outside the scope of this study. We consider the advantages and disadvantages of using a LRIC-based approach in order to set price caps in different possible circumstances, always assuming that any major new investment in airports or runways in the South East will be decided by Government and not by market forces alone.

As further background, we note that at present the CAA has significantly less need to be involved in the details of capital expenditure planning than other regulators, as a combination of airlines' commercial interest and government strategic policy provide evidence on which investments are most justified.

The alternative assumptions we make about the extent of current and expected competitive pressures on Stansted and Gatwick and hence on their market power are:

a) No SMP and no justification for regulation of prices.

b) Definite SMP and justification for *ex ante* or other specific regulation, and expectation that this will continue to be the case indefinitely (as with water or energy infrastructure services).

c) Uncertain SMP and justification for *ex ante* regulation; competitive forces may be developing but it is not certain whether or when they are sufficient to allow regulatory limits on charges to be withdrawn.

In situation (a), clearly, no regulation is needed.

In situation (b) or (c) price regulation may be needed, and the advantages and disadvantages of using LRIC may be compared to continued use of an historic-cost based RAB approach at the two airports.

As above, we consider the whole airport increment the most relevant to setting prices. Using other increments could have significant disadvantages:

- If prices are to be set for the airport as a whole, the costs of an expansion in capacity will not necessarily inform the appropriate price level, particularly if the airport has market power and willingness to pay for the expansion cannot be robustly established.
- LRIC estimates based on small capacity increases would vary significantly depending on the particular nature of the expansion, and would be potentially very volatile across price control periods as new expansion projects are proposed and included in the LRIC calculations, or as key inputs to the calculations change.[150]
- If prices were based closely on LRIC estimates of capacity increases, the price path would be volatile over the years as the airport reached full capacity and then after the investment had taken place. If prices were to be smoothed over the years there may be a risk of over- or under-recovery in periods of lesser or greater investment.

[150] Our review of the use of LRIC in other sectors, and our modelling results, have shown how sensitive LRIC calculations are to changes in input assumptions; this is a particular issue if the LRIC calculations require inputs to be forecast far into the future, as such forecasts may be subject to significant change as time passes.

- The cost of new runways or terminals might be above or below the costs of existing facilities, and depend on particular circumstances that would be difficult to evaluate; it would be hazardous to use such estimates for overall price setting.

If a whole airport increment were used, a LRIC based approach could give prices closer to those of a competitive market than prices set on the basis of an historic cost RAB. As the CC noted, this would help by "providing the appropriate signals to the market to foster efficient entry, investment and innovation."

With regard to entry, the particular circumstances of airports significantly reduce this advantage as this is driven more by government planning and less by price signals. However, setting the prices at Stansted and Gatwick at competitive market price levels would avoid distorting competition between them and other airports, and the correct signals would be given to all concerned in the related markets, helping (as the CC noted) to encourage innovation and efficient use of resources[151].

The practical disadvantages of using LRIC (even using the whole airport increment), as discussed in our commentary on the CC's findings, include its unfamiliarity in the airports sector and hence a risk that it would reduce regulatory certainty. It would also involve the greater uncertainty that is inherent in making assessments of the current costs of efficient levels and types of investment instead of using historic cost values of what was spent.

6.3.1 An airports regulatory regime based on a LRIC approach

We summarise the above discussion by illustrating what an airports regime based on a LRIC approach to cost estimation might look like. We begin with Stansted, and then discuss the differences at Gatwick.

As LRIC and RAB are methods of estimating costs, we concentrate on this. There are many features of regulation which are independent of the method of cost estimation and so can be used in either case.

What increment to use

If a LRIC-based approach were to be used to set prices at Stansted, the most appropriate increment would be a 'whole service' increment. For reasons outlined above, increments based on small or large increases in capacity would not necessarily convey correct information about the costs of the airport as a whole; would be too volatile; and would in any case rely on establishing sufficient demand for the expansion which may be difficult.

How would the long-run costs be established?

Net costs (total airport costs less non-regulated revenue) would be determined via a bottom-up approach. Airport planners and engineers would provide values for the modern equivalent assets necessary to provide the service, taking account of today's materials and technology.[152] Given that Stansted is a relatively new and well-designed airport, the current configuration might be found to be the most efficient. In valuing the assets, decisions would be made about the level of quality (considering, for example, the type of airline customers). The model would also include decisions on the level of operating expenditure associated with the airport (both that which varies with passenger numbers and that which is fixed). Other costs to consider would be the value of land and connections to utilities and transport. Non-regulated revenues would be included, with forecasts of how these may vary with passengers or be fixed to the building.

[151] Although it may not be apparent now, there may be many related markets that use airport price signals, including new markets relevant to innovation.

[152] This is because the essential feature of a LRIC based approach is that a direct attempt is made to estimate the long run costs that would be incurred by a normally efficient competitor or entrant to the market. This means that assets are valued at the current cost of acquiring an asset that would supply the services defined using modern technology (modern equivalent asset (MEA) valuations).

The number of passengers to be served by the airport would be decided on the basis of the best available forecasts.

Finally, a decision about the forecast period would be made (most likely some weighted average of asset lives) and the discount rate (most likely the cost of capital). Net costs would be discounted back, and divided by discounted passenger numbers to arrive at the long-run average incremental cost of the airport.

A cross-check could be performed through a top-down approach. This would involve estimating the MEAVs of the current assets (possibly through indexation, as we have done in this report) using the operator's existing accounts and records. Similarly, operating costs and revenues would be obtained from accounts and included in the model (with some apportionment if necessary).

The results of the two approaches could be similar; a key cause of any variation would lie in how the assets in the bottom up model were conceptualised and valued.

The results of the two approaches could then be reconciled to arrive as an estimate of the LRAIC for the airport as a whole.

How would prices be set?

Prices would be set for a single control period, and then reviewed at the next period. The LRIC calculations would be updated by new asset valuations, taking into account technology advances. If an increase in capacity was needed at this stage, the increment would change to be the whole airport including the new capacity.

The advantages and disadvantages this approach

The key advantage of this LRIC-based approach using the whole service increment is that by using MEAVs assets are correctly valued and the operator only reimbursed for efficient costs.

A disadvantage of this approach is that there will be some uncertainty attached to estimating the MEAVs of assets required to provide the serviced, particularly if the current airport configuration is not considered ideal. There is no such uncertainty in using historic costs as the method of asset valuation.

Assuming that LRIC estimates would be revised at price controls, there may also be some volatility resulting from changes in input prices or technologies, as asset values are adjusted to take account of the new situation.[153]

When would this approach be used?

The main advantage of a LRIC-based approach is to send appropriate price signals based on the costs that an efficient entrant would incur. This approach would therefore be very relevant if entry and innovation are to be encouraged through market mechanisms. However, in the context of the airports sector in South East England there is less point in sending efficient price signals if entry and expansion is not based on prices and is rather influenced by government planning.

Further, if the case of Stansted bottom up LRIC estimates are similar to the results of a top down approach or a RAB-based approach using modern equivalent asset values, then it may not be desirable to change to a full LRIC approach.

6.3.2 A LRIC-approach for Gatwick

As the essential feature of a LRIC-based approach is to establish the costs an efficient entrant would incur in providing a service, in our view this approach in the context of Gatwick airport (using the whole service

[153] We note the example in telecoms of the volatility caused by changing copper prices.

increment) would be difficult. As we understand, the current configuration of Gatwick is held to be inefficient and any redesign would result in significant changes (for example, the idea of having two parallel runways with a 'toast-rack' of terminals in between). A proper LRIC calculation would entail a detailed specification of an alternative efficient configuration, which would then be valued on a modern asset value basis. Given the uncertainty and effort involved in specifying a complete new airport for the purposes of regulation (it would not be proportionate to undergo the detailed planning involved in developing a new airport), any cost estimates would be very high level and uncertain, thus undermining the value of the LRIC approach. In our view, therefore, a full LRIC-based approach to establishing the costs of Gatwick is not appropriate.[154]

6.4 Summary

The CAA used the following framework in its Policy Update document, published in May 2012 (Appendix 1). Similar assessments were made of alternative forms of price regulation; to, here we summarise our conclusions on LRAIC-based price caps.

The assessments made depend on the definition of the LRIC system. This is a full-service increment, representing the services of the airport as a whole, and not a significant addition to planned capacity (which was the increment which the CC had in mind in drawing some of its conclusions in 2008). The method of implementation would be to estimate the cost a new entrant would need to incur in order to provide those service levels over the expected lifetime of the assets, and express this as an average annual charge per passenger. However, this method of cost calculation does not imply that charges limits would be set would be set at the same level each year; different patterns of charging over time may yield the same present values, and can be set to take into account cash flow and other issues. LRIC is a method of cost estimation, not a complete system of price control.

It follows from this that the main effect of a LRIC calculation would be the estimation of MEA values of the existing assets, so that the assessment of a MEA RAB would be similar. Compared with the existing RAB method, there would be greater uncertainty (because of the need for judgements about MEA values) but the result should be closer to the outcome that would be expected in a normally competitive market.

In the case of Stansted, the airport configuration and other main characteristics under a LRIC estimation might not be very different from the present.

[154] We note that the LRAIC estimates put forward by GAL were not intended as the basis for setting price limits, but to develop the argument that the present RAB-based price limits are below the competitive market level.

Table 6.1: Assessment of LRAIC-based price caps, for whole airport service

Feature of system	Assessment	Comment
Price protection	✓	The "price protection" needed is to prevent charging above competitive cost levels. Other features of the price control regime – how detailed, the extent to which prices may vary from year to year, how to deal with under- or over- recovery in a particular year etc. – are separate matters from the method by which the costs that can be recovered are estimated.
Promote competition and provide information about competitive price levels	✓	Note however that major investments in capacity will be decided by government, so that there is limited advantage in encouraging competition compared to what would be found in other circumstances.
Service quality protection	✓	There is no practical difference between LRIC and RAB-based cost estimation systems as a service quality regime can be included under either
Allows efficient business to finance its activities	?	In moving away from historic cost based RAB, the risk is created of either capital gains or losses, and this is an added business risk. It is a risk that characterises any competitive market, (and is to be welcomed insofar as it increases the incentives for airport owners to make robust business plans). This added risk could add to the cost for an efficient business to finance its activities.
Efficient and effective investment	?	There is less risk of over-spending if the RAB is to be re-valued at periodic reviews according to MEA principles, and the same applies to LRIC since both are based on an assessment of what an efficient entrant or competitor would decide to spend, and on which assets. However reduced certainty that an investor would get a return on an investment may discourage investment.
Operational efficiency	✓	The incentives for operational efficiency come from setting price limits for a reasonably long period, during which the operator will gain from any out-performance (and rollover provisions will allow a reasonable period for such incentives if efficiency gains are made at the end of a control period). The focus on MEA asset valuations would carry with it a need to find the most efficient balance between operating costs and capital costs.[155]
Transparent, accountable, proportionate, consistent and targeted	?	LRIC involves judgements about the modern efficient assets that are not made in a historic cost-based RAB system. The RAB system is more familiar, and as CAA noted in 2008 some stakeholders are concerned that a LRAIC approach can be complex, time consuming and lead to uncertain future price paths with a high level of regulatory discretion.
Practical implementation and stakeholder confidence	?	Regulatory commitment and clarity are important. A RAB-based approach has an 'established' credibility in airports, although it is

[155] Operating cost incentives that are based on purely future-looking calculations, not necessarily with MEA asset valuations, may provide more limited opex incentives.

Feature of system	Assessment	Comment
		also criticised.[156]

[156] However, the CAA cited Ofcom's transition to LRAIC-based pricing in its regulation of BT's local loop networks as evidence that this consideration does not prevent LRAIC-based approaches from being adopted. See 'CAA comments on the CC's LRAIC working paper and suggested way forward', August 2008

Appendix 1: Sector Reviews

Telecommunications

Introduction

LRIC is used as a cost estimation methodology in a number of contexts in the telecommunications sector. In this section we discuss the use of LRIC in setting wholesale mobile voice termination rates; and, more briefly, the use of LRIC in fixed wholesale access pricing.

Practice is changing in response to a European Commission (EC) recommendation in 2009, which asked for the use of "pure LRIC" (explained below) in setting both mobile and fixed line termination charges.

In essence, the methodology for setting mobile and fixed termination charges prior to the recommendation was to use LRIC with broadly defined increments and to estimate service charges within those increments on the basis of usage. This remains the position for countries moving to "pure LRIC".

In the case of fixed networks two broadly defined increments were identified, namely access and core. The access increment was defined to include all services between the subscriber and the initial exchange as well as the subscriber driven costs within the exchange (principally the line card). The core increment was defined to include all exchange related costs (except line card costs) and all transmission links between exchanges.

In the case of mobile networks the normal practice was to identify a single element consisting of all services. The difference between the approach adopted in fixed and mobile networks arose because while it is relatively straightforward to identify subscriber driven costs in a fixed network it is much more difficult to do so in a mobile network.

Wholesale mobile termination rates

Background

Wholesale mobile voice call termination (MCT) is the service necessary for a network operator (fixed or mobile) to connect a caller with the intended recipient of a call on a different mobile network. Mobile termination rates (MTRs) are the wholesale charges that the originating operators must pay the mobile operator to complete the call.[157]

The market for voice call termination services is generally characterised as having significant market power, as called parties often have no incentive to respond to termination prices set by their network providers, implying that these network providers have little constraint on the termination charges they set.

In May 2009 the EC issued a Recommendation calling for MTRs to be based on a definition of LRIC under which the increment was defined to be limited to voice termination calls rather than (as previously) also including a contribution to common costs. Because there are significant common fixed costs in mobile networks, the application of this definition results in much lower MTRs. In the EC's view the previous definition of LRIC results in excessive pricing of MTRs which in turn results in competitive concerns.[158]

[157] This is based on a 'calling party pays' charging model.

[158] Commission Recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU, 7 May 2009

According to the recommendation MTRs should be set at LRIC without adding any contribution to common costs, implying that all common fixed costs should be recovered through charges for other services. The recommendation has, or is in the process of being, implemented in a number of countries although it has yet to be accepted by others.

Here we discuss Ofcom's approach to regulating wholesale mobile voice call termination charges in the UK, for the period 1 April 2011 to 31 March 2015.[159] This approach draws on the methodology recommended by the EC in its May 2009 Recommendation.

In markets where it believes regulation is required, Ofcom's approach is to set a price cap based on a view on the likely level of efficient costs (LRIC in mobile markets) during and at the end of the price cap period.

In Ofcom's view a price control is required "where it appears to us from our market analysis that there is a relevant risk of adverse effects arising from price distortions".[160] Ofcom's market review undertaken in preparation for the current regulatory framework found that all 32 individual mobile communications providers providing mobile voice call termination services on their individual networks had significant market power. The current regulatory framework limits the MTRs of the four national mobile communication providers,[161] and requires that all other designated mobile communications providers offer "fair and reasonable" rates.

Approach to the use of LRIC

Estimation of costs

Ofcom defines two types of LRIC:

- Pure LRIC. Incremental costs are considered as the difference between the costs of the operator's total services with the termination service, and the costs of the operator's total services without the termination service. This is essentially an avoidable cost methodology and is consistent with the definition proposed in the EC recommendation.
- LRIC+. The increment is defined to include all services provided by a mobile operator with the incremental costs for call termination being considered as a proportion of the total costs of all services provided by the operator, often allocated in a top-down way. This comes to the same thing as defining the increment as the service of call termination, but recognising that this is but one of the services provided by the telecom companies, and that each should recover a share of fixed common costs. If the incremental costs are allocated a share of common costs, this is LRIC +.

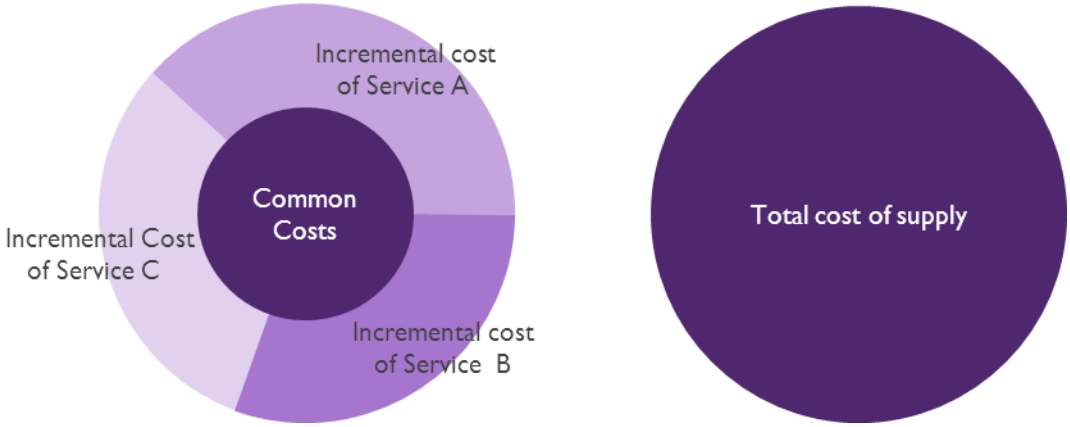
An illustration follows:

[159] See Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011 and associated modelling annexes 6-10

[160] Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011

[161] The four national mobile communications providers are H3G, Everything Everywhere, O2 and Vodafone

Figure 1: Pure LRIC and LRIC+



Suppose a supplier provides services A, B, and C, and incurs costs of 100 in doing so. Suppose also that if it were to not to supply service A its costs would be 75, and the same is true of each other service. This means that the avoidable costs of A, B and C add up to 75, and there are common costs of 25.

The "pure LRIC" of service A, B or C is 25, since these are the costs caused by providing the service. In order to cover the total costs of 100, the charges for these services would need to add another 25 between them, making their average charge 33 1/3. This would be the "LRIC+" charge (25+1/3*25).[162]

If the whole of the output of the supplier is to be regulated as a single service, all that matters is that the total cost is 100. These are the avoidable costs of supply, so pure LRIC.

In previous price control periods MTRs were set using LRIC+ to allow operators to recover a share of their fixed common costs from MTRs[163]. In the current framework Ofcom has moved to the pure LRIC approach under which there is no allowance for overhead cost recovery through termination charges.[164]

The costs considered in Ofcom's approach are based on the costs of a hypothetical efficient national operator. This hypothetical operator is assumed to have entered the markets at a certain point in the past and grown to its notional market share (defined as 1 divided by number of mobile network operators) and efficient scale along an assumed path. Forward-looking costs are based on the efficient current costs to a new entrant using modern equivalent assets and making efficient technological choices.[165] This is consistent with the EC Recommendation which states that assets which are valued in historic cost terms should be re-valued in current cost terms so as to reflect the costs of an efficient operator employing modern

[162] There is no reason why the common costs should be shared equally, if some other pattern of recovery were more efficient.

[163] The crucial difference between the two methodologies is that under a LRIC+ fixed costs which are not service specific are recovered across services in proportion to usage levels. By way of contrast under a pure LRIC measure these costs cannot be recovered from the voice termination service. Common fixed costs, as described here, includes both equipment related costs and any operating costs both direct and overhead which do not change with traffic volumes.

[164] Ofcom considers that it may be possible to recover common costs more efficiently from retail services and/or other unregulated wholesale services. See Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011, Chapter 8

[165] Ofcom adjusts its choice of parameters for efficient costs and technology choices following consultation with market participants.

technology, as in a competitive market operators would compete on the basis of current costs and would not be compensated for costs that have been inefficiently incurred.

In line with the EC's Recommendation, Ofcom calculates the costs using a bottom-up economic/engineering model of an efficient network. Ofcom calibrates parts of the model against financial and network parameter data obtained from national mobile communications providers, to ensure that its model of a hypothetical efficient operator reasonably matches the average infrastructure deployment of the national operators. The model calculates LRIC by subtracting the costs of all services excluding termination from the costs of all services including termination, and dividing this by the termination services output (all terminated minutes provided to other communications providers).

Asset valuation

Ofcom bases its cost calculations on a modern equivalent asset (MEA) approach, which takes into account changes in the investment and maintenance costs associated with each asset type, as well as technological developments that improve asset productivity.

In line with the EC's recommendation, Ofcom's preferred approach to depreciation is a form of economic depreciation referred to as "Original ED". This method matches cost recovery to actual and forecast usage and asset price trends over the long term. Therefore there is relatively little depreciation in years when utilisation or asset prices are low and relatively high depreciation in years of high equipment utilisation or asset prices.[166] This approach enables the model to calculate a cost per unit of output in each year for every asset of the model

Time period over which LRIC is calculated

Ofcom's model calculates the network costs for the period 1990/91 to 2039/40 with a perpetuity-based terminal value thereafter, although forecasts for all inputs are constrained to constant from 2020/21 onwards (as operators are assumed to reach efficient scale in 2020/21 — 25 per cent market share each for the four national operators). MTR charges are set over a four-year period (the current control period from April 2011 until March 2015), with scope for the model to be recalibrated after this with more up-to-date data.

Ofcom raises the concern that a four-year period in the mobile telecommunication sector may be too long given the rapid pace of technological change. A shorter control period would enable Ofcom to rebase the model more often and thus have more accurate efficient costs, but would remove some of the certainty to regulated firms given by a longer control period. Ofcom has addressed the potential problem of forecasting error by considering a range of parameters in its modelling for sensitive variables (such as traffic volume and equipment costs), and using conservative traffic assumptions to reduce the risk of under-recovery of costs.[167][168]

Use of LRIC in regulatory decisions

Ofcom uses LRIC as the cost standard against which to benchmark the charge controls for MTRs, set over the four-year control period. Ofcom sets the same charge control for all four operators, regardless of the technology or platform that is used to provide call termination services. In addition to being in line with

[166] See Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011, Annex 6
[167] Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011, Chapter 9
[168] Ofcom mentions in particular that data traffic on mobile networks has grown significantly ahead of forecasts. An under-forecast of traffic is said to be less important when using pure LRIC compared with LRIC+ as with the former common costs are not allocated to call termination, so that the level of permitted charges is lower, and so in consequence are changes result from differences in demand. Ofcom states this as an advantage of pure LRIC, rather than a reason for using pure LRIC.

the principle of technology neutrality, using a single technology-neutral cap spares Ofcom the burden of "ever-increasing" detailed cost analyses in the face of new and uncertain technologies.[169][170]

The MTR charges are constructed as a yearly cap on mobile call termination (in pence per minute). The cap is set on a four-year glide path from the regulated charges at the end of the current control period (31 March 2011) to the efficient unit cost level in 2014. Thus the maximum permitted charge for mobile call termination reaches the pure LRIC benchmark by 1 April 2014.

Ofcom sets the nominal maximum charge in the first year, and for the remaining three years the charge is calculated on an RPI-X basis, where RPI is the percentage change in yearly inflation and X is the yearly percentage change required to equalise unit costs and unit charges at the end of the glide-path. The charge structure aims to limit disruptive price-setting flexibility ('flip-flopping') by setting a simple cap with a single maximum charge in each year after a two-month transition period.

Advantages and disadvantages of using LRIC

Ofcom's previous MTR charge controls have been set using LRIC+, allowing for the recovery of common costs. Ofcom's rationale for the change to pure LRIC keeps it in line with the changed EC recommendation; both Ofcom and the EC think this should promote efficient production and consumption and minimises potential competitive distortions.[171] There is a debate to be had about this reasoning as applied to these markets, but this is not relevant for our present purposes

The change in the way Ofcom assesses cost makes a significant difference to the expected flows of funds between interconnecting providers. According to Ofcom, on the basis of charges set using pure LRIC, MTRs would, by 2015, be less than half of the charges calculated on a LRIC+ basis.

While this case study does not look at fixed termination rates the EC recommendation also applies to these rates and a number of regulators are in the process of moving away from the traditional broadly defined core increment to the termination increment – France has already done this, other countries such as Sweden and Denmark are in the process of doing so.

Fixed Access Charges

Background

The copper access network is commonly recognised as an economic bottleneck characterised by a high proportion of sunk costs arising from investments made over the last few decades. The Body of European Regulators for Electronic Communications (BEREC) notes that cost-oriented pricing is a well-established tool for promoting competition on copper access networks. Cost-orientation is particularly relevant in the context of low transparency on production costs, as this information is usually held by an incumbent operator.

According to the latest BEREC report on regulatory accounting, many national regulatory authorities (NRAs) in the EU use LRIC as a cost standard for regulating charges in fixed wholesale markets, such as wholesale network infrastructure access at fixed location and wholesale broadband access.[172]The LRIC approach provides a price signal which focuses on the cost of the service whose charges are to be

[169] Ofcom 'Wholesale mobile voice call termination: Statement' 15 March 2011, Chapter 9

[170] The EC also recommends that any deviations from a single efficient cost level should be based on objective cost differences outside the control of operators. An example of this is uneven spectrum allocation in the context of mobile networks (no such cost differences have been identified in fixed networks).

[171] Commission Recommendation on the Regulatory Treatment of Fixed and Mobile Termination Rates in the EU, 7 May 2009

[172] BEREC (2012) 'Report on Regulatory Accounting Practices'

regulated. This gives an incentive towards productive and dynamic efficiency as it only allocates efficiently incurred costs to a given wholesale product.[173]

The alternative cost allocation methodology used in these markets is the fully distributed cost (FDC) methodology. Also known as fully allocated costs (FAC), this methodology allocates the whole set of costs incurred by the regulated operator to its various products and services, including fixed and common costs. As all costs of production for a given wholesale product are accounted for in the cost base, the FDC methodology may incentivise regulated firms to inflate their asset base.[174] In both approaches the relevant increment is the wholesale access service in question; the two are different ways of assessing the costs associated with the same increment. In many cases where the FDC methodology is preferred (perhaps with adjustments for efficiency assumptions) the legacy networks operated by single incumbents are still providing the main services, rather than many competing operators as in the mobile call termination example.

Ofcom's use of RAB / RAV methods

Ofcom uses the FAC methodology and the CCA valuation as the cost basis of its charge controls for fixed access networks. Ofcom also makes use of a RAV valuation as described in the document 'Valuing BT's copper access network - Final statement' Issued 18|08|05.[175] Ofcom was concerned that as a result of a change from HCA to CCA in 1997 for BTs network assets and due to insufficient competition in the access network, BT's charges to competitors for the use of its access network would result in over-recovery of the costs of its copper network assets. To address this concern it introduced a RAV to represent the remaining value of pre-August 1997 copper network assets. The rationale – described in e.g. 1.6 and 1.7 of the above document - was to stop cost over-recovery and not to adjust for inefficiencies.[176]

Ofcom considers that the CCA FAC approach provides a robust and transparent basis for the regulation of wholesale access charges. It is a well understood concept and has been the cost basis for many previous charge control obligations imposed by Ofcom. Furthermore, CCA FAC uses data which can be reconciled to the regulatory accounts, which are published by BT and independently audited.[177]

A potential disadvantage of the CCA approach by Ofcom has been raised by fluctuating copper prices. Ofcom continues to value copper assets on a like for like basis, termed 'anchor pricing', rather than on a true MEA basis. Copper prices have shown a very high level of volatility in recent years, noted by Ofcom in its March 2011 document:

"During the 2009 Consultation, there was a high degree of volatility in copper prices, marked by a significant decline in copper prices in later 2008. When determining the charge control, we concluded that the most up to date valuation should be reflected in the underlying unit cost." Since March 2009, copper prices have increased significantly and are now at levels above their 2008 peak.[178]

Since post 1997 copper is valued on a CCA FCM basis any swings in copper prices will have an impact both

[173] It should be noted that Commission Recommendation only applies to voice termination services. Charges for the access network are determined using a LRIC+ approach.

[174] BEREC's answer to the Commission's questionnaire on Costing methodologies for key wholesale access prices in electronic communications, December 2011, BoR (11) 65, page 13

[175] See Ofcom 'Charge control review for LLU and WLR services – Statement' 7 March 2012, page 14

[176] As the RAV adjustment includes HCA cost elements for pre-1997 assets, its inclusion in Ofcom's cost model means that the costs used are not 'pure' CCA.

[177] Ofcom 'Charge control review for LLU and WLR services – Statement' 7 March 2012, page 14

[178] Ofcom 'Charge control review for LLU and WLR services' 31 March 2011, paragraph 7.63 and 7.64

on estimated costs both through the change in asset values and also through holding gains (price increases will result in holding gains which will push down costs; price decreases will push up costs). The latter impact can have particularly significant impacts on estimated cost levels resulting in big year on year fluctuations.

Electricity

Ofgem regulates both electricity and gas markets within the RIIO framework.[179] We discuss the use of LRIC in the regulation of both markets, beginning with electricity. OFGEM's application of LRIC focuses on the demand side and due to concerns with LRIC does not apply it to generators.

Background

Ofgem is responsible for the regulation of the natural monopolies in the markets for electricity transmission and distribution and the system operator.

In England and Wales the electricity transmission network consists of the portion of the network over which electricity is transported at voltages above 132kV, whilst the distribution portion of the network uses voltages of 132kV and below. In Scotland, transmission includes the 132kV assets.

Electricity transmission networks are owned and maintained by regional monopoly Transmission Owners (TOs): National Grid (NGET) in England and Wales; Scottish Power Transmission Limited (SPTL)[180] in southern Scotland; and Scottish Hydro-Electric Transmission plc (SHE Transmission) in northern Scotland.[181] These transmission networks are all operated by a single System Operator (SO), NGET. Hence, the customers of the SO are each of the TOs.

There are 14 licensed distribution network operators (DNOs), each responsible for a distribution services area.[182] Customers of the distribution network are electricity suppliers, independent distribution network operators (IDNOs), local electricity generators and large individual companies.

The SO, each TO and each DNO are subject to regular revenue controls by Ofgem. Once every five years (to become eight years) Ofgem approves a specific revenue allowance for each company.[183] The current revenue control for TOs and the SO (TPCR4 rollover) took effect on 1 April 2012 and is due to expire on 31 March 2013.[184] The next price control period will be under RIIO, Ofgem's new regulatory framework. The current price control for DNOs (DPCR5) runs from 1 April 2010 to 31 March 2015, when it will be replaced by RIIO-EDI.[185]

LRIC is not used to set the total revenue which the regulated companies are expected to be able to earn; this has been set through a RAV approach, and will continue to be set in this way under Ofgem's latest RIIO proposals. LRIC is however relevant to the structure of charges.

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[179] RIIO stands for Revenue=Incentives+Innovation+Outputs.

[180] ScottishPower's Infrastructure Division includes the UK wires businesses, which comprises three asset owning companies and an asset management company, These are: SP Transmission Ltd (owns the transmission network in south and central Scotland); SP Distribution Ltd (owns the distribution network in south and central Scotland); SP Manweb plc (owns the distribution network in Merseyside, Cheshire and North Wales); and SP Power Systems Ltd (manages and maintains the networks on behalf of the three asset owners).

[181] Ofgem 'Transmission' http://www.ofgem.gov.uk/Networks/Trans/Pages/trans.aspx

[182] Ofgem 'IDNOs' www.ofgem.gov.uk/Networks/ElecDist/Policy/IDNOs/Pages/IDNOs.aspx

[183] Ofgem Network 'Transmission' www.ofgem.gov.uk/Networks/Trans/Pages/trans.aspx

[184] Ofgem Transmission 'Price Controls' www.ofgem.gov.uk/Networks/Trans/PriceControls/pages/PriceControls.aspx

[185] Ofgem Electricity Distribution 'Price Controls'www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/Pages/PriceCntrls.aspx

Distribution Network Operators

The DNO revenue controls implemented by Ofgem mainly use a regulatory asset value (RAV) approach. The RAV is constructed from an estimate of the initial market value of the licensee's regulated asset base at privatisation, subsequent additions to this at cost and annual depreciation. Charges limits are set on the basis that licensees should be able to earn revenues that cover depreciation and a return on the capital investment.[186] The assessment of future cost expectations for DNOs, where there is a reasonable number of participants in the market, is based on a benchmarking exercise of actual costs between DNOs, combined with forecasts for future trends and an assessment of investment requirements.[187]

Within their predicted revenue cap, DNOs are then required to set their own prices for access to the network. There are various incentive arrangements that allow DNOs to earn more than the predicted revenues, in cases of good performance, and that reduce their allowed revenues in cases of under-performance.

Use of system charges - Low Voltage and High Voltage customers

Distribution charges set by DNOs have used a common charging approach (the common distribution charging model (CDCM)) for lower voltage levels (less than 22 kV) since 1 April 2010.[188] The model was jointly developed by DNOs and approved by Ofgem in 2009.[189] The CDCM follows a Distribution Reinforcement Model (DRM) methodology. This follows the principle of customers at the same voltage level within a DNO's area paying the same charges, regardless of their location within that DNO's area. To take account of the relationship between the LV/HV methodology and the Extra High Voltage (EHV) methodology, certain aspects of the EHV LRIC charge are passed into the DRM model as inputs.[190]

Use of system charges - Extra High Voltage customers[191]

Use of system charges for EHV customers apply to all properties at 22 kV or above (and HV customers under site-specific arrangements). In 2007, LRIC was approved as one of the two methodologies (the other being forward cost pricing, or FCP) to be used for the structure of charges on electricity distribution for EHV, customers. The methodologies both aim to produce £/kVA/annum costs that are "reflective of the cost of future reinforcement of the network". Ofgem originally proposed that the methodology employed would have to be one based on LRIC. Some parties were opposed to this and favoured the FCP approach (the key objections are summarised in the disadvantage of LRIC below). Ofgem therefore introduced flexibility to choose between LRIC and FPC costing.[192]

[186] Ofgem 'Electricity Distribution Price Control Review Final Proposals' 7 December 2009 www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/DPCR5/Documents1/FP_1_Core%20document%20SS%20FINAL.pdf

[187] Ofgem 'Electricity Distribution Price Control Review Final Proposals –Allowed revenue- Cost assessment' 7 December www.ofgem.gov.uk/Networks/ElecDist/PriceCntrls/DPCR5/Documents1/FP_3_Cost%20Assessment%20with%20SS%20comments.pdf

[188] Ofgem Electricity Distribution Policy 'Distribution Charges' www.ofgem.gov.uk/Networks/ElecDist/Policy/DistChrgs/Pages/DistChrgs.aspx

[190] Ofgem 'Next steps in delivering the electricity distribution structure of charges project' 20 March 2009 www.ofgem.gov.uk/Networks/ElecDist/Policy/DistChrgs/Documents1/Next%20steps%20SoC%20decision%20doc.pdf

[191] It apply to all properties at 22 kV or above and HV customers under site-specific arrangements

[192] Ofgem 'Next steps in delivering the electricity distribution structure of charges project' 20 March 2009 www.ofgem.gov.uk/Networks/ElecDist/Policy/DistChrgs/Documents1/Next%20steps%20SoC%20decision%20doc.pdf

Currently, the DNOs have chosen between the two charging systems as follows:[193]

- LRIC: North Powergrid (Yorkshire and Northeast), ENW, UKPN (EPN, LPN, SPN), WPD (Wales and South West)
- FCP: SP (SPD and SPMW),SSE (SSEH and SSES), WPD (East and West Midlands)

A consultation has concluded on the DNOs' proposed common charging methodology for higher voltage distribution generation. The DNO members of the Energy Networks Association (ENA) have developed two EDCM's for EHV customers; one where the locational calculations use the LRIC method, and one where the calculations use the FCP method. Until charges are set using this common methodology (from 1 April 2013), each of the individual DNOs will employ their own methodology.

In its guidance on the development of this common charging methodology, Ofgem published a decision in February 2012 to allow DNOs to use alternative methods to LRIC and FCP to calculate the locational charge in the EHV generation charging methodology. In response to industry feedback, Ofgem decided that it is appropriate that charges for distributed generators should not be based around LRIC or FCP. [194] [195] It should be noted that Ofgem was not moving in favour of an alternative to LRIC; rather it decided that it was not appropriate for generators to have this particular charge element being locational (whether LRIC or FCP). Ofgem stated that it still considered locational cost signals to be important, but that these would be preserved in other parts of the methodology, in particular locational credits – credits provide a locational signal at the time of connection as well as for generation during peak times.

In the final model, as approved by Ofgem, locational credits are based on LRIC or FCP.[196]

The characteristics proposed by DNO members of the Energy Networks Association for the common charging methodology for EHV use of system charges are described below.

Definition of increment

A 0.1MW nodal increment of demand or generation is used for power flow analysis as part of any charging methodology.[197] The following values are calculated:

- Base power flows using maximum and minimum demand data; and
- Incremental power flows using maximum and minimum demand data.

Maximum demand is typically found during the winter period and minimum typically during the summer.

The incremental cost of reinforcing a branch is the difference in the cost of reinforcing under base and incremental conditions.

Nodal incremental costs are then calculated by the summation of branch incremental costs that results from applying an increment at that node. Only branches that experience a charge greater than both 1kVA and 0.01 per cent of Base Power Flow are used in the calculation of Nodal charges. The period used to

[193] Energy Networks Association (ENA) (2012) "EDCM Workshop – Future Electricity Distribution Use of System Charges" Presented at Elexon Offices, London,19 January 2012

[194] Ofgem letter "Distribution use of system charging – decision and further guidance on higher voltage generation charging" 2 Feb 2012

[195] Concerns were raised over the cost reflectivity of the LRIC/FCP charge for generators in certain circumstances and the potential volatility of the charge itself which could be impacted by other generators' behaviour.

[196] Energy Networks Association 'EHV Distribution Charging Methodology (EDCM) Export (generation) charges' Report to Ofgem 1 June 2012 www.energynetworks.org/modx/assets/files/electricity/regulation/EDCM/7%20EDCM%20Deliverables/EDCM%20DG%20Report%201June2012.pdf

[197] This is a small increment, and appears to be a standard electricity increment for nodal pricing

determine the amount of reinforcement needed (off-peak or peak) is that with the highest absolute incremental cost.[198]

EDCM charge components consist of:[199]

- Import/export fixed charge (p/day) – direct operating costs and network rates relating to assets only used by the individual user (sole-use assets)
- Import/export capacity charge (p/kVA/day) – local element of FCP/LRIC charge,[200] direct operating costs, indirect costs, network rates, demand scaling charge, relating to assets used by more than one user (shared-use assets)
- Exceeded import/export capacity charge (p/kVA/day) – charge for exceeding authorised capacity: charged at import/export capacity charge rate
- Import/export super-red unit charge/rate (p/kWh) – FCP/LRIC charge[201]

Scaling of the charges calculated using LRIC is applied to the import/export capacity charges to adjust the prices to match the revenue target.

Estimation of costs

Information contained within each DNO's Forward Business Plan Questionnaire (FBPQ) submissions to Ofgem would be used for estimating operations and maintenance costs. These submissions contain each DNO's forecasts of new generation capacity and the qualifying capital expenditure that would need to be incurred to connect them.

Asset valuation

The incremental cost of reinforcing a branch is evaluated based on modern equivalent asset cost.[202]

Time period over which LRIC is calculated

The current LRIC EDCM model uses an annuity period of 40 years.

Use of LRIC in regulatory decisions

Ofgem has a duty to consider the methodologies used by DNOs to set charges, approving or rejecting them as appropriate. Ofgem required DNOs to use LRIC or FPC to structure their EHV charges during DPCR5 and checked their compliance to this. The DNOs are not permitted to change from one methodology to the other during DPCR5. Any DNO could decide to change for the start of RIIO-ED1.

Advantages of LRIC

In 2008, Ofgem considered the LRIC model as advantageous as it provided a simple and efficient method to estimate the economic value of spare capacity and the economic cost/benefit of incremental use of electricity. Also, it provided the maximum granularity of locational incremental cost signal for user charges which Ofgem considered to be a more cost reflective charges than the one using G3 approach.

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[198] Energy Networks Association 'Schedule 17 – EHV Charging Methodology (FCP Model) www.energynetworks.org/modx/assets/files/electricity/regulation/EDCM/7%20EDCM%20Deliverables/Appendix%201a-1d.zip

[199] Energy Networks Association (ENA) (2011) "EDCM Development Workshop 13 January 2011"

[200] Relating to branch incremental costs associated with branches that are operating at the same nominal voltage to that of the node where the increment was applied or higher voltages than that of the node.

[201] Relating to branch incremental costs associated with branches operating at a lower voltage to that of the node where the increment was applied.

[202] Energy Networks Association 'Schedule 17 – EHV Charging Methodology (FCP Model) www.energynetworks.org/modx/assets/files/electricity/regulation/EDCM/7%20EDCM%20Deliverables/Appendix%201a-1d.zip

In addition, the LRIC generation model used similar principles as the one on the demand side and hence, provides consistency between the charges for generation and demand. This was considered to promote efficient behaviour between generators and operators.[203]

Disadvantages of LRIC

In its 2012 decision to no longer require DNOs to use the LRIC or FCP approach, Ofgem considered that LRIC/FCP charges may not be cost reflective due to inappropriate growth assumptions used in both methodologies, such as the one per cent assumption of distributed generation growth across all areas in the LRIC model and the potential volatility of the charges generated from the models. This decision was in line with the views of majority of respondents from the consultations in 2011.[204]

The major concern about the use of LRIC is the potential volatility of the charges. One DNO in its response to the 2011 consultation has found the methodology extremely volatile and it can produce very high or very low prices depending on the capacity level of the network or the rate of underlying load growth. LRIC could also lead to charging volatility if there is a significant change in loading capacity in a particular part of the network.[205] In addition, LRIC can generate reinforcement charges in cases where no real reinforcement is required.

Other arguments include the failure of the particular version of LRIC in use to take account of all relevant reinforcement costs drivers, especially the fault level costs.[206]

Comments from Ofgem

The comments from Ofgem on the use of LRIC in relation to EHV pricing have been mixed over the years.

In relation to the 2009 decision to allow either LRIC or FCP: "Our view was that the pros and cons of FCP and LRIC were finely balanced,[207] but we considered that LRIC would provide the more cost reflective foundation for the common methodology."[208]

"…it remains our view that EHV charging methodologies can and should play an integral role in promoting efficient DG connections and network investment efficiency, and we continue to consider that the LRIC methodology would provide the most cost reflective foundation for a common methodology."

In relation to its most recent decision not to mandate the use of LRIC or FCP for export charges: "….We no longer think it should be a requirement that DNO's charging methodology for export charges be based around LRIC and FCP. We still think that locational cost signals are important and recognise these would still be preserved in other parts of the methodology."[209]

Transmission network operator

There is a single electricity licence which covers both TO and SO activities. Only one TO licensee is allowed to perform the SO activities.

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[203]Ofgem decision document 'Delivering the electricity distribution structure of charges project' 1 October 2008 http://www.ofgem.gov.uk/Networks/ElecDist/Policy/DistChrgs/Documents1/Decision%20document%201%20October%202008.PDF

[204]Ofgem letter "Distribution use of system charging – decision and further guidance on higher voltage generation charging" 2 Feb 2012

[205]SSE response: Next steps in delivering the electricity distribution structure of charges project, 11 December 2008

[206]Ofgem decision document 'Delivering the electricity distribution structure of charges project' 1 October 2008

[207] These are the same concerns raised in the section above.

[208] Ofgem 'Next steps in delivering the electricity distribution structure of charges project' 20 March 2009 www.ofgem.gov.uk/Networks/ElecDist/Policy/DistChrgs/Documents1/Next%20steps%20SoC%20decision%20doc.pdf

[209]Ofgem letter "Distribution use of system charging – decision and further guidance on higher voltage generation charging" 2 Feb 2012

The TO revenue control implemented by Ofgem, TPCR4 rollover, uses a regulatory asset value (RAV) approach.[210] TOs are then required to propose the charging methodology they will use to collect this revenue from customers – this charging methodology currently used is an Investment Cost Related Pricing (ICRP) model.

The difference between an ICRP and LRIC model is the introduction in the LRIC model of an extra parameter that considers the extent of utilisation of the existing network capacity.[211] In the ICRP model the charges depend on the distance the electricity has to travel (MWkm), with no recognition of the degree of network utilisation e.g. any additional power is thus assumed to require immediate network reinforcement. Whilst in a LRIC model, testing on a simplified model has shown that the utilisation of branches becomes one of the main factors on which the outcome of the model depends.[212]

Comments from Ofgem

Ofgem commissioned a piece of work in 2008 to review the network charging methodologies used for transmission and distribution networks.[213] This evaluated the outcomes of ICRP, LRIC and DRM in a simplified electricity network model. The authors found that with LRIC, nodal prices were driven by both the distance to the node (asset cost) and utilisation. Comparing the three methodologies, DRM produced the highest investment cost over the period considered and ICRP encouraged major activities at distant nodes. The main benefit of LRIC was found to be the lack of any requirement to reinforce the system for new demand, as generation was encouraged to locate at highly loaded areas.[214]

Ofgem considered moving to a LRIC model in their recent Significant Code Review (SCR),[215] but concluded that LRIC was less attractive than the ICRP approach due to its potential to increase the volatility and complexity of charges levied on users. The application of a LRIC model at transmission level would impose the full cost of an enhancement of transmission capacity on a single user, potentially leading to this increase in volatility and complexity. Since investments in the electricity network tend to be 'lumpy' and therefore typically leave some spare capacity, entry by one user would be likely to make it easier for other users; yet this is not taken into account in the cost allocation. Research suggested that this effect could be reduced by sharing the transmission charges between the two users based on the ratio of their relative capacities once the second one enters.[216]

Another issue identified with the LRIC model was the sensitivity of the power flow analysis to the assumptions made for demand growth, for the generators that will have access to the system in the future and for how generator power will be dispatched. This power flow analysis guides the timing for reinforcements made on any one branch. This problem was seen to be more significant for the

[210] Ofgem 'TPCR4 Rollover: Final Propsals' 28 November 2011 www.ofgem.gov.uk/Networks/Trans/PriceControls/TPCR4Roll-over/Documents1/TPCR4_Rollover_Final_Proposals.pdf

[211] Ofgem 'Comments from United Utilities on Bath University Benefit Analysis Work' www.ofgem.gov.uk/Networks/ElecDist/Policy/DistChrgs/Documents1/13074-United%20Utilities%20response.pdf

[212] CIRED 'Comparison Between Long-Run Incremental Cost Pricing And Investment Cost-Related Pricing for Electricity Distribution Network' May 2007 www.cired.net/CIRED07/pdfs/CIRED2007_0717_paper.pdf

[213] Dr Furong Li (2008) "Network Charging Methodologies for Transmission and Distribution Networks" University of Bath www.supergen-networks.org.uk/filebyid/204/Furong%20Li.pdf

[214] Dr Furong Li (2008) "Network Charging Methodologies for Transmission and Distribution Networks" University of Bath www.supergen-networks.org.uk/filebyid/204/Furong%20Li.pdf

[215] Ofgem 'Electricity transmission charging arrangements: Significant Code Review conclusions' 4 May 2012 www.ofgem.gov.uk/Networks/Trans/PT/Documents1/TransmiT%20SCR%20conclusion%20document.pdf

[216] Bell, Keith, Green, Richard, Kockar, Ivana, Ault, Graham and McDonald, Jim (2011) "Project TransmiT: Academic review of transmission charging arrangements" Produced on behalf of Ofgemwww.ofgem.gov.uk/Networks/Trans/PT/WF/Documents1/E.ON_comments_transmission_charging_arrangements.pdf

transmission network than the distributional network since the distribution network has a radial structure and (presently) relatively little embedded generation whilst the transmission network has many degrees of freedom, all of which are uncertain.[217]

A third issue identified was that the model focussed on breach of branch capacity limits when considering when reinforcements would be triggered. This makes the method very sensitive to small changes when the limit is approached. However, Ofgem's research report suggested that this problem could be reduced by averaging nodal charges across pre-specified zones.[218]

Although the issues of moving to a LRIC approach were not seen to be insurmountable, Ofgem felt that consideration of this methodology did not represent the most appropriate means of considering the issues that were the main priority of the current SCR.[219]

Gas

Ofgem is responsible for setting the price control for the single gas transmission network owner and system operator in the UK, National Grid Gas Transmission (NGGT). The current price control (TPCR4) took effect on 1 April 2007 and was scheduled to expired on 31 March 2012, however Ofgem extended this price control for one year to allow time for its new RIIO price control framework to be implemented. The first price control review under the new framework – RIIO-T1- will take effect from 1 April 2013. Ofgem will publish its Final Proposals for RIIO-T1 at the end of 2012. Under the RIIO framework the duration of the price control will be extended from five years to eight years, with the possibility of a mid-period review around 2017. Ofgem uses a RAV-approach to set total revenue allowances for gas transmission, and does not make use of LRIC for this purpose.

However, the transmission owner (TO) NGGT makes use of the LRIC concept in calculating its charges within the overall revenue cap, through the use of the long-run marginal cost (LRMC) in its transportation model.

Thus in gas as in electricity regulation, LRIC methods are used to establish individual tariffs or tariff structures, but not to set the overall limits to the levels of charges.

Background

Due to the monopoly structure of the gas sector, Ofgem is responsible for the regulation of NGGT, the owner and the operator of the gas National Transmission System (NTS). The NTS is a network of gas pipelines across the UK and transports gas from coastal terminals and storage facilities to exit points which are connected to various distribution networks, storage facilities, power stations and industrial companies.

Ofgem carries out a price review to determine the maximum revenue NGGT can generate from a different range of activities in the transportation of gas. The allowed revenue is split into two separate streams – the transmission owner (TO) revenue which covers the costs of owning and maintaining the NTS; and the

[217] Bell, Keith, Green, Richard, Kockar, Ivana, Ault, Graham and McDonald, Jim (2011) "Project TransmiT: Academic review of transmission charging arrangements" Produced on behalf of Ofgemwww.ofgem.gov.uk/Networks/Trans/PT/WF/Documents1/E.ON_comments_transmission_charging_arrangements.pdf

[218] Bell, Keith, Green, Richard, Kockar, Ivana, Ault, Graham and McDonald, Jim (2011) "Project TransmiT: Academic review of transmission charging arrangements" Produced on behalf of Ofgemwww.ofgem.gov.uk/Networks/Trans/PT/WF/Documents1/E.ON_comments_transmission_charging_arrangements.pdf

[219] Ofgem 'Electricity transmission charging arrangements: Significant Code Review conclusions' 4 May 2012 www.ofgem.gov.uk/Networks/Trans/PT/Documents1/TransmiT%20SCR%20conclusion%20document.pdf

system operator (SO) revenue which represents the cost of operating the system. This allowed revenue for the TO must be recovered equally from exit and entry charges (under a 50:50 ratio). In the first instance TO entry and exit revenues are recovered from entry and exit capacity charges, however a TO entry commodity charge and a TO exit commodity charge is levied to deal with any under-recovery of allowed revenues.

NGGT derives the transportation charges it imposes within its revenue cap using the NTS charging methodology. TO entry capacity charges are determined at auction. TO exit capacity charges are set annually from 1 October 2012 and NGGT publishes indicative charges at 150 days advance notice. Commodity charges are set annually from 1 April each year.

The NTS charging methodology

The charging methodology is designed in a way so that actual revenue collected is equal to the maximum allowed in a way that is cost reflective, non-discriminatory and promotes competition. To collect the allowed revenue for TO and SO, National Grid uses a different approach to set the optimal charges. The TO levies capacity charges on entry and exit flows using auction and fixed rate mechanisms respectively. In addition, commodity charges are levied on entry and exit flows where entry auction revenue, or exit capacity charging revenues is estimated to be below the allowed revenue. The SO mainly relies on entry and exit commodity charges to meet its allowed revenue. With effect from 1 October 2012 interruptible exit capacity will be replaced by NTS daily off-peak exit capacity. User will acquire NTS daily off-peak exit capacity via pay as bid auctions with zero reserve prices, but there will be no revenue foregone in relation to this capacity product.

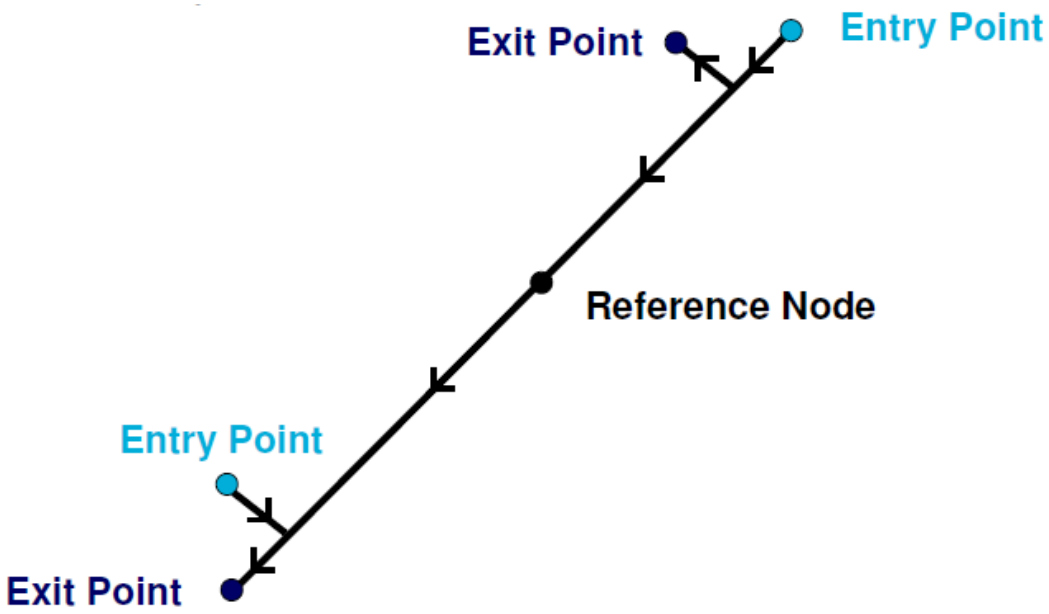
To set both reservation prices for the entry auction and exit capacity prices, NGGT uses the transportation model which comprises two models, the transportation model and the tariff model.

Long Run Marginal Cost (LRMC) is used in the transportation model to calculate the incremental costs of investment in the transmission system caused by an increase in demand or supply at each connection point on the system, based on analysis of peak conditions. The tariff model then adjusts the LRMCs to either maintain the targeted split of revenue between the entry and exit flows or to adjust the level revenue to the optimal level.[220]

The Transportation Model calculates the LRMCs of transporting gas from each entry point to a "reference node" and from the "reference node" to each relevant off-take point. The reference node does not affect the final charges and is included in the Model for transparency. This diagram below illustrates the concept of the distance between entry and exit points.

[220] NGGT 'NTS Transportation Model', ENA London, 16 September 2011

Figure 2: Entry and exit point illustration



Source: National Grid 'NTS Transportation Model', ENA London, 16 September 2011

The transportation model has three key stages:

1. Calculate flows from demand and supply data. This calculates the required flows between entry and exit points that are needed based on peak conditions.

2. Calculate reinforcement costs for each pipe section. Unit costs are calculated from the expansion factor (£/GWh/km) multiplied by the pipe distance (km) to give unit costs in £/GWh.

3. Reference node costs. To obtain entry and exit costs the costs to and from a reference node are considered. The unit cost will be the sum of the unit costs for each pipe where the flow increases less the unit costs for each pipe where the flow decreases.

Types of approach

The LRMC transport model adopts a bottom up modelling approach. The model uses the following inputs to estimate the capacity prices to cover the costs in increased usage:

- Demand and Supply Forecasts
- Updates to the Network and any future projects
- Expansion Constant (capital costs to build the transmission infrastructure (such as pipeline) to transport 1GWh over 1km)
- Revenue amount to be recovered from Exit Capacity
- New supply points
- Baselines capacity that National Grid are obligated to offer within its GT licence
- Any requests for incremental (over and above the baselines) capacity

Definition of increment

The investment costs are measured at the costs associated with the marginal changes in flow distance as a consequence of the increased usage. The unit costs are measured as the costs of pipeline to transport 1GWh over 1km (the expansion constant), and these are then applied to the relevant increase in flow distance for each entry point.

Efficient costs/ incumbents costs
National Grid uses its own cost data to calculate the costs associated with an expansion in capacity.

Asset valuation
The assets of the notional models are costed in terms of their modern equivalent asset value and their cost is annuitised.

Use in regulatory decisions

The TO's LRMC transport model is not used by Ogfem in its regulatory decisions concerning the overall revenue to which the regulated businesses may aspire, but is used by the TO to structure its charges. [221]

[221] It is not clear why LRIC is not used by Ofgem to set overall revenue charges, but we assume the rationale for LRIC

Appendix 2: Review of LRAIC Calculations for Gatwick

Introduction

Our understanding is that Gatwick commissioned the model to contribute to the CAA's assessment of market power at Gatwick Airport. Gatwick intended to show, through the model, that the current price cap is below the LRAIC of a number of increments, implying that the prices at the airport are below the long-term average competitive price level.[222] Gatwick did not intend the model results to address the question of how LRAIC could be used to set price caps.

The main purpose of this review is to analyse the underlying assumptions and theoretical underpinning of the model and assess the sensitivity of the calculations to changes in key assumptions. Whilst we comment, where relevant, on the values of some of the inputs, our remit is not to undertake a technical or cost audit of the investment plans.

Information sources

Information used for this critique includes:

- FTI Consulting's draft LRAIC model for Gatwick Airport ("draft for CAA December 2011"). This model is the main subject of our review.
- FTI Consulting's presentation of the model to the CAA workshop.[223]
- FTI's reconciled LRAIC model for Gatwick ("2 November 2012"). This model reconciles the differences between the original model and a model developed by FTI Consulting using the approach the CAA used in 2008 in the Stansted price review.[224]
- FTI Consulting's report on the reconciled models which addresses comments raised by the CAA on the original model.[225]
- Gatwick Airport's Master Plan (July 2012) and Capital Investment Plan (August 2012). These contain information about Gatwick's expenditure plans, the levels of increased capacity that could be achieved and traffic forecasts. However the Plan does not provide detailed data on capital investment to enable straightforward reconciliation with the data included in FTI Consulting's model.

Review of FTI Consulting's Approach

Definition of the increment

[222] CAA 'Gatwick - Market Power Assessments Non-confidential Version: The CAA's Initial Views', February 2012
[223] FTI Consulting 'LRAIC for Gatwick Airport: Presentation to CAA workshop' 7 December 2011
[224] The key differences between the two models is that FTI Consulting's own approach considered in more detail the phasing of capital expenditure, and the profile at which new passengers would take up the newly available capacity.
[225] FTI Consulting 'Long run average incremental cost of airport capacity – an update for Gatwick Airport Limited' 2 November 2012

FTI Consulting uses the following increments in its model:

Increment 1 – small increase in capacity

A series of capital projects which would have the combined effect of providing capacity for an additional eight to 10 million passengers per annum ("mppa") by around 2025 (from 35mppa to 43-45mppa). These are based on actual plans provided by Gatwick, with a capital cost of around £1.3bn in 2013/14 prices. The projects include those directly related to capacity enhancement (around 70 per cent of cost), as well as those related to quality improvements which enhance capacity (around 30 per cent).[226] The length of the forecast period is 25 years for Increment 1, from the end of the capital expenditure in 2018/19 until 2043/44.

Increment 2 – additional runway

This estimates the costs of constructing a new terminal, a second runway and associated other infrastructure. The additional new capacity would be between 27 mppa and 37mppa (from 43mppa to 70-80 mppa). The cost estimates for this project are indicative, and range from £3bn to £5bn in 2013/14 prices.[227] The forecast period is until 2058/59, 35 years after the new capacity enters service in 2023/24.

Increment 3 – replacement airport

This estimates the replacement cost of a new airport under three scenarios: on a similarly located greenfield site (both with and without the cost of acquiring the land) and on the basis of replacing the airport on its existing site (brownfield).[228] The costs are indicative and range from £8.3bn to £6.5bn in 2013/14 prices. Under all of these scenarios, FTI assumes that the new airport would accommodate 45 mppa upon opening, consistent with the capacity of Gatwick Airport after the projects considered in Increment 1. For Increment 3 the airport enters service in 2020/12 or 2023/24 depending on the scenario. The forecast period is 35 years after the capacity enters service.

An implicit assumption of the model is that the replacement airport would be of similar configuration to the existing one, allowing for a slight increase in capacity similar to Increment 1.[229]

The LRAIC figures for the three increments are summarised in the table below.

[226] The capital costs quoted here represent the model's central estimate. Options exist for excluding quality-related investments, or including other types of investment such as asset replacement.

[227] Based upon the CAA's estimate of the cost of delivering similar additional capacity at Stansted (£2.5bn), adjusted for inflation and allowing some additional headroom for the likely higher costs of undertaking such a project at Gatwick, particularly with respect to the cost of acquiring the necessary additional land.

[228] 'Brownfield' site assumes the land is set up for an airport, including connections to utilities and transport, and all planning permission and land acquisition costs. 'Greenfield' site assumes the use of new land not currently set up for an airport. Costs therefore include land acquisition and planning, and connects to utility and transport services.

[229] We base our reading on this on FTI's description of the Increment in its presentation "we assume a replacement airport is built on a brownfield site with the same characteristics as Gatwick's current site": FTI Consulting 'LRAIC for Gatwick Airport: Presentation to CAA workshop' 7 December 2011 and on the discussion about the historical development of Gatwick in FTI Consulting 'Long run average incremental cost of airport capacity – an update for Gatwick Airport Limited' 2 November 2012, page 23-24

Table 1: Summary of FTI Consulting's model increments

Increment	Description	Incremental passengers	Capital costs (2013/14)	£/passenger
Current average price	2011/12 level in 2013/14 prices			9
Increment 1	Indicative capital programme	8 – 10 mppa	£1.3bn	10 – 11
Increment 2	Additional runway	27 – 37 mppa	£3bn - £5bn	14-28
Increment 3a	New airport: relocation	45mppa	£8.3bn	20
Increment 3b	New airport: relocation net of sale value	45mppa	£7.3bn	17
Increment 3c	New airport: brownfield site	45mppa	£6.5bn	15

Source: FTI Consulting 'LRAIC for Gatwick Airport: Presentation to CAA workshop' 7 December 2011

Most relevant increment

In the context of FTI's model, the purpose of the LRAIC calculations is to provide price benchmarks against which to compare the current price cap. The assumption is made that the LRAIC estimates represent the competitive price level.

In our view, the relevant increment to LRIC calculations is the service or product for which prices are to be determined.[230] In the context of Gatwick Airport this is at present the airport as a whole — Increment 3. However, the estimates should be of the costs of the most modern, efficient airport configuration, using modern equivalent asset valuations rather than the costs of replacing the existing airport. MEA valuations would reduce the estimates.

Although the model does not go into detail about the design of the new airport in Increment 3, it is implied that the costs are associated with reconstructing Gatwick as it is today (with some additional capacity), including airport services not related to passenger capacity and keeping the same airport structure. In our view, Gatwick airport could be more efficiently configured, for example by having a 'toast-rack' of terminal buildings between two runways. If only one runway was built to begin with, the terminals would still be placed such that a second runway could be built on the other side.

It may be argued that the historic development of Gatwick has resulted in its current configuration and therefore a replacement cost that replicates this is appropriate. However, a LRIC based on replacement costs must reflect modern costs; in a competitive market, the current level of Gatwick prices would be constrained by the price that a new entrant could charge — this would be based on the costs of the most efficient airport configuration.

If the resulting LRIC estimate is below the current cap at Gatwick, this implies that the assets may have been earning too high a return. If the resulting estimate is above the current cap, this would support the view that prices at Gatwick are below the competitive price level. It would also be reasonable to use these LRAIC estimates to help to set per-passenger prices at the airport as a whole as this is the directly reflected by the increment.

[230] For example in telecoms the whole termination service; in electricity, the peak capacity flows.

The other increments

The LRAIC of a second runway would not be appropriate, as the cost calculation in itself does not tell anything about the actual demand for that service.[231] If it were possible to establish that there was willingness to pay for the additional capacity, then it would more closely reflect the market price. We acknowledge that evidence on willingness to pay (both from airlines and passengers) is challenging to gather.

There are further complications in using a capacity-based increment (such as a second runway) to inform prices for the airport as a whole. If an airport has market power, then there is a danger in using a (higher) LRIC for the increment to set average process at the airport as a whole as the airport could inflate the costs or need for the expansion (as in a RAB-based approach) and use its market power over existing customers to extract higher prices.

Inputs and data

The data used in the model vary in detail across the three increments. We note that the results included in FTI Consulting's presentation at the CAA workshop in December 2011 differ somewhat to the results of this model, as a non-confidential version of inputs was used in the former.

We describe and comment briefly on the inputs used for the three increments.

Increment 1 – small increase in capacity

The data for Increment 1 were provided by Gatwick Airport and represent the airport's 'best prevailing best estimate' of the costs of its preferred projects for developing the airport in line with customer demands and expectations.[232] These data are relatively detailed as they represent actual investment plans of Gatwick Airport Ltd. (GAL). We understand that the data used in FTI Consulting's model have not been reviewed by an independent body, such as the Airports Operating Committee. The costs represent the incumbent operator's estimates rather than objective consideration of 'efficient' costs.

- Passenger demand. Passenger growth used in the model is informed by traffic forecasts provided to FTI Consulting by Gatwick Airport. These forecasts are broadly in line with the 'base case' forecasts included in Gatwick's latest investment plan, although slightly higher. The long-run growth rate after 2019/20 used in the model is closer to the high case forecast from the investment plan.[233] We note that, regardless of terminal capacity, in order for Gatwick Airport to accommodate the maximum number of passengers for Increment 1 the average number of passengers per flight would have to increase from 140 to around 161 per flight, as well as the intensity of the runway use up to 280,000 passenger air traffic movements (PATMs) compared to just over 242,000 in 2011/12.[234] Our view is that attaining these levels will be difficult and unlikely for a long time, both from logistical considerations and from the likely evolution in demand (particularly if a recession continues).
- Capital expenditure. Whilst we are not in a position in this project to audit the nature and cost of the capital expenditure proposed for Increment 1, we do note that inflated capital figures would increase the LRAIC estimates. The level of capital expenditure could be influenced by the following:
  - Different service levels. We note that the capital projects in the model do not differentiate between different levels of service that could be offered by the expansion. For example, low-cost

[231] Even if there is a capacity shortage in the South East, the locational differences between the airports and planning barriers make it impossible to assume that the demand for additional capacity must equal the demand for additional capacity at Gatwick.
[232] FTI Consulting (2012) 'Long Run Average Incremental Cost of airport capacity – an update for Gatwick Airport Limited
[233] Gatwick Airport '2012: Capital Investment Programme' August 2012, page 12
[234] Gatwick Airport '2012: Capital Investment Programme' August 2012

airlines may prefer less costly expenditure that fits with their business model, such as less retail space. The detail in the project descriptions is not sufficient to enable an assessment of the implied service level, although given Gatwick's aim of becoming a hub airport we assume these are not targeted solely at low-cost airlines. The costs of Increment 1 could vary if this distinction between service levels were made.[235]

- We would also expect to be able to reduce the proposed capital expenditure for a general 'cosmetic' quality reduction (although one that does not compromise the lifespan of the assets), should this be desired by customers.
- Allocation of capital expenditure. The capital investment items are categorised as 'capacity enhancement'; 'quality improvement'; 'other non-capacity enhancement' and 'asset maintenance'. In the base case of the model, capacity enhancement projects are included along with an allocation of certain quality improvement projects (at a ratio of approximately 70:30 of the increment costs). In our view it is appropriate to allocate some quality improvements to capacity expansion as these would enhance the utilisation of the existing assets. We have reviewed the allocations used in the model and regard them as reasonable.[236]

- Asset lives. FTI Consulting assumes a weighted average asset life for the new assets of 23 years, and has chosen 2043/2044 as the end of the forecast period, 25 years after the capital expenditure has supposedly been completed in 2018/19. However, in the model there is capital expenditure that continues until 2022/23, which suggests the forecast period should continue until 2027/48.[237]

  In addition, although we are not in a position to analyse the asset lives of individual capex items, it is our view that asset lives could be significantly longer than this – at least 35 years (the Annual Report gives a range of 20 to 60 years as the depreciation period). Understating the asset lives of new investments would allow Gatwick Airport to recover its costs more quickly.[238]

- Capital maintenance. The model assumes that capital maintenance is 3 per cent of additional capex and begins 10 years after construction is completed. In our view a figure of 3 per cent is very high.[239] It is likely that maintenance will be needed at an earlier stage, at a lower proportion of capital expenditure in the early years.

- Operating expenditure. The operating expenditure in FTI Consulting's model has been hard-coded in and therefore we cannot assess how this was derived. It does not appear that FTI Consulting has made a disaggregation for wage rates. This implies an assumption that wages will grow at the same rate as RPI, and that real wage increases will be offset by productivity gains. However, it is likely that productivity gains over time may outweigh real increases in wage rates, particularly due to productivity-improving equipment that is probably included in the forecast capex. This implies that the FTI Consulting model overestimates the opex forecasts over the years of the model.

- Non-aeronautical revenue. This revenue has been hard coded into the model, and is a function of each capacity investment rather than of the increase in passenger numbers. In our view these revenues should be related to passenger growth, and thus should enter the model along the same timing as this growth.

[235] We would have liked to have included a reduced cost of retail space as a sensitivity calculation, but information on the capex dedicated to retail space was not available.
[236] We do however conduct sensitivity analysis including only capacity enhancing investments.
[237] If the end of the capital period is changed to 2022/23, the LRAIC estimate decreases by eight per cent
[238] Increasing the average forecast period from 25 to 35 years decreases the LRAIC estimate by just under eight per cent.
[239] As a cross-check, maintenance as a proportion of the RAB was 1.3 per cent at the end of 2010/11. Maintenance of un-depreciated assets would be an even lower proportion. See Gatwick Airport Limited Report and Financial Statements for the year ended 31 March 2011, page 17

Increment 2 – additional runway

Data for Increment 2 are less detailed than those used for Increment 1, and are based on costs developed for Stansted on the building of a second runway.[240] Whilst this increment may be more appropriate for the calculation of LRAIC for setting price limits, the high-level nature of the data means that the results should be treated with more caution.

We have the following additional comments to make on the data used for Increment 2. Some of these comments also apply to Increment 3:

- Capital expenditure. Whilst the costs associated with an additional runway at Gatwick are indicative, they are nevertheless based on high estimates of a similar capacity increase at Stansted (approximately £2.5 billion). Updated figures based on analysis by the Competition Commission are available (approximately £1.8bn) which, if used as a base by FTI Consulting, would significantly reduce the indicative costs of the additional runway.[241]
  - Asset lives. FTI Consulting assumes the combined asset life of the new capacity is 35 years. In our view this is reasonable, although a longer asset life would also be appropriate (up to 50 years).
- Operational expenditure. Opex is assumed to be equal to non-aeronautical revenue and therefore not modelled for Increment 2 or Increment 3. Our view is that opex and non-aeronautical revenue should be modelled separately as these are likely to be different: for example, opex at Gatwick in 2011/12 was approximately £287 million and non-aeronautical revenue approximately £166 million.[242] If revenue and opex had been modelled as a function of passenger growth it would have been relatively straightforward to include these in the model.

Increment 3 – new airport

FTI Consulting uses information from GAL, BAA/Stansted and its own assumptions to estimate the capital costs of building a replacement airport under the three scenarios. The table below provides the sources for different elements of the costs for the three scenarios. The level of detail for Increment 3 data is significantly less than the other options, although many of the underlying assumptions are the same.

The capital expenditure information provided for the three scenarios is as follows:

[240] CAA reference to the Competition Commission for Stansted Airport:Supporting paper III Advice to CAA on BAA's Capital Investment Plans at Stansted Airport, May 2008

[241] The original CAA reference to the Competition Commission included costs of approximately £2.5 billion. These were subsequently reduced significantly by the Competition Commission and its consultants to between £1.6 and £1.8 billion. See ASA and Competition Commission: 'Review of the master plan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008.

[242] Operating costs exclude depreciation, and non-aeronautical revenue consists of retail and car parking revenue. See Gatwick Airport Limited Report and Financial Statements for the year ended 31 March 2011, page 15.

Table 2: Capital expenditure for Increment 3

Cost (£ billions, 2013/14 prices)		Source
Land acquisition	1	GAL
Planning	0.27	Competition Commission
Connections to utilities	0.4	GAL
Connections to transport	0.09	Deloitte report for BAA/GAL
Construction cost	6.5	GAL

Source: FTI Consulting model of LRAIC at Gatwick Airport

General inputs and assumptions

The model includes the following general inputs and assumptions:

- Discount rate at the cost of capital – 7 per cent
- All values discounted to 2013/14
- Capital maintenance – 3 per cent of capital
- Years after end of initial investment before capital maintenance starts – 10
- Assumed long-run inflation – 3 per cent

Modelling decisions

LRAIC models are sensitive to both the values of the inputs and to the modelling approach. We note the following key elements of FTI Consulting's approach:

- Nature of capital investment. In increment 1 FTI includes historic costs for some capital projects necessary for expansion that have already been undertaken. As these assets are written off over the life of the forecast period this is reasonable in our view. However, as explained later, incremental passengers should only be attributed to the investment once it is needed (i.e. once existing capacity is breached).
- Timing of revenue and opex. The model takes into account that new capacity will only become operational at a date in the future. In relation to Increment 1, if associated revenue and opex is modelled as a function of additional passengers, then these should only enter the model when the capacity becomes available and incremental passengers appear. As it is, the model assumes that revenue and opex are a function of the capital expenditure, and therefore these enter the model at the same time as the capital expenditure.[243] In our view it would be more accurate if these entered in line with incremental passengers.

[243] In FTI Consulting's update report for Gatwick, they state that incremental revenues are only relevant once the capacity is operational, and that the revenue values are discounted back over a long period to an evaluation date before any project activity began, hence being relatively small in present value (if the revenues are assumed to arise immediately after the evaluation date, then the LRAIC calculation would be lower). However, our examination of the model shows that revenue is included from 2010/11 which suggests that it does not in fact only enter when capacity becomes operational. The same applies to opex, which enters in 2009/10.

- Timing of capital investment. The model times the capital investments broadly in line with passenger growth - when total passenger numbers reach the existing capacity of the airport the new capacity becomes operational (with an assumed lead time for construction). This timing is less precise in Increment 1, however, as the model assumes that some of the relevant increase in passenger numbers occurs before the investment scheme is completed, owing to the phased nature of the programme.
- Incremental passengers. The model makes two main assumptions of incremental passengers.
  - In Increment 1, the model assumes that some of the relevant increase in passenger numbers occurs before the investment scheme is completed, owing to the phased nature of the programme. However, some of this increase in passengers occurs within the existing capacity of the airport (i.e. before passenger numbers reach 35mppa) and therefore is not necessarily attributable to the new investment; rather to the existing capacity being more fully utilised. It is our view that the new capacity should become available when the existing capacity constraint begins to bind, and that incremental passengers are counted only after this point. This may, however, be explained by a discrepancy in the maximum capacity of the existing airport: in FTI Consulting's presentation this is 35mppa, whereas in FTI Consulting's update report for Gatwick this is stated as 33mppa (in which case the 'extra' incremental passengers are appropriate).[244]
  - In Increment 2, the model assumes an additional incremental block of passengers using Gatwick when the additional capacity becomes available (on day one), labelled as the 'demand kick'. The LRAIC without this kick is greater, as the PV of incremental passengers would be smaller. In our view it is reasonable to assume that there would be an incremental block of passengers using the new capacity on day one as the airlines would wish to make the most use of the additional capacity (for example, by offering incentives to passengers). However, we consider a magnitude of 10,000 passengers as used in the central estimate too large.
- Inflation of capital expenditure. The model adjusts all figures to constant prices (2013/14) using RPI. However, our view is that adjusting capital expenditure by the construction price index (COPI) would be more appropriate. In addition, the model assumes that in the long-run construction prices do not change relative to other prices. However, all capital expenditure begins around 2014/15 and this long-run change may not be relevant.
- The FTI Consulting model includes an indicative RAB-based calculation for Increment 1. This calculates the NPV allowed revenue and passenger numbers over the five-year Q6 period both with and without Increment 1, and then takes the difference to reach a revenue per passenger based on the 'incremental RAB'.

Table 3: FTI Consulting's incremental RAB-based approach

NPV at 2013/14	With increment	Without increment	Difference
NPV of revenues (£000s)	1,481,803	1,219,993	261,809
NPV of passengers (£000s)	152,758	143,940	8,818
Revenue per passenger	9.70	8.48	29.69

The revenue per passenger of the incremental RAB (£29.69) is significantly higher than the corresponding LRAIC estimate. This is almost entirely due to the fact that the majority of the capital expenditure takes place in Q6, whilst the additional number of passengers is still relatively small. If the 'incremental RAB' approach was conducted over a longer time period, one would expect the two figures to be similar.

[244] See FTI Consulting (2012) 'Long Run Average Incremental Cost of airport capacity – an update for Gatwick Airport Limited

Model audit

We conducted an audit of the model calculations to ensure that these were correct and consistent and produced the intended output. We also checked the correct implementation of a number of formulae such as the application of discount rates, forecast periods, inflation and cash flows.

Sensitivity analysis

We conduct sensitivity analysis on key assumptions and inputs. We do not analyse any detailed changes to the modelling approach – our LRAIC model for Gatwick will include the modelling decisions that we consider more appropriate.

We present a table illustrating the actual changes to the LRAIC estimates, and one showing only the percentage change.

Table 4: Variables for sensitivity analysis

Variable	Original value	New value	Note
Discount rate	7%	6% 8%	A higher (lower) discount rate should increase (decrease) the LRAIC estimate by changing the relative benefit of future investments
Capital expenditure Increment 1	Included all 'capacity enhancement' and 'quality' projects with allocation	Include only 'capacity enhancement' projects	Uncertainty regarding the rationale behind quality projects.
Capital costs for Increments 2 and 3	Values for Base Low (Increment 2) and Option A (increment 3)	+15% -30%	Upside variation reflects a risk factor; downside variation reflects the difference between the original and revised Stansted figures.
Asset lives	25 (Increment 1) 35 (increments 2 and 3)	30 45	We consider the asset lives of new investments should be greater, in particular additional runways and new airports.
Increment 2 maximum capacity	80mppa for base case	70mppa	This reflects uncertainty in the additional capacity of the new runway and terminal.
Increment 2 demand 'kick'	10,000	5,000	The reduced incremental block of passengers would increase the LRAIC estimates.
Increment 1 traffic forecasts	Passenger growth rate average 2.38% (2011/12 – 2023/24)	+50% -50%	Medium to high growth forecasts for Gatwick vary by 100%.[245] A more conservative 50% range for sensitivity is chosen.
Increment 2 traffic growth	3%	2% 4%	Ranges included in FTI Consulting model

[245] Gatwick Airport Capital Investment Programme August 2012, page 12

The results of the sensitivity analysis are presented in the tables below.

Table 5: Results of sensitivity analysis, LRAIC per passenger (2013/14 prices)

	Increment 1 (£/pax)	Increment 2[1] (£/pax)	Increment 3[2] (£/pax)
Central LRAIC estimate	10.94	13.62	19.93
Discount rate 6%	9.95	11.70	17.81
Discount rate 8%	11.99	15.83	22.25
Increment 1 'capacity only' investment 3[3]	8.60		
Capital costs less 30%		11.27	13.95
Capital costs more 15%		15.67	22.92
Asset life 30	10.47		
Asset life 45		12.85	19.21
Increment 2 maximum capacity 70mppa		16.09	
Increment 2 demand kick 5,000		16.48	
Increment 1 Traffic forecast less 50%	10.25		
Increment 1 Traffic forecast plus 50%	11.72		
Increment 2 Traffic growth scenario 2%		15.65	
Increment 2 Traffic growth scenario 4%		12.61	

Notes: 1. Increment 2 central estimate based on 'broad low' capital costs.
2. Increment 3 central estimate is based on Option A (Relocation gross)
3. This represents a change from £1.3bn to £1.08bn)
Source: Europe Economics analysis of FTI Consulting model

Table 6:Results of sensitivity analysis, percentage change in LRAIC per passenger

	Increment 1 (£pax)	Increment 2 (£/pax)	Increment 3 (£/pax)
Discount rate 6%	-9%	-14%	-11%
Discount rate 8%	10%	16%	12%
Increment 1 'capacity only' investment 3[3]	-21%		
Capital costs less 30%		-17%	-30%
Capital costs more 15%		15%	15%
Asset life 30	-4%		
Asset life 45		-6%	-4%
Increment 2 maximum capacity 70mppa		18%	
Increment 2 demand kick 5,000		21%	
Increment 1 Traffic forecast less 50%	-6%		
Increment 1 Traffic forecast plus 50%	7%		
Increment 2 Traffic growth scenario 2%		15%	
Increment 2 Traffic growth scenario 4%		-7%	

The results of the sensitivity analysis show that the LRAIC calculations are very sensitive to changes in capital costs and demand forecasts. The change in demand forecasts does not affect Increment 3 as this assumes a constant increment of 45mppa. The calculations are also sensitive to the assumed maximum capacity of the investments and hence the number of incremental passengers in each in increment.

FTI Consulting conducted further sensitivity analysis in response to queries by the CAA, using a simplified model. The results are presented in the table below, and further highlight the sensitivity of the calculations to changes in assumptions and inputs.

Table 7: FTI Consulting's sensitivity analysis

	Option 1		Option 2		Option 3		
(£/pax)	Low	High	Low	High	A	B	C
FTI Consulting estimate of LRAIC using CAA approach	**12**	**14**	**15**	**25**	**10**	**9**	**9**
Impact of adding incremental volume on day 1			-7	-11			
Impact of asset life ending in 2043/44	1	1					
Impact of using a growth forecast instead of the average growth rate	-1	-1					
Impact of pre-day 1 incremental passenger volume	-3	-3					
Impact of using a 3% instead of a 2% growth rate			-1				
Impact of future operational start date			7	14	10	8	6
FTI Consulting estimate of LRAIC using the FTI Consulting approach (Dec 2011)	**10**	**11**	**14**	**28**	**20**	**17**	**15**

Note: FTI Consulting's sensitivity analysis was conducted on the results of their simpler model (CAA approach); the results of their original model are shown as a cross-reference.
Source: FTI Consulting (2012) 'Long Run Average Incremental Cost of airport capacity – an update for Gatwick Airport Limited, page 19

Appendix 3: LRIC estimates for Stansted

Introduction

This model is intended to illustrate the LRAIC per passenger of different capacity increments for Stansted Airport. The increments chosen relate to capacity expansions that have either been proposed in the past or are currently being considered by Stansted. Our purpose is not to conclude what the most appropriate expansion at Stansted would be, and therefore we do not undertake a detailed audit of the proposed capital projects, nor comment on the likelihood of these occurring. Before price limits were set on the basis of a LRIC calculation, the input assumptions would need to be subject to greater scrutiny.

In some instances a level of judgement is required in deciding which data are most appropriate to use for the modelling. For this Europe Economics has drawn on the technical expertise of our external advisor from MSP solutions (an aviation consultancy).

Model structure

Our long run average incremental cost calculation is of the form:

$$\text{LRAIC} = \frac{\text{Sum of the present value of net costs forecast over the investment horizon}}{\text{Sum of the present value of number of passengers over the investment horizon}}$$

The present value (PV) of net cost is (capital expenditure + operating expenditure –non-regulated expenditure) over the investment period, discounted at the assumed cost of capital. The PV of passengers is the additional number of passengers related to the investment over the investment period, discounted at the same rate.

Demand forecasts

Stansted traffic forecasts until 2018/19 are based on the Memorandum of Information recently submitted by Stansted to the CAA.[246]These forecasts assume a starting point based on forecasts of overall traffic growth that have been revised to include consideration of incentive-led growth at Stansted. The timescale is extended to 2020/21 using forecasts from Stansted's draft Strategic Business Plan 2011, which are of a similar magnitude and based on the same assumptions.[247] We assume that the incentive-led growth will tail off after 2020/21. To reflect this, we assume the central average long-run growth after 2020/21 from a consultancy report prepared for Stansted. We assume that the transition from a high to a low growth rate occurs smoothly over a five year period.

[246] Stansted Airport, 'Information Memorandum' October 2012
[247] Stansted Airport 'Draft Strategic Business Plan 2011'

Table1: Stansted Passenger Forecasts

	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Passenger (m)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Growth		[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Long-term annual growth rate beyond 2020/21		[✂]							

Notes: 1. Forecasts until 2018/2019 from Stansted Airport, 'Information Memorandum' October 2012, adjusted to spread over financial year. Forecasts for 2019/2020 onwards from Stansted Airport 'Draft Strategic Business Plan 2011'. Long-term growth beyond 2020/21 based on average of central forecast estimate (2012/13 – 2023/24) from [✂]

The central forecast estimates [✂] are more conservative [✂], partly we believe because the former do not assume the same degree of incentive-driven growth. We conduct sensitivity analyses on our model using these more conservative figures.

Definition of increments

Our LRAIC model for Stansted covers three increments based on plans published at different times by Stansted, but with some adjustments which will be explained. The plans were, in chronological order:

- Increment One - based on SG1 plans in 2006, updated to current prices (2011/12). These plans would provide an increase in airport capacity to 35mppa from current assumed maximum capacity of 25mppa.[248] The additional number of passengers that can be attributed to the investment is uncertain, as Stansted has implied that the proposed investments were designed to bring the full capacity of 35mppa into full use but include some spending for purposes other than capacity increase. We divide this increment into two options: Increment 1(a) excludes projects not clearly related to capacity expansion; Increment 1(b) includes all projects in the SG1 plans.
- Increment Two – based on SG2 plans from 2008, also updated to current prices (2011/12). These plans would provide a further increase in airport capacity with additional runway and terminal facilities to 70mppa. They are additional to Increment One (i.e. assume baseline capacity at 35mppa). There is a clearly attributable link between the investment and the additional 35mppa.

  (These plans were not implemented, although some projects were carried out from those in SG1 and SG2).
- Increment Three – based on current plans (2011), representing remaining investment projects needed after capacity reaches 25mppa in order to utilise maximum terminal capacity of 35mppa.
- Increment Four: - a whole service increment for Stansted Airport, representing the modern equivalent asset value (MEAV) of Stansted airport at the existing site. The increment is based on the value of the tangible fixed assets as seen in Stansted's statutory accounts (1999 – 2011) and the current investment plans (represented by Increment 3) The capacity of the airport will be 35mppa.

The table below presents a description of all the increments.

[248] Estimating current levels of capacity is not straightforward, since the numbers of passengers landed depends in the turn-round times achieved by different airlines and on airlines' willingness to use off-peak times of day.

Table 2: Description of Increments

	Increment 1(a) (2006)	Increment 1(b) (2006)	Increment 2 (2008)	Increment 3 (2011)	Increment 4
Baseline capacity	25mppa	As 1(a)	35mppa	25mppa	
Capacity on completion of plan	35mppa	As 1(a)	70mppa	35mppa	35mppa
Incremental capacity	10mppa	As 1(a)	35mppa	10mppa	35mppa
Capital expenditure (£m at 2011/12 prices)	231.8	595.3	1,798	[✂]	2,285
Forecast period (years)	35	35	50	35	50
Information source	Capital projects in SG1 plans (2006)	Capital projects in SG1 plans (2006)	Capital projects in SG2 plans (2008)	Capital projects in draft Strategic Business plans (2011)	Tangible fixed assets in Stansted's Financial Statements (1999 – 2011) plus Increment 3
Investment projects included	Projects clearly relating to relevant capacity increase	All projects	All projects	Projects identified by Stansted as necessary for completing capacity increase	The modern equivalent value of existing assets plus projects identified by Stansted as necessary for completing capacity increase

Notes: 1. Projects for Increment 1 selected from Scott Wilson assessment of Stansted Airport CIP in 'CAA reference to the Competition Commission for Stansted Airport, Supporting paper II: Advice to CAA on BAA's Capital Investment Plan at Stansted Airport, April 2008. Relevant projects selected from airline and ASA commentary in Competition Commission 'Stansted Airport Limited: Q5 price control review, October 2008, Appendix F'.
2. Projects for Increment 2 taken from ASA and Competition Commission: 'Review of the master plan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008. We used ASA's 'minimum cost' estimates.
3. Projects for Increment 3 selected from Stansted [✂].

Modelling of increments

Each increment is associated with a specific capital expenditure plan that would expand the airport capacity. In our central scenario, increments are timed to become operational in the same period where the additional capacity is necessary to satisfy the forecast demand. The capital expenditure is divided equally over the corresponding number of years necessary for construction.

Expansions can take place at once (e.g. Increment 1) or can be spread across more than one phase (Increments 2 and 3). The time horizon of each increment is based on the average asset life of the capital expenditures. When the investment is phased, the LRIC calculation is based on the asset life of the first phase and a recovery value is subtracted for the remaining asset life of investments undertaken in subsequent phases.

All prices are expressed in the current period (2011/12 in our model), and all present values are discounted back to this period. We have used the Output Price Index for New Construction (COPI) to deflate capital expenditures to constant prices and the Retail Price Index (RPI) for non-regulated sources of revenue. Maintenance costs start after a given number of years after the increment has been finalised and are assumed to be a percentage of the capital expenditure. Depreciation is assumed to be linear.

While the model allows for different passenger types (low-cost and full-service), this distinction is immaterial in the model for Stansted which is currently predominantly serviced by low-cost and charter airlines.

Inputs and assumptions

The model inputs and assumptions are similar across increments, with the exception of capital expenditure. We first discuss the capital expenditure associated with each increment, and then present the other inputs and assumptions.

Capital investment

Increments 1(a) and 1(b)

The capital projects included in Increment 1(a) and 1(b) are taken from Stansted's investment plans for SG1 adjusted for efficiency, as they appear in the CAA's reference to the Competition Commission.[249] Whilst our remit for this work does not include a technical audit of the capital plans, we have reviewed the projects listed and assessed the extent to which they can be considered to add to capacity. Increment 1(a) only includes those we consider capacity enhancing – a total of £231.8 million in 2011/12 prices. Increment 1(b) includes all projects – a total of £595.3 million in 2011/12 prices. Some of the projects labelled 'replacement' would still have an element of capacity enhancement, as the replacement would provide additional capacity that would be needed in the future. The table below presents our analysis.

Table 3: Investment projects included in Increments 1(a) and 1(b), 2006 prices

Investment project	Asset Life	Cost (£m)	Proportion of investment included in Increment 1(a)	Proportion of investment included in Increment 1(b)	Explanation for inclusion or exclusion in Increment 1(a)
Above/Below Ground Drainage	20	1.5	0%	100%	Unrelated to capacity
Additional Baggage Reclaim Belt (6th Belt)	15	1.9	100%	100%	Directly related to increased passenger traffic
AHU Replacement/Upgrade Inverter Controls	15	6.6	15%	100%	Replacement would allow for increased capacity
Airport Operational System Replacement	15	2.4	10%	100%	Replacement would allow for increased capacity
Baggage Control Upgrade	15	4.6	0%	100%	Not directly related to capacity expansion
Baggage System Replacement	15	15.4	15%	100%	Replacement would allow for increased capacity
Bassingborne Road	35	0.0	0%	100%	Not directly related to capacity expansion
Car Rental Ready Return	35	1.9	0%	100%	Not directly related to capacity expansion
Cargo Shed Development	35	36.9	0%	100%	Our model does not consider cargo investment or revenues

[249] 'CAA reference to the Competition Commission for Stansted Airport, Supporting paper II: Advice to CAA on BAA's Capital Investment Plan at Stansted Airport, April 2008

Investment project	Asset Life	Cost (£m)	Proportion of investment included in Increment 1(a)	Proportion of investment included in Increment 1(b)	Explanation for inclusion or exclusion in Increment 1(a)
Check-in Island 4 (Zone G & H)	15	3.9	100%	100%	Directly related to increased passenger traffic
Echo Cul-de-sac North West	50	10.7	100%	100%	Directly related to capacity expansion
Echo Cul-de-sac South	50	10.1	100%	100%	Directly related to capacity expansion
Echo Final Phase	50	4.2	100%	100%	Directly related to capacity expansion
Fuel Farm Tanks	35	2.9	100%	100%	Directly related to capacity expansion
Full Depth Delta East	50	4.8	100%	100%	Directly related to capacity expansion
Hangar 8	35	6.3	0%	100%	Excluded based on CC analysis
Hold Baggage Screening (HBS) Replacement	35	6.3	0%	100%	Not directly related to capacity expansion
Hotel Taxiway Extension to Echo Cul-de-sac	50	4.0	100%	100%	Directly related to capacity expansion
Juliet Taxiway - Phase 4	50	5.5	100%	100%	
Junction 3 Grade Separation/Dual of Thremhall Avenue	35	2.9	0%	100%	Not directly related to capacity expansion
Loading Bridge & Links	15	3.9	100%	100%	Directly related to capacity expansion
Long Stay Car Park - Phase 4	35	8.5	100%	100%	CC report raised doubt regarding necessity, but still related to capacity expansion
Long Stay Car Parking (Phase 5)	35	3.9	100%	100%	CC report raised doubt regarding necessity, but still related to capacity expansion
Other "A" List Projects	35	197.8	0%	100%	Nature of projects not identified. Later Stansted document implies these are replacement/upgrade.
Rail Infrastructure	35	14.7	100%	100%	Directly related to capacity expansion
RET Runway 05	60	7.2	100%	100%	Stand-by runway enables increased capacity utilisation
Runway Rehabilitation	35	15.5	15%	100%	Resurfacing with improved asphalt would allow for capacity increase
Satellite 2 Gate Room Expansion	35	1.9	100%	100%	Directly related to capacity expansion
Satellite 4	35	47.2	100%	100%	Directly related to capacity expansion
Second Departures Out of Gauge (OOG) System	15	1.8	100%	100%	Directly related to capacity expansion

Investment project	Asset Life	Cost (£m)	Proportion of investment included in Increment 1(a)	Proportion of investment included in Increment 1(b)	Explanation for inclusion or exclusion in Increment 1(a)
Security Compliance Project	35	2.4	0%	100%	Not directly related to capacity expansion
Short Stay Multi Storey Car Parks (MSCP's)	35	14.3	100%	100%	Short-stay car parks required for capacity expansion
Short-Stay CP Zone G Phase 3	35	3.1	100%	100%	Short-stay car parks required for capacity expansion
SSCP Reconfiguration	35	1.9	0%	100%	Car park re-con an internal cost control rather than capacity-related
Sustainable Heat Source	20	5.0	15%	100%	Partly quality improvement to reduce energy usage that would increase with capacity
Terminal Extension Arrivals	50	29.3	100%	100%	Directly related to capacity expansion
Terminal Extension Departures (Bay 9)	35	44.1	10%	100%	Excluded, except for passenger lounge allowance, based on CC analysis
Track Transit System Cars Replacement	35	5.8	0%	100%	Not directly related to capacity expansion
Western Apron Refurbishment	35	2.0	0%	100%	Not directly related to capacity expansion
Yankee Cul-de-sac	50	8.5	100%	100%	Directly related to capacity expansion
Zulu Cul-de-sac (Phase 1 Additional Aircraft Stands)	50	5.4	100%	100%	Directly related to capacity expansion
Zulu Cul-de-sac (Phase 2 Additional Aircraft Stands)	50	13.3	100%	100%	Directly related to capacity expansion
Total cost			**£222m**	**£570.3m**	

Source: Figures from CAA (2006) "Advice To CAA On BAA's Capital Investment Plans At Stansted Airport", Appendix D: Summary of Revised CIP 2006 Projects revised costs from Scott Wilson Ltd. Assessment of capacity-related nature from Competition Commission 'Stansted Airport Limited: Q5 price control review' October 2008, Appendix F and Europe Economics' analysis.
Note: asset lives based on Europe Economics assessment of investment. Asset lives range from 10 to 60 years.

Increment 2

The capital projects included in Increment 2 originate from Stansted Airport but were revised by the Competition Commission and its consultants in the Q5 price control review.[250] As Increment 2 is a discrete set of investments for an additional runway and terminal facilities, we consider all capital projects relevant. Implicit in the SG2 plans is some allowance for full-service airlines. However, for the purposes of the modelling exercise we take the necessary projects at face value. We have nevertheless excluded the allowance for "risk" so as to include what we assume were intended to be the central cost estimates for each project. The full capital cost is £1.8 billion in 2011/12 prices.

[250] Competition Commission and ASA Consulting 'Review of the masterplan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008.

Table 4: Investment projects included in Increment 2, Q2 2006 prices

Investment project	Asset life	Cost (£m)	Allocation to Increment 2
Terminal	35	194.8	100%
Pier/ Satellite	35	191.8	100%
Baggage	15	34.8	100%
Runway & Airfield	60	295.9	100%
Airfield Infrastructure	35	90	100%
Car Parks	35	92.1	100%
Airport Roads	35	227.7	100%
Public transport facilities	35	15.1	100%
Other landside infrastructure	35	32.1	100%
Utilities	20	95.6	100%
Site acquisition & blight	60	99.3	100%
Site clearance & preparation	35	37.6	100%
Site management & logistics	35	63.5	100%
Design & project management	35	127	100%
BAA project & other costs	35	120.4	100%
Risk	35	128.8	0%
Total cost		**1,717**	

Source: Competition Commission and ASA Consulting 'Review of the masterplan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008.

Increment 3

The projects for Increment 3 are selected from Stansted's response to the CAA's request for information [✂].[251] The table below presents the capital projects considered relevant by Stansted. These are a sub-section of the projects included in Stansted's draft Strategic Business Plans 2011.[252] Total capital cost £ [✂] million in 2011/12 prices.

Table 5: Investment projects included in Increment 3, 2008/09 prices

Investment project	Asset life	Cost (£m)	Allocation to Increment 3
Phase 1 (after 25mppa)			
Hotel Taxiway to Echo	50	[✂]	100%
Rapid access Taxiways	50	[✂]	100%
Full depth Delta east	50	[✂]	100%
Part depth Echo NE (now full depth)	50	[✂]	100%
Full depth Echo to Sat 4	50	[✂]	100%
Phase 2 (after 30mppa)		[✂]	
Satellite 2 Full fit-out	10	[✂]	100%
Construction/extension of Yankee and Zulu cul-de-sacs	50	[✂]	100%
Construction of Satellite 4	50	[✂]	100%
Additional bays	50	[✂]	100%
Total cost		[✂]	

Source: Stansted [✂]
Note: [✂]

[251] Stansted [✂]
[252] Stansted: Draft Strategic Business Plan: Planning for the future - a consultation, August 2011

These investment projects are those necessary to complete the expansion of Stansted and therefore do not represent the entire capital expenditure that has been necessary to move Stansted to a maximum capacity of 35mppa. For example, the terminal building can already accommodate 35mppa; these investments are just the remaining ones needed to enable the airfield to accommodate this increase in passenger numbers. Therefore any LRAIC estimate using only these capital projects will be very low, as the full additional 10mppa is being attributed to only a proportion of the expenditure. This highlights the importance of the definition of the increment to LRAIC calculations.

In addition, as we have already noted, estimating the existing maximum capacity at Stansted without these investments is not a straightforward matter. Capacity depends in part on the type of airlines using the airport (with different turnaround times) and therefore existing capacity may be somewhere between 25mppa and 30mppa. For the purposes of our modelling exercises we have assumed that the baseline maximum capacity before these investments is 25mppa, based on Stansted's response to the CAA that these investments would be needed after demand reaches 25mppa. Some investments are phased in once capacity is at 30mppa.

Increment Four

This increment represents the replacement costs of Stansted Airport at the existing site. We include the MEA values of the existing assets as well as the final investments needed to bring the capacity to 35mppa (as represented by Increment 3). We consider only those assets directly related to the airport (excluding, for example, office buildings and land held for development). We assume the airport is constructed over a five-year period from 2011/12, to be ready in 2016/17. When it opens we assume that the traffic level will be high enough to have the airport operate at full capacity throughout the increment duration (35mppa). [253]

We emphasise that the replacement costs are indicative and subject to uncertainty regarding the true modern equivalent asset values. We use available data on existing assets from the Financial Statements available in Stansted's Annual Reports from 1999 – 2011. In order to arrive at an approximation of the MEA values for the existing assets relevant to the airport we consider the following:

- Current configuration — we assume the current configuration represents the modern efficient equivalent given that the airport is relatively new and well-designed, and in the absence of information about an alternative configuration.
- Efficient capacity — we assume that the capacity of the current airport (after final investments) is needed and would be replicated in a replacement airport.
- We consider the following asset categories directly relevant to the airport:[254]
  - Investment properties (in 2011 the majority of assets in this category were directly related to the airport (such as car parks and the airfield. Approximately seven per cent relate to offices and industrial which we do not consider directly relevant and so exclude).[255]
  - Terminal complexes
  - Airfields
  - Plant equipment and other assets

[253] In our sensitivity analysis, we consider the alternative in which traffic would be equivalent to the forecasted levels at Stansted in 2016/17 (21 mppa).
[254] These asset categories are taken from the latest financial statement: Stansted Airport Limited 'Annual report and financial statements for the year ended 31 December 2011', page 28
[255] See the CAA 'Mid-quinquennium review – Stansted RAB' May 2012, page 8

  - We do not include 'land held for development' as this is entered into investment properties once it comes into use; or 'group occupied properties/other land and buildings' as this appears to relate to buildings for the BAA Group as a whole and not directly to the airport.
  - Neither do we include 'assets in the course of construction' as these are added to the other relevant asset groups when complete. The exception is 'assets under construction' in 2011 which should be included in the asset base but which would not yet have been allocated to a specific asset group.
- We assume that the disposals reflected in the final values of the assets were made at fair value and represent the removal of unwanted assets from the total value which should not be included in a MEA valuation (such as the removal of planning costs associated with the redundant second runway plan).
- The 'investment properties' are valued each year and as such the final value in 2011 represents the modern equivalent value.[256]
- The terminal, airfields and plant and equipment are valued at historic cost and not updated for inflation. We adjust for inflation in the following ways:
  - For terminals and airfield we use COPI; for plant equipment and other assets we use RPI in the absence of another index.[257] If a more specific index for equipment assets were available this may affect the MEA values.
  - We take the asset value at 1999 as the base value for each category and update it to 2011 prices. We first inflate the 1999 value on the assumption that this was the same value in 1991 when the airport came into use.[258]
  - For each asset category we update the additions to the assets in each year by the correct index (COPI or RPI) for that year. These are net of disposals for that year.

We note that if the value of the land upon which the buildings and airfield are based is not reflected in the value of these assets, then the total MEA value of the replacement airport would be higher. We also note that there are no assets dedicated to the provision of utilities or transport in the financial statements. Again, if these values are not reflected in the available assets then the total MEA value of the replacement airport would be higher.

The table below presents the updated asset values for the airport, including the additional investments represented by Increment 3.

[256] See Stansted Airport Limited 'Annual report and financial statements for the year ended 31 December 2011', page 29

[257] The other possible indexes are Producer index and Consumer index, neither of which seemed significantly preferable.

[258] We note that this may overstate the value of the asset base in 1999 as additions to the base are likely to have been made between 1991 and 1999 and should not be subject to inflation for the whole period. However, in the absence of data from 1991 we consider this the best way to account for inflation. Further, it may be likely that no substantial investment was made in the first few years of the airport coming into operation.

Table 6: Replacement cost asset values, 2011/12 prices

		Modern equivalent value (£m)
1998/99 assets base		949.2
Investment Properties (end of 2011 value)		505.1
Additions to asset base 1999 - 2011		
	Terminal complexes	458.9
	Airfields	79.4
	Plant Equipment & Other Assets	58.9
	Assets in the course of construction	42.7
Additional investment		190.4
Total Replacement Cost		2,284.6

Note: 1. Investment properties already at MEA value at end 2011
2. Additional investments represent those from Increment 3
Source: Stansted Airport Limited Financial Statements 1999 – 2011, updated for inflation using COPI and RPI; Projects for Increment 3 selected from Stansted '[✂].

We assume an average asset life of 50 years for the replacement airport.[259] Other general assumptions on the relationship between operating costs and non-regulated revenues, and passenger numbers; maintenance; demand forecasts and cost of capital are the same as the other increments.

We have modelled other elements of capital expenditure in the same way across increments.

- The weighted average of asset lives across all investment projects are used in each increment. The time period over which the LRAIC is modelled is therefore the length of the weighted average asset life after the investment projects are completed. For capital projects that are phased in over time, we calculate the model time period from when the first phase is completed. Capital projects related to subsequent phases will have a residual value at the end of the model period as these will not have reached their full asset life.
- Capital maintenance is calculated as a proportion of capital expenditure for each increment. This is based on current maintenance as a proportion of cost-value assets at Stansted as seen in the 2011 financial statements, at a value of 0.58 per cent.[260] We assume maintenance begins five years after the asset is completed.
- All capital costs have been updated to constant prices (2011/12) using the COPI.[261]

  For our central scenario our long-term capital forecasts assume that construction prices increase at the same rate as inflation. In our sensitivity analysis we allow for COPI to vary in relation to RPI.

[259] Our sensitivity analysis on assets lives (40 and 50 years) does not result in a significant change in the LRAIC calculations
[260] Maintenance as proportion of cost-value assets (£9.9m/£1,695.2m), Stansted Airport Limited Annual Report 2011, pages 4 and 28
[261] BIS, Construction Output Price Indices, Table 1: Output Price Index for New Construction (2010), - September 2012.

Operating expenditure

Operating expenditure is calculated as a proportion of passenger growth: a one per cent increase in passenger traffic results in a 0.44 per cent increase in operating expenditure.[262] As the largest element of operating expenditure at Stansted Airport in 2010/11 was staff (and of that, security staff), it is possible that the figure could be higher due to increased security demands in recent years.[263] We include this in our sensitivity analysis.

We consider it likely that operating expenditure would also increase with a large increase in capacity, such as the building of an additional runway and terminal facilities in Increment 2. This would include utilities costs and maintenance (the second largest element of operating expenditure at Stansted in 2010/11 was utilities, and of that, electricity). However, there is not a similar elasticity available for fixed operating expenditure and thus we only model operating expenditure that varies with passenger growth.

The initial operating expenditure value at the start of the modelling period is £144.6 million, which was the value at the end of 2011/12 adjusted to exclude depreciation and other items.[264]

Non-regulated revenue

Non-regulated revenue is calculated as retail revenue plus a proportion of 'other revenue' that is related to passenger traffic according to Stansted Airport.[265] We use the average retail and 'other' revenue per passenger between 2005/06 and 2011/12. In 2011/12 prices these are £4.3 and £0.28 per passenger respectively. As the model does not consider cargo movements we do not include revenue received from cargo.

Increment Four considers the full replacement of Stansted airport. Therefore, we include in our estimate all sources of revenue. This approach differs with the one taken for increments 1, 2 and 3, where only the revenue that depended on traffic levels was considered. In order to calculate the fixed revenue, we follow Stansted Baseline Business Plan from May 2012 and we assume that half of other revenue will remain fixed at their 2011/12 levels throughout the duration of the increment (the other half varies with traffic levels and is already included in the model).[266] Fixed revenue from other sources is £28.05m in 2011/12, broken down in the following categories:

Table 7: Fixed Revenue, 2011/12 prices

Other traffic charges (£m)	**0.5**
Retail revenue (£m)	74.8
Property (£m)	14.2
Other revenue (£m)	5.45
Revenue from non-pax flights (£m)	7.9
Total (£m)	28.05

[262] Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, p57. The figure is based on an econometric exercise that related operating expenditure to passenger traffic for a panel of airports.

[263] Of total operating expenditure for 2010/11, 38 per cent was staff. See Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, page 8

[264] BAA Financial Results for 2011/12. http://www.baa.com/investor-centre/results-and-performance/financial-results

[265] Stansted Airport Limited 'Baseline Business Plan, 31 May 2012, page 36. Figures updated to 2011/12 prices.

[266] In particular, we include the category Operational Facilities and Utilities income from the Other Revenue accounts.

We note that this revenue includes non-airport rents from residential properties purchased to pursue a second runway at Stansted. Due to insufficient information, we are not able to subtract this amount not related to airport operations.

Summary of general inputs and assumptions

The table below summarises our key inputs and assumptions.

Table 8: Model Inputs

	Central estimate	Source
Cost of capital	7.1%	[✂]
Maintenance cost (proportion of capex)	0.58%	Maintenance as proportion of cost-value assets (£9.9m/£1,695.2m), Stansted Airport Limited Annual Report 2011, pages 4 and 28
Maintenance timing	To begin 5 years after expenditure	
Asset lives	Weighted average asset life (between 33 and 50 years)	Europe Economics' judgement
Operating costs (elasticity of passenger growth)	0.44%	Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, p57
Non-regulated revenues (£/pax)	[✂]	Stansted Baseline Business Plan, 31 May 2012 p36. Includes "retail revenue" and "'other revenue' (half of the latter will increase in line with passenger numbers).
Inflation		
- Retail revenues	RPI	ONS, CPI And RPI Reference Tables, Table 20: RPI all items index: 1947 to 2012, August 2012
- Capital expenditure	COPI	BIS, Construction Output Price Indices, Table 1: Output Price Index for New Construction (2010), - September 2012.

Costs per passenger

The LRAIC per passenger are shown in the tables below.

Table 9: LRAIC model results, 2011/12 prices: key components

	Increment 1(a) (2006)	Increment 1(b) (2006)	Increment 2 (2008)	Increment 3 (2011)	Increment 4
PV capex (£m)	150.4	386.4	482.6	[✂]	2,097.8
PV opex (£m)	192.5	192.5	180.5	192.5	2,131.0
PV non-regulated revenue (£m)	247.5	247.5	232.1	247.5	1,952.43
PV pax (m)	54.0	54.0	50.6	54.0	362.5

Note: present values are all discounted back to the same point (2011/12) and therefore very large values that are incurred further into the future (such as Increment 2) appear of similar magnitude to smaller values incurred earlier. Table 5.2 presents the undiscounted costs for comparison.

Table 10: LRAIC model results, 2011/12 prices: cost per additional passenger

	Increment 1(a) (2006)	Increment 1(b) (2006)	Increment 2 (2008)	Increment 3 (2011)	Increment 4
LRAIC (£/pax)	1.77	6.14	8.51	0.76	6.28

As the table shows, the LRAIC per additional passenger is highest for Increment 2 at £8.15 (the additional runway), followed by Increment 4 (the replacement airport), and 1(b) at £6.14 (the full SG1 investment plan). Increment 1(a) and Increment 3 are the smallest, at £1.77 and £0.76 respectively. This is due to the very small capital expenditure attributed to the increase in capacity from 25mppa to 35mppa.[267]

We note that for increment 1(a) and Increment 3 the operating costs and non-regulated revenues are greater than the capital expenditure. This is because these two variables are entirely dependent on passenger traffic and not capital expenditure. The definition of the increments is such that a relatively small capital expenditure is related to a large incremental increase in passengers.

The LRAIC for Increment 4 is lower than for Increment 2 despite the capital costs being higher. This is because the incremental number of passengers for Increment 4 is higher (as represented by the total number of airport users when the airport opens, rather than just the additional passengers over and above current capacity as in Increment 2).

The model results highlight the importance of the definition of the increment, in particular obtaining a realistic relationship between costs and additional volumes. The results also highlight the sensitivity of LRAIC calculations to capital expenditure estimates. Increments 1(a) and (b) are very similar save for the capital projects included, and the estimates for 1(b) are significantly higher than for 1(a).

Sensitivity analyses

The LRAIC calculations are sensitive to changes in a number of key variables. The table below shows the sensitivities considered.

[267] As a comparison, the model for Gatwick Airport by FTI Consulting attributed a cost of £1.3bn to a capacity expansion to accommodate an additional eight to ten mppa. Whilst not directly comparable for a number of reasons, this gives an indication of the small magnitude of the costs included in this model.

Table 11: Description of sensitivities considered

Discount rate	We consider two alternative scenarios using 6 and 8 per cent as the discount rate.
Traffic	Our sensitivity analysis uses two alternative demand forecasts. First, we consider [✂]'s central scenario and we assume that the long run growth rate is average for their forecast period, which covers Q6 and Q7.[268] Second, we use Stansted's Information Memorandum forecasts and we assume that the long run growth rate is this average growth rate in the forecast period.[269]
Non-regulated Revenue	We consider two scenarios, in which the non-regulated revenue has been over- and underestimated by 10 per cent from the level in our central estimate.
Capex	We consider two scenarios, in which the non-regulated revenue has been over- and under-estimated by 15 per cent. This percentage increase is in line with BAA's risk factor of about 15 per cent for SG2.
COPI over RPI	We consider the possibility of a change in relative prices, in which construction becomes more expensive relative to other goods. This would be reflected by having annual inflation measured by COPI 1 per cent higher than inflation measured by RPI.
Pax-elasticity Opex	In addition to Steer Davies Gleave's central estimation, we consider two scenarios in which the pax-elasticity of Opex is 0.3 and 0.6. The first scenario coincides with the lower end of the Competition Commission's estimation of this elasticity in 2002.[270]
Timing	In our model, the timing of increment is assumed to be perfect: new capacity expansions open right when they become necessary according to the demand forecast. For Increments 1,2 and 3 our sensitivity analysis considers two possibilities: that the increments are build two years too early (-2) or two years too late (2). For Increment 4 we consider the airport being built only when traffic has reached the same level of the full capacity (35mppa).
Construction time	For Increment 4 we assume a central construction time of 5 years, and conduct sensitivity around 3 and 10 years.
Inflation for 1991-1999 assets for Increment 4	Our central scenario assumes the 1991 asset base when the airport opened was the same value as the value in the 1999 financial statements (in the absence of other data), and we inflate the 1999 value accordingly. We conduct sensitivity on the alternative: assuming the 1999 value is the correct value for 1999 and do not inflate this.

[268] [✂]
[269] See the Appendix for a chart to illustrate different forecasts
[270] Competition Commission 'Stansted Airport Limited: Q5 price control review, October 2008, Appendix H'.

Figure 1: Passenger demand forecasts for Stansted

[✂]

Note: [✂]

Table 12: Sensitivity analysis for Increment 1a

Sensitivity variable	New values	New LRAIC (£/passenger)	Percentage change in LRAIC from central estimate
Discount rate			
	6%	1.36	-22.88%
	8%	2.13	20.58%
Traffic			
	STN Information Memorandum	1.54	-12.79%
	[✂]: Central Scenario	2.38	34.89%
Non-regulated Revenue			
	+10%	1.31	-25.95%
	-10%	2.22	25.95%
Capex			
	+15%	2.18	23.66%
	-15%	1.35	-23.66%
COPI over RPI			
	+1%	1.97	11.31%
Pax-elasticity Opex			
	0.3	0.63	-64.21%
	0.6	3.06	73.38%
Timing			
	2 years early	2.24	26.90%
	2 years late	1.89	6.90%

Table 13: Sensitivity analysis for Increment 1b

Sensitivity variable	New values	New LRAIC (£/passenger)	Percentage change in LRAIC from central estimate
Discount rate			
	6%	5.10	-16.91%
	8%	7.07	15.21%
Traffic			
	STN Information Memorandum	5.56	-9.46%
	[✂]: Central Scenario	7.72	25.80%
Non-regulated Revenue			
	+10%	5.68	-7.47%
	-10%	6.59	7.47%
Capex			
	+15%	7.21	17.49%
	-15%	5.06	-17.49%
COPI over RPI			
	+1%	6.65	8.36%
Pax-elasticity Opex			
	0.3	5.00	-18.48%
	0.6	7.43	21.12%
Timing			
	2 years early	7.36	19.89%
	2 years late	6.45	5.10%

Table 14: Sensitivity analysis for Increment 2

Sensitivity variable	New values	New LRAIC (£/passenger)	Percentage change in LRAIC from central estimate
Discount rate			
	6%	6.63	-22.0%
	8%	10.27	20.8%
Traffic			
	STN Information Memorandum	5.71	-32.9%
	[✂]: Central Scenario	8.08	-5.0%
Non-regulated Revenue			
	+10%	8.05	-5.4%
	-10%	8.96	5.4%
Capex			
	+15%	9.93	16.8%
	-15%	7.08	-16.8%
COPI over RPI			
	+1%	10.52	23.7%
Pax-elasticity Opex			
	0.3	7.37	-13.3%
	0.6	9.80	15.2%
Timing			
	2 years early	10.05	18.1%
	2 years late	8.55	0.5%

Table 15: Sensitivity analysis for Increment 3

Sensitivity variable	New values	New LRAIC (£/passenger)	Percentage change in LRAIC from central estimate
Discount rate			
	6%	0.53	-29.9%
	8%	0.95	25.6%
Traffic			
	STN Information Memorandum	0.70	-6.8%
	[✂]: Central Scenario	0.83	9.3%
Non-regulated Revenue			
	+10%	0.30	-60.6%
	-10%	1.21	60.6%
Capex			
	+15%	1.03	36.3%
	-15%	0.48	-36.3%
COPI over RPI			
	+1%	0.94	24.9%
Pax-elasticity Opex			
	0.3	-0.38	-150.0%
	0.6	2.05	171.4%
Timing			
	2 years early	1.06	40.1%
	2 years late	0.83	10.3%

Table 16: Sensitivity analysis for Increment 4

Sensitivity variable	New values	New LRAIC (£/passenger)	Percentage change in LRAIC from central estimate
Central LRAIC		6.28	
Discount rate			
	6%	5.44	-13.4%
	8%	7.01	11.6%
Non-regulated Revenue			
	+10%	5.74	-8.6%
	-10%	6.82	8.6%
Capex			
	+15%	7.15	13.8%
	-15%	5.41	-13.8%
COPI over RPI in future			
	+1%	6.39	1.7%
Pax-elasticity Opex			
	0.3	5.72	-8.9%
	0.6	6.91	10.1%
Timing			
Airport opens to current traffic, not full capacity		7.48	19.1%
Time horizon			
	40	6.46	2.9%
	60	6.19	-1.4%
Construction time			
	3 years	5.90	-6.1%
	10 years	7.41	18.0%
Inflation for asset base	Take 1999 values as base	6.14	-2.2%

We discuss briefly the results of the sensitivity analysis across the four increments.

- Discount rate: a higher discount rate makes the future less valuable relative to the present. Therefore, the benefits of long term investments are smaller compared to their initial cost and the LRAIC increases. The elasticity of LRAIC estimates to changes in the discount rate is relatively high: a one percentage point change in the discount factor changes the LRAIC estimates by between 15 – 30 per cent.
- The model is very sensitive to traffic forecasts, as this affects the number of incremental passengers and the timing of capacity investments. Using the STN IM as a long run forecast increases the long-term traffic growth rate from [✂] per cent to [✂] per cent, leading to a decrease in LRAIC between 6.8 and 32.9 per cent across the four increments. Our second sensitivity analysis, using the [✂] central

estimates, decreases the volume of traffic in the short run. For Increments 1 and 3, LRAIC estimates increase significantly, due to a fall in the PV of incremental passengers and less-than proportionate fall in the present value of capital costs. However, since Increment 2 takes place significantly later, the change in the timing of investments resulting from the traffic forecast change decreases the present value of capital expenditure by a larger proportion than the other components of the LRAIC calculation, leading to a decrease in the LRAIC estimate.

- Non-regulated revenue: as expected, the sensitivity analysis shows that a change in the amount of non-regulated revenues has the largest effect on Increments 1a and 3, where such revenue is very large in relation to capital expenditure. For Increments 1b and 2, the change in LRAIC is less than 10 per cent from the central estimate.
- Capital expenditure: the LRAIC estimates are very sensitive to variations in capital expenditure, leading to changes between 16.8 and 36.3 per cent across the increments. The elasticity of the changes is also significant – for a percentage change in capital expenditure, the LRAIC figure changes by more than a per cent (between 1.1 and 2.4 per cent across the increments).
- COPI over RPI: our sensitivity analysis shows that a persistent increase of construction prices over average retail prices has a large impact on LRAIC. An increase of COPI of 1 per cent over RPI will have the largest effect on projects with large capital expenditure and those that occur far into the future. This can be seen for example on the effect on the Increment 2 LRAIC, which is over 20 per cent greater than the central estimate.
- Pax-opex elasticity: the difference between the Competition Commission and Steer Davies Gleave estimates has a large effect of our LRAIC calculations. The lower Competition Commission estimate results in a decrease in LRAIC of between 13 and 150 per cent. The Increments where opex forms a large proportion of the overall costs are the most sensitive to changes in the opex-elasticity.
- Timing: our analysis shows that the LRAIC estimates are not greatly affected if the increments occur later than necessary. However, the change in LRAIC caused by making capacity available too early can be significant. The construction of an increment two years too early results in a change of between 18 and 40 per cent across the increments.
- The sensitivity analysis shows that the Increment Four calculations are less sensitive to changes in input variables than the other increments. This is most likely due to the simplifying assumptions about construction (we do not assume any phasing of construction, and it is not reliant on passenger traffic to signal the need for construction). The elasticity of change with respect to capex is the largest, which is in line with the other increments, highlighting the significance of investment costs to LRAIC estimates.
- For Increment Four our central assumption on the timing of the airport is that it is built today (ready by 2016/17) and opens at full capacity (35mppa). Given the current traffic forecasts at Stansted, this is unlikely to happen. If the building of the airport was delayed until traffic had reached 35mppa (in approximately 2030/31), the LRAIC estimate would increase by approximately 19 per cent to £7.48, as the PV of incremental passengers would be significantly lower. The same outcome would occur if we assumed that the new airport was opened in 2016/17 but opened to the passenger throughput based on current traffic forecasts. The latter situation might imply that the airport was overcapitalised for the current traffic, although the expectation of future growth could justify the building of the airport now.[271]

[271] Indeed, this is an advantage of LRAIC calculations, in that they show the effects of building capacity before it is needed. The entrant airport operator's decision on when to build would be informed in part by such calculations.

Appendix 4: LRIC Estimates for Gatwick

Introduction

This model is intended to illustrate the LRAIC per passenger of different capacity increments for Gatwick Airport. The increments chosen relate to capacity expansions that are included in Gatwick's investment plan, based on benchmarking expansion costs from other airports and on the airport's statutory financial statements. Our purpose is not to conclude what the most appropriate expansion at Gatwick would be, and therefore we do not undertake a detailed audit of the proposed capital projects, nor comment on the likelihood of these occurring.

In some instances a level of judgement is required in deciding which data are most appropriate to use for the modelling. For this Europe Economics has drawn on the technical expertise of our external advisor from MSP solutions.

Model structure

We follow the same model structure as used for our Stansted model. The long run average incremental cost calculation is of the form:

$$\text{LRAIC} = \frac{\text{Sum of the present value of net costs forecast over the investment horizon}}{\text{Sum of the present value of number of passengers over the investment horizon}}$$

The present value (PV) of net cost is (capital expenditure + operating expenditure –non-regulated revenue) over the investment period, discounted at the assumed cost of capital. The PV of passengers is the additional number of passengers related to the investment over the investment period, discounted at the same rate.

Demand forecasts

Gatwick annual traffic forecasts until 2019/20 are based on the Initial Business Plan To 2020 prepared by Gatwick,[272] which in turn is based on the demand forecast prepared by SH&E.[273] The long-run traffic growth rate, as predicted by SH&E in its base scenario is 1.5 per cent. We project traffic for the remainder of the increment period using this rate as our central scenario.[274] [✂].[275]

[272] Gatwick Airport, 'Initial Business Plan to 2020', April 2012.
[273] This report was prepared in February 2012 and it can be found in Appendix B of Gatwick Airport, 'Initial Business Plan to 2020', April 2012,
[274] We note that this is a low growth rate and that has an impact of the LRAIC estimates. We conduct sensitivities using higher growth rates.
[275] [✂]

Table 1: Gatwick Passenger Forecasts

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
Passenger (m)	33.7	34.3	35.2	35.7	36	36.4	36.8	37.2	38.1
Growth		1.8%	2.6%	1.4%	0.8%	1.1%	1.1%	1.1%	2.4%
Average long run growth		1.5%							

Note: Forecasts from Gatwick Airport, 'Initial Business Plan to 2020', April 2012.

Definition of increments

Our LRAIC model for Gatwick covers three increments. These are described briefly below, with more detail about the inputs in the subsequent sections.

Increment 1 – small increase in capacity

A series of capital projects which would have the combined effect of providing capacity for an additional 10 million passengers per annum by around 2025 (from 35mppa to 45mppa). Based on actual plans provided by Gatwick, with a capital cost of around £1.26bn in 2011/12 prices. The projects include those directly related to capacity enhancement (around 70 per cent of cost), as well as those related to quality improvements which enhance capacity (around 30 per cent).[276] The length of the forecast period is 35 years, from the end of the capital expenditure in 2018/19 until 2043/44.

Increment 2 – additional runway

This estimates the costs of constructing a new terminal, a second runway and associated other infrastructure. The additional new capacity would be 35mppa (increase from 45mppa to 70mppa). The cost estimates for this project are indicative, based on SG2 expansion costs at Stansted Airport of £1.8bn in 2011/12 prices. We add an uplift of £471m to take account of higher land costs at Gatwick.[277] The forecast period is 50 years after the new capacity enters service.

Increment 3 – replacement airport

This increment represents a replacement cost airport built on a site with comparable land value.[278] For a proper LRAIC calculation the costs should reflect modern equivalent asset values and should be based on the most efficient way of providing the existing service. This is likely to imply a different configuration to the current one at Gatwick Airport. As information is not available to us on the nature of this new configuration, we estimate the modern equivalent value of Gatwick's existing fixed assets. The total cost is estimated at £3.74bn. The capacity of the new airport would be 35mppa. The forecast period is 50 years after the capacity enters service. As these capital costs are based on Gatwick's current assets, which may be higher than a more efficiently configured airport, we include a sub-increment that benchmarks the capital costs on the replacement cost of Stansted used in our model in Section 4, using an uplift for higher land costs. This is shown as Increment 3(b) in the table below.

The figures for the three increments are summarised in the table below.

[276] The capital costs quoted here represent the model's central estimate. Options exist for excluding quality-related investments, or including other types of investment such as asset replacement.

[277] Based on half of the land acquisition cost for the whole replacement airport quoted by Gatwick Airport in FTI Consulting's estimate, £942m in 2011/12 prices.

[278] We assume that the value of the land and the connections to utilities and transport are included in the existing asset values for the airport.

Table 2: Summary of Increment Description

	Increment 1	Increment 2	Increment 3	Increment 3(b)
Description	Indicative capital programme	Additional runway	New airport	New airport
Incremental passengers	10mppa	35mppa	35mppa	35mppa
Capital costs (2011/12)	£1.26bn	£2.27bn	£3.74bn	£3.23bn
Forecast period	35	50	50	50
Capex information source	Gatwick's Investment plans as used in FTI Consulting's LRAIC model	Benchmark of Stansted's second runway (SG2)	Indexation of existing fixed asset base	Benchmarked against Stansted replacement cost

Modelling of increments

The capital projects for Increment 1 are modelled according to how they have been planned by Gatwick, with different projects occurring at different times. As the costs for Increment 2 and 3 are more indicative, we model these investments as a single expenditure, spread out equally over a set construction period.[279] In our central scenario, increments are timed to become operational in the same period where the additional capacity is necessary to satisfy the forecasted demand.

In our model, all investment takes place at the same time. In reality it is likely that some investments would be phased to make additional capacity available in smaller increments. However, this approach requires a more detailed capital expenditure plan than available.[280]

We also assume that the additional capacity (and corresponding incremental passengers) is only available once the whole investment plan is complete.

All prices are expressed in the current period (2011/12 in our model), and all present values are discounted back to this period. We have used the Output Price Index for New Construction (COPI) to deflate capital expenditures to constant prices and the Retail Price Index (RPI) for non-regulated sources of revenue and equipment. Maintenance costs start after a given number of years after the increment has been finalised and are assumed to be a percentage of the capital expenditure.

Inputs and assumptions

The model inputs and assumptions are largely similar across increments, the main difference being capital expenditure. We first discuss the capital expenditure associated with each increment, and then present the other inputs and assumptions.

Capital investment

[279] In our central scenario, construction requires five years. Our sensitivity analysis considers alternatively construction times of three and 10 years.

[280] If investments are phased over time then the resulting LRAIC estimate is likely to be lower, as the present value of the capital expenditure would be lower for those investments incurred further into the future. This point particularly affects our results for Increment 2.

Increment 1

The data for Increment 1 are obtained from FTI Consulting's model, provided by Gatwick Airport, representing 'best prevailing best estimate' of the costs of its preferred projects for developing the airport in line with customer demands and expectations.[281] These data are relatively detailed as they represent actual investment plans of Gatwick Airport Ltd. (GAL).

The capital investment items are categorised as 'capacity enhancement'; 'quality improvement'; 'other non-capacity enhancement' and 'asset maintenance'. In the base case of the model, capacity enhancement projects are included along with an allocation of certain quality improvement projects (at a ratio of approximately 70:30 of the increment costs). In our view it is appropriate to allocate some quality improvements to capacity expansion as these would enhance the utilisation of the existing assets. We have reviewed the allocations used in the model and regard them as reasonable. However, some of the 'capacity enhancement' projects included could be considered unnecessary, and we conduct sensitivities around a lower capital expenditure.

Table 3: Investment projects included in Increment 1, 2011/12 prices

Capital Plan scheme	Allocation to capacity	Total Cost (£m)
North Terminal Pier Service (Pier 5)	100%	77.8
North Terminal IDL Capacity Expansion	100%	133.6
South Terminal Baggage & Pier 1	50%	167.8
Public Car Park	100%	68.0
North Terminal Security - Capacity	100%	13.1
North Terminal Security - Service	50%	26.9
Bus Terminal / PTI	50%	27.5
26L Reconfiguration of Taxiways	100%	27.2
NT Early Bag Store Expansion	100%	16.7
North Terminal Pier Service (Pier 6 Southern Expansion)	100%	136.2
Taxiway Rehabilitation	0%	28.5
Taxiway AGL Rehabilitation	0%	8.6
South Terminal Ceiling	0%	17.3
GCC	0%	17.5
Airfield Asset Replacement Programme	0%	41.0
Asset Replacement Programme	10%	105.3
Commercial & Property Programme	0%	16.0
Airfield Peak Capacity Expansion	100%	6.6
Compliance & Risk	0%	43.0
Crew Reporting	10%	11.3
Runway Rehabilitation	0%	43.8

[281] We note that the plans have not been reviewed by an independent body, such as the Airports Operating Committee.

Capital Plan scheme	Allocation to capacity	Total Cost (£m)
Staff Car Park	100%	14.2
NT arrivals	50%	1.4
ST Arrivals	50%	1.4
NT IDL Reconfig	50%	6.6
ST IDL Reconfig	50%	9.4
Norfolk House	0%	3.8
JDI Minor Programmes	0%	3.2
Engineering Asset Replacement	0%	9.0
North Terminal Baggage Reclaim	100%	3.3
Immigration Lanes	100%	23.0
Second Runway Design & Consultation	100%	3.5
Upgrade Check in & Bag Drop	50%	15.5
Pier 3	50%	49.5
ST Energy Centre	0%	28.0
NT Energy Centre	0%	23.9
Return - Other	0%	10.4
Compliance & Risk - Other	0%	22.7
A380	100%	4.7
Domestic Arrivals	0%	14.1
Minor Service Projects	0%	5.7
ST IDL Phase 3 and 4	100%	14.1
CCTV	0%	6.0
IT Core Infrastructure	0%	7.8
Baggage System Rehabilitation	50%	22.6
NT Fire Systems	0%	12.4
Q5 NT Baggage upgrade	100%	41.1
Q5 NT Extension	50%	78.8
Q5 Pier 2 modifications	50%	42.4
Q5 MSCP 6	100%	17.9
Q5 North West Zone	100%	43.1
Q7 ST Pier extension	100%	115.0
Q7 NT Pier extension	100%	115.0
Q7 ST IDL project	100%	150.0

Source: FTI Consulting, obtained from GAL

Increment 2

The capital investment for Increment 2 is based on the costs of the second runway at Stansted Airport. The original costs were provided by BAA, but were revised by the Competition Commission and its consultants in the Q5 price control review.[282] In our model for Stansted we included all the investment costs with the exception the allowance for risk, which gave a total cost of approximately £1.8 billion in 2011/12 prices. For the Gatwick model we add an uplift of £471m to take account of higher land costs at Gatwick.[283] The full cost of this increment is therefore £2.27 billion in 2011/12 prices.

Increment 3

This increment represents the replacement costs of Gatwick Airport at a site equivalent to the existing one. We include the MEA values of the existing assets, and consider only those assets directly related to the airport (excluding, for example, office buildings and land held for development). We do not include Gatwick Airport's current investment plan (used in Increment 1) and therefore the capacity of the replacement airport is 35mppa. We assume the airport is constructed over a five-year period from 2011/12, to be ready in 2016/17. According to our traffic forecast, the traffic level will be high enough to have the airport operate at full capacity from the date at which it becomes operational.

We emphasise that the replacement costs are indicative and subject to uncertainty regarding the true modern equivalent asset values. We use available data on existing assets from the Financial Statements available in Gatwick's Annual Reports from 1999/00 – 2011/12. For pre-1999 assets, we base our estimates on the financial accounts presented by BAA for its Q3 price control period on 1996, which were reported under a replacement cost basis.[284]

In order to arrive at an approximation of the MEA values for the existing assets relevant to the airport we consider the following:

- Current configuration — we note that the current configuration of Gatwick is unlikely to represent the modern efficient way of providing the same services. Therefore our estimate for this increment cannot be considered a full LRAIC estimate.
- Efficient capacity — we assume that the capacity of the current airport is needed and would be replicated in a replacement airport.
- We consider the following asset categories directly relevant to the airport:[285]
  - Investment properties: we assume that in 2011/12 all assets in this category were directly related to the airport (such as car parks and the airfield).
  - Terminal complexes
  - Airfields
  - Plant equipment and other assets
  - We do not include 'land held for development' as this is entered into investment properties once it comes into use; or 'group occupied properties/other land and buildings' as this appears not to relate directly to the airport.

[282] Competition Commission and ASA Consulting 'Review of the masterplan options and costs of the Generation 2 proposals at London Stansted Airport' Section 5.7, September 2008.
[283] Based on half of the land acquisition cost for the whole replacement airport quoted by Gatwick Airport in FTI Consulting's model, £942m in 2011/12 prices.
[284] BAA plc, 'A report on the economic regulation of the London airports companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd)', June 1996
[285] These asset categories are taken from the latest financial statement: Gatwick Airport Limited 'Directors' Report and Financial Statements for the year ended 31 March 2012', page 54

- Neither do we include 'assets in the course of construction' as these are added to the other relevant asset groups when complete. The exception is 'assets under construction' in 2011/12 which should be included in the asset base but which would not yet have been allocated to a specific asset group.

- We assume that the disposals reflected in the final values of the assets were made at fair value and represent the removal of unwanted assets from the total value which should not be included in a MEA valuation (such as the removal of planning costs associated with the redundant second runway plan).
- The 'investment properties' are valued each year and as such the final value in 2011/12 represents the modern equivalent value.[286]
- The terminal, airfields and plant and equipment are valued at historic cost and not updated for inflation. We adjust for inflation in the following ways:
  - For terminals and airfield we use COPI; for plant equipment and other assets we use RPI in the absence of another index.[287] If a more specific index for equipment assets were available this may affect the MEA values.
  - We update the prices of asset additions between 1996 and 1999 assuming that the price base is 1995/96.
  - For each asset category we update the additions to the assets in each year by the correct index (COPI or RPI) for that year. These are net of disposals for that year.

We note that if the value of the land upon which the buildings and airfield are based is not reflected in the value of these assets, then the total MEA value of the replacement airport would be higher. We also note that there are no assets dedicated to the provision of utilities or transport in the financial statements. Again, if these values are not reflected in the available assets then the total MEA value of the replacement airport would be higher.

Table 4: Replacement cost asset values, 2011/12 prices

		Modern equivalent value (£m)
Pre 1995/96 Assets		1,099.2
Additions	*1995/96 - 1998/99*	
	Terminal complexes	355.0
	Airfields	26.9
	Plant Equipment & Other Assets	62.0
	1998/99 - 2011/12	
	Terminal complexes	1,086.0
	Airfields	139.1
	Plant Equipment & Other Assets	32.9
2011/12 Assets		
	Investment Properties	667.1
	Assets in the course of construction	168.2

[286] See Gatwick Airport Limited 'Directors' Report and Financial Statements for the year ended 31 March 2012', page 55

[287] The other possible indexes are Producer index and Consumer index, neither of which seemed significantly preferable.

Total Replacement Cost	3,736.4

Note: 1. Investment properties already at MEA value at end 2011
Source: Gatwick Airport Limited 'Directors' Report and Financial Statements for the year ended 31 March 2012; BAA plc, 'A report on the economic regulation of the London airports companies (Heathrow Airport Ltd, Gatwick Airport Ltd and Stansted Airport Ltd)', June 1996; and Gatwick Statutory accounts from 1999/00 – 2011/12

For Increment 3(b) we benchmark the costs against the replacement cost for Stansted that we estimated in Section 4: £2.3 billion. We uplift this to account for higher land values at Gatwick –£942.6 million as used in FTI Consulting's mode for Gatwick Airport, in 2011/12 prices. This results in a total of £3.3 billion.

Operating expenditure

Incremental operating expenditure is calculated as a proportion of passenger growth: a one per cent increase in passenger traffic results in a 0.44 per cent increase in operating expenditure.[288] As the largest element of operating expenditure at Gatwick Airport in 2010/11 was staff, it is possible that the figure could be higher due to increased security demands in recent years. We include this in our sensitivity analysis by considering a higher elasticity.

The initial operating expenditure at the start of the modelling period is £280.9 million, which was the value at the end of 2011/12 excluding exceptional costs.[289] For increments 1 and 2, we include only the incremental opex using the elasticity specified above. As Increment 3 relates to the whole airport, we include a baseline opex as represented by the initial operating expenditure at the beginning of the period, and incremental opex using the elasticity for the additional passengers over and above those reflected in the 2011/12 value. For Increment 3(b) we use the initial opex figure from the Stansted replacement cost model (£144.6 million) as the airport structure is based on Stansted. However, as this opex is related to passenger numbers, in our model we adjust the initial Stansted figure to account for higher passenger numbers at Gatwick. We assume that this opex figure reflects the configuration of Stansted.

Non-regulated revenue

We distinguish between the fixed and variable (i.e. related to passenger traffic) components of non-regulated revenue. We regard property revenue as fixed, since it does not depend on passenger traffic. This category amounts to £34.3 million in 2011/12 and it is relevant to Increment 3 only, as it is part of the total airport revenues. Variable revenues are included in all increments, and include retail, car parks and other non-regulated revenues. Our model uses the values for 2011/12 as reported in Gatwick's regulatory accounts for 31 March 2012. We model variable revenue linearly, with each incremental passenger representing £5.76 of additional revenue.

For Increment 3(b) we again use the non-regulated revenue for Stansted as our replacement cost airport is based on a configuration similar to Stansted. This gives a figure of £ [✂] per pax and a fixed revenue of £28.05 million.

[288] Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, p57. The figure is based on an econometric exercise that related operating expenditure to passenger traffic for a panel of airports. While this report as a whole was developed for Stansted airport, the nature of the benchmarking exercise makes it applicable to other airports as well.
[289] Gatwick Airport Limited 'Regulatory Accounts for year ended 31 March 2012'

Table 5: Non-regulated revenue for Gatwick Airport (2011/12 prices)

Fixed revenue		
	Property	34.3
	Total (£m)	**34.3**
Variable revenue		
	Retail and car parks	160.2
	Other	34.0
	Total (£m)	**194.2**
	Passenger traffic	33.7
	Variable revenue per passenger (£/pax)	**5.76**

Summary of general inputs and assumptions

The table below summarises our key inputs and assumptions.

Table 6: Model Inputs

	Central estimate	Source
Cost of capital	6.5%	Cost of capital at Q5 price control. CAA, 'Economic Regulation of Heathrow and Gatwick Airports: 2008-2013', 11 March 2008, page 121.
Maintenance cost (proportion of capex)	1.2%	Maintenance as proportion of cost-value assets (£35.2m/£2017m), Gatwick Airport Limited Directors' Report and Financial Statements for the year ended 31 March 2012, pages 19 and 54.
Maintenance timing	To begin 5 years after expenditure	
Asset lives	35 years for Increment 1 50 years for Increments 2 and 3	Europe Economics' judgement
Operating costs (elasticity of passenger growth)	0.44%	Steer Davies Gleave 'Review of operating expenditure and investment consultation (Annex D) Mid term Q5' 12 May 2012, p57
Non-regulated revenues (£/pax)	5.76	Gatwick Airport, 'Regulatory Accounts, 31 March 2012
Inflation		
- Retail revenues	RPI	ONS, CPI And RPI Reference Tables, Table 20: RPI all items index: 1947 to 2012, August 2012
- Capital expenditure	COPI	BIS, Construction Output Price Indices, Table 1: Output Price Index for New Construction (2010), -

	September 2012.

Costs per passenger

The LRAIC per passenger are shown in the tables below.

Table 7: LRAIC model results, 2011/12 prices: key components

	Increment 1	Increment 2	Increment 3	Increment 3(b)
PV capex (£m)	1,069.96	924.52	3,675.98	3,173.86
PV opex (£m)	206.85	177.40	3,269.67	2,354.71
PV non-regulated revenue (£m)	325.01	278.74	2,701.09	2,155.80
PV pax (mppa)	56.4	48.4	400.6	400.6

Note: present values are all discounted back to the same point (2011/12) and therefore very large values that are incurred further into the future (such as Increment 2) appear of similar magnitude to smaller values incurred earlier.

Table 8: LRAIC model results, 2011/12 prices: cost per additional passenger

	Increment 1	Increment 2	Increment 3	Increment 3(b)
LRAIC (£/pax)	16.9	17.0	10.6	8.4

As seen in the table above, the LRAIC estimates are highest for Increment 2 at £17 in 2011/12 prices. The LRAIC estimate for Increment 3 is noticeably lower, at £10.6 in 2011/12 prices. This is primarily due to the larger number of incremental passengers, as all 35mppa are considered incremental. The estimates for Increments 1 and 2 are not very different; although Increment 1 has lower capital expenditure it also includes fewer incremental passengers.

Sensitivity analyses

The LRAIC calculations are sensitive to changes in a number of key variables. The table below shows the sensitivities considered.

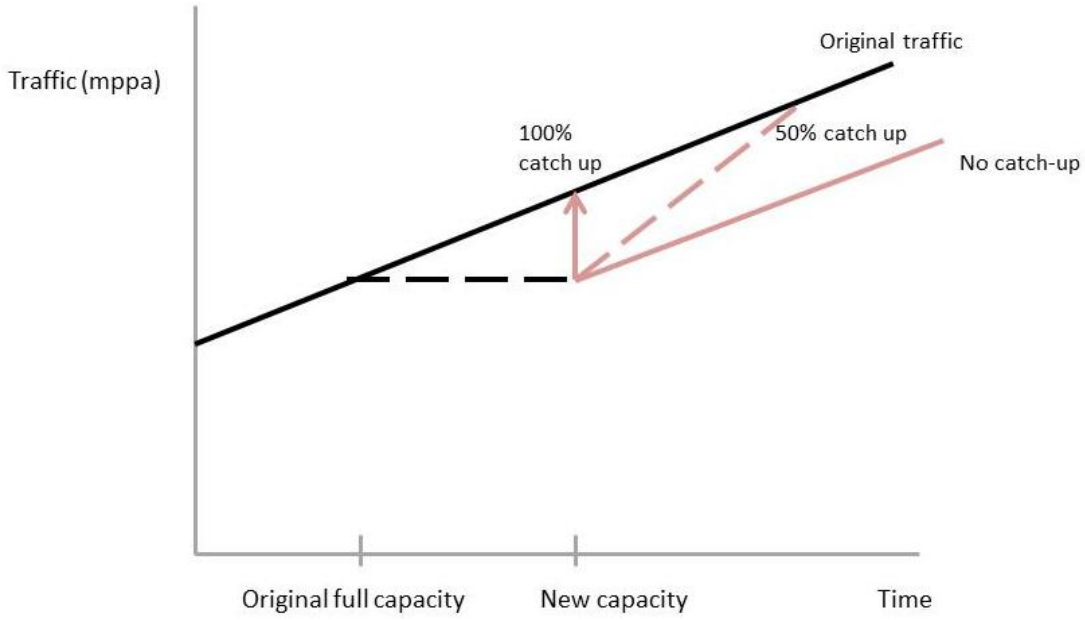
Table 8: Description of sensitivities considered

Discount rate	We consider two alternative scenarios using 6 and 7 per cent as the discount rate.
Traffic	Our sensitivity analysis uses alternative long run growth rates for passenger demand. We consider scenarios with 2.1 and 2.5 per cent growth [✂].
Non-regulated Revenue	We consider two scenarios, in which the non-regulated revenue has been over- and underestimated by 10 per cent from the level in our central estimate.
Capex	We consider two scenarios. The first is an increase in capex of 15%, in line with BAA's risk factor SG2. The second applying a 15% reduction in the costs for Increments. For increment 1 we consider an additional scenario, which includes only the capital expenditures that are directly related to capacity expansion.
COPI over RPI	We consider the possibility of a change in relative prices, in which construction becomes more expensive relative to other goods. This would be reflected by having annual inflation measured by COPI 1 per cent higher than inflation measured by RPI.
Pax-elasticity Opex	In addition to Steer Davies Gleave's central estimation, we consider two scenarios in which the pax-elasticity of Opex is 0.3 and 0.6. The first scenario coincides with the lower end of the Competition Commission's estimation of this elasticity in 2002.[290]
Timing	In our model, the timing of increment is assumed to be perfect: new capacity expansions open right when they become necessary according to the demand forecast. For Increment 2 our sensitivity analysis considers two possibilities: that the increments are build two years too early (-2) or two years too late (2).
Capacity delivered	This variation allows for the possibility that the capacity delivered by the increment is different than projected. We consider alternative scenarios where the capacity delivered is 5 mppa lower as well as 5 and 10 mppa higher than expected.[291]
Catch-up rate	Our central scenario for Increment 1 assumes no 'catch-up' of demand from the time when the original airport capacity is reached to the time when the capacity expansion is complete (i.e. passenger traffic does not jump to the level that it would have been had the capacity constraint not kicked in). Alternatively, we consider two scenarios with 50 and 100 per cent catch-up. The chart below illustrates this.

[290] Competition Commission 'Stansted Airport Limited: Q5 price control review, October 2008, Appendix H'.

[291] We note that, under the current assumptions, the replacement airport (Increment 3) would be at full capacity (35mppa) throughout the exercise. If the capacity delivered were higher (40 or 45mppa), as it is assumed in this alternative scenario, the construction of the airport would be delayed until there is enough traffic to operate the new airport at full capacity from the first period.

Figure 1: Illustration of demand catch up



The following three tables present our sensitivity analysis for all our increments. The LRAIC estimates are particularly sensitive to the discount rate and the long-run passenger growth rate. For the former, a variation of half percentage point can lead to changes in the estimate up to 14.5 per cent, as it is the case for Increment 2. An increase in the long-run growth rate from 1.5 to 2.5 per cent would lead to a substantial decrease in the LRAIC, up to 37 per cent for. An exception to this is Increment 3. Since current passenger traffic is currently almost at capacity, the replacement airport would operate at full capacity irrespective of the long-run growth rate.

Increment 1 currently assumes no 'catch up' in passenger traffic from when the airport reaches full capacity of 35mppa to when the new capacity is ready. If we assume 100 per cent catch up (i.e. on the opening of the new capacity, traffic jumps to the level that would have existed had the original airport capacity not become binding) then the LRAIC estimate falls significantly, by 19 per cent.

We have assumed that the replacement cost of current fixed assets at Gatwick would enable the construction of an airport with capacity for 35 mppa. If the capacity delivered with Gatwick's current configuration was instead 40 or 45 mppa, the LRAIC would decrease substantially by 15.6 and 27.8 per cent, respectively.

Table 9: Sensitivity analysis for Increment 1

Sensitivity variable	New values	Percentage change in LRAIC from central estimate
Discount rate		
	6%	-9.2%
	7%	9.8%
Traffic		
	2.1%	-12.1%
	2.5%	-16.6%
Catch-up rate		
	50%	-17.5%
	100%	-19.1%
Non-regulated Revenue		
	+10%	-4.0%
	-10%	4.0%
Capex		
	+15%	-6.1%
	-15%	6.1%
Capital Scheme		
	Only capacity enhancing	-25.2%
COPI over RPI		
	+1%	4.5%
Pax-elasticity Opex		
	0.3	-7.7%
	0.6	8.8%
Capacity delivered		
	- 5mppa	63.1%
	+ 5mppa	-18.2%
	+ 10 mppa	-25.0%

Table 10: Sensitivity analysis for Increment 2

Sensitivity variable	New values	Percentage change in LRAIC from central estimate
Discount rate		
	6%	-13.1%
	7%	14.5%
Traffic		
	2.1%	-30.7%
	2.5%	-37.0%
Non-regulated Revenue		
	+10%	-4.0%
	-10%	4.0%
Capex		
	+15%	-6.0%
	-15%	6.0%
COPI over RPI		
	+1%	19.9%
Pax-elasticity Opex		
	0.3	-7.6%
	0.6	8.7%
Timing		
	2 years early	18.4%
	2 years late	-10.5%
Capacity delivered		
	- 5mppa	8.9%
	+ 5mppa	-2.7%
	+ 10mppa	-2.8%

Table 11: Sensitivity analysis for Increment 3

Sensitivity variable	New values	Percentage change in LRAIC from central estimate
Discount rate		
	6%	-5.7%
	7%	5.9%
Traffic		
	2.1%	0.0%
	2.5%	0.0%
Non-regulated Revenue		
	+10%	-7.0%
	-10%	7.0%
Capex		
	+15%	-10.4%
	-15%	10.4%
COPI over RPI		
	+1%	1.7%
Pax-elasticity Opex		
	0.3	-0.4%
	0.6	0.5%
Timing		
	2 years early	
	2 years late	
Capacity delivered		
	- 5mppa	20.8%
	+ 5mppa	-15.6%
	+ 10mppa	-27.8%

Reconciliation with FTI Consulting modelling

The capital expenditure data we use for Increment 1 is the same as that used in the LRAIC model for Gatwick prepared by FTI consulting. Our LRAIC estimate for this increment is £16.32 per passenger, whilst FTI's estimate is £10.02 per passenger. The LRAIC estimates are broken down in the following table:

Table 12: LRAIC estimates for Increment 1

	Europe Economics (2011/12 prices)	FTI Consulting (2013/14 prices)	FTI Consulting (2011/12 prices)
PV capex (£m)	1,069.96	1,235.7	1,164.7
PV opex (£m)	206.85	181.6	171.2
PV non-regulated revenue (£m)	325.01	373.1	351.7
PV pax (mppa)	56.4	104.24	104.24
LRAIC estimate (£/pax)	16.88	10.02	9.44

As it can be appreciated from Table 12 the main differences in assumptions and our modelling approach relate to the traffic volume. The table below summaries the key differences.

Table 13: Difference in assumptions related to passenger traffic in Europe Economics and FTI models

	Europe Economics (central scenario)	FTI Consulting
Discount rate	6.5%	7%
Baseline capacity (mppa)	35	33.275
Long run passenger growth rate	1.5%	2%
Forecast period[292] (years)	35	31
Increment operational	2018/19	2012/13
Incremental passengers counted	When the new capacity is operational	When capital expenditure on the new capacity begins

In addition, our model assumes that when capacity is constrained, all excess demand is foregone. The consequences of our approach would be mitigated by assuming a catch-up rate of 100 per cent.

Table 12 shows further differences in Capex, Opex and Non-regulated revenue. The main difference in Capex is due to assumptions related to capital maintenance. We assume a maintenance cost of 1.2 per cent of capital starting 5 years after the investment is complete while FTI assumes a cost of 3 per cent starting 10 years after the increment is operational. Differences in Opex and Non-regulated revenue could be attributed to our modelling approach, in which considers opex as an elasticity of passenger growth, and revenue linearly related to incremental passengers.

We conduct a number of sensitivities to illustrate how our results would change if we used assumptions and inputs similar to FTI Consulting. These are shown in the table below.

[292] This is the number of years for which incremental passengers are considered.

Table 14: Variations of LRAIC estimates using different inputs and assumptions

	PV Capex	PV Opex	PV Revenue	PV Pax	LRAIC
Original EE values	£1,069.96m	£ £206.85m	£ £325.01m	56.40	16.88
EE with FTI Opex & Revenue figures	£1,069.96m	£183.30m	£380.67m	56.40	15.47
EE with FTI pax forecast	£1,069.96m	£ £244.25m	£ £383.77m	66.60	13.97
EE with FTI pax, 100% catch-up and 33.275mppa capacity	£1,069.96m	£ £351.77m	£ £552.72m	95.91	9.06
EE with FTI Opex, Revenue & pax, 100% catch-up and 33.275mppa capacity	£1,069.96m	£183.30m	£380.67m	95.91	9.10

We note that there are further differences between FTI Consulting's modelling approach and ours that would require a different model structure to adopt. The above table, however, clearly shows that main reasons for the difference.

There are also differences between the results of our model and FTI Consulting's for Increments 2 and 3. These can be explained by the different capital expenditure values used and the modelling decisions regarding investment timing (FTI Consulting assumes difference phasing of investment that affects the PV of the total capital costs); passenger numbers (FTI Consulting assumes a 'demand kick' following the building of the new runway; and assume that the new airport would open to a peak capacity of 45mppa); and other inputs (for example, FTI Consulting assumes that operating expenditure and non-regulated revenues cancel each other out and do not model these).

Our LRAIC for Increment 2 is higher than FTI Consulting's lowest estimate of £14 per pax (although its highest estimate is £28 per pax), even though we used lower capital values. This can largely be explained by the traffic forecasts used – if we use the same forecasts as FTI Consulting our LRAIC estimate for Increment 2 declines from £17 to £13.5. It would further reduce if we were to incorporate a demand kick that increased passenger numbers after the building of the second runway.