Department for Transport

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Aviation Appraisal

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Department for Transport

Transport Analysis Guidance (TAG)

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This TAG Unit is guidance for the **APPRAISAL PRACTITIONER**

This TAG Unit is part of the family **A5 – UNI-MODAL APPRAISAL**

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Contents

1 Introduction

1.1.1 The appraisal of government interventions in the aviation industry presents some analytical issues which have no close analogue in surface transport modes. This WebTAG unit sets out where WebTAG guidance can be applied directly, and additional guidance to cover the estimation of impacts that are specific to an aviation appraisal.

1.1.2 The main user of this guidance is expected to be the DfT itself. Therefore one of the key objectives of this unit is to provide transparency to stakeholders about the methodology which underpins DfT aviation appraisal, which informs the economic case for policy interventions. In practice, Ministerial decisions will consider the full transport business case for an intervention, including the strategic, commercial, financial and management cases.

1.1.3 This unit is expected to apply to the appraisal of most government interventions in the aviation industry, including individual policies, broader strategies, many regulations and the approach to planning applications for individual schemes. The DfT regards this unit as best practice for the appraisal of aviation interventions and would assess the merits of any aviation intervention against this benchmark, while recognising that any appraisal ought to be proportional to the scale of the likely impacts and the appraisal process may be very different for alternative types of intervention.

1.1.4 Section 2 describes the principles which underpin the appraisal of transport schemes across the DfT. Section 3 is specifically related to aviation. It sets out how aviation policies can impact on national welfare and how these impacts can be appraised.

2 Principles of Transport Appraisal

2.1.1 The basic principles of appraisal are explained in The Transport Appraisal Process and Guidance for the Technical Project Manager sets out the appraisal process in detail. A key output of any transport appraisal (including aviation) is the Appraisal Summary Table which formally sets out the economic, environmental and social impacts of an intervention. In addition, there are also considerations around the intervention's contribution to local and regional objectives; and other considerations such as the social and distributional impacts as well as affordability.

3 Measuring the Impacts of Aviation Policies

3.1 Introduction

3.1.1 Where possible, government appraisal quantifies and monetises the welfare impacts of government policies such as a change in aviation taxation or support for the expansion of an existing airport. Where monetary valuation is not possible, some quantitative, or as a minimum qualitative assessment should be sought.

3.1.2 The DfT has developed a sophisticated suite of models of the UK commercial aviation sector, which produce forecasts of passengers and Air Transport Movements (ATMs) at UK airports and of carbon dioxide (CO_2) emissions from aviation to underpin the development of government policy. The models have been continuously improved and updated, as set out in the published technical reports[1]. As far as possible, the models use the same transport modelling principles that are used for other modes.

3.1.3 The following sections, drawing on the diagrammatic presentation in 5Appendix A, explain the approach used to assess the effects of aviation interventions.

[1] https://www.gov.uk/government/collections/uk-aviation-forecasts

3.2 Economic impacts

3.2.1 **Transport Economic Efficiency** - The key players in the aviation market are the producers (airport operators and airlines), consumers (passengers and freight), and government which sets the overall aviation policy and levies taxes on the sector. In the UK there is also an important role played by the Civil Aviation Authority (CAA), which is the independent regulator of the aviation market.

3.2.2 As part of the appraisal, the key impacts on the various groups should be monetised as far as possible. The areas of surplus identified in the diagrams in 5Appendix A can be calculated by comparing prices and quantities across two different scenarios, such as a baseline scenario and a policy intervention scenario.

3.2.3 In addition to these impacts, there may be travel time related impacts associated with policy interventions, such as increased flight frequency and a reduction in delays. Increased frequencies gives passengers more choice over their preferred flight times, access to a greater range of destinations without having to transfer and reduced waiting time for those interlining. Reduced delays save passengers and airlines time. The various factors affecting travel time are captured within “Generalised Journey Time”, which is defined below.

3.2.4 The economic surplus relating to passengers, producers and government, must be assessed in a consistent unit of account. In the calculations below, economic surplus is calculated in the market prices unit of account. See TAG Unit A1.1 – Cost Benefit Analysis for more detail on this. Although the notation differs slightly, the equations below are comparable to those in Appendix A of TAG Unit A1.3 – User and Provider Impacts. The following notation is used in the equations:

a = airport

m = market segment (e.g. journey purpose, residency of passenger and origin / destination)

y = year

sc_i = shadow cost per passenger in scenario i. Shadow costs represent the economic profit that airlines are able to capture at capacity constrained airports through charging a fare greater than the average cost per passenger of producing the service.

oc_i = other airline costs per passenger in scenario i (including fuel costs, the costs of carbon allowances and other operating costs)

tax_i = aviation tax per passenger in scenario i

GJT_i = Generalised Journey Time per passenger in scenario *i*. GJT is a measure of dis-utility expressed in units of time. Within this TAG unit, it is used to represent non-monetary costs associated with taking a flight, such as time spent at airports (for example, for security checks), in-flight time, flight frequency, flight delays, and interchange penalties. It does not include surface access time.

pax_i = passenger numbers in scenario i

VoT_p = aviation value of time by journey purpose p.

t = average level of indirect taxation in the economy (see TAG Unit A1.1)

GC_i = Generalised Cost of travel per passenger in scenario i. GC is measure of dis-utility expressed in units of money. Within this unit, it is used to represent the total dis-utility of taking a flight, including all monetary and non-monetary costs. Therefore it includes GJT, converted to money units.

Producers – For the purposes of appraisal, producers are represented by airport operators and airlines. The change in economic surplus for producers is calculated by the following formula:

$$(1) \quad (1+t)\sum_{a,m,y}\left(sc_2\,pax_2 - sc_1\,pax_1\right)$$

Passengers – For the purposes of appraisal, these are commercial air transport passengers. The change in economic surplus for passengers, split by business and leisure, is calculated using the following formulas:

Business Passengers

$$(2) \quad \frac{1}{2}(1+t)\sum_{a,m,y}\left\{\left(pax_1 + pax_2\right)\left[\left(sc_1 + tax_1 + oc_1 + GJT_1 \cdot VoT_p\right) - \left(sc_2 + tax_2 + oc_2 + GJT_2 \cdot VoT_p\right)\right]\right\}$$

Leisure Passengers

$$(3) \quad \frac{1}{2}\sum_{a,m,y}\left\{\left(pax_1 + pax_2\right)\left[\left(sc_1 + tax_1 + oc_1 + GJT_1 \cdot VoT_p\right) - \left(sc_2 + tax_2 + oc_2 + GJT_2 \cdot VoT_p\right)\right]\right\}$$

and

$$\left(sc_i + tax_i + oc_i + GJT_i \cdot VoT_p\right) = GC_i$$

3.2.5 If (i) the airline market is perfectly competitive and (ii) there are no capacity constraints at airports (the default assumptions), this implies that any change in airline costs between scenarios is fully passed onto air passengers, and that there are no shadow costs.

3.2.6 However, if either (i) or (ii) does not hold then shadow costs are expected. As a result, changes in airline costs will affect the shadow cost values entering the producer and consumer impact calculations, with any change in airline costs in equations (2) and (3) offset to some extent by a change in shadow costs. If the change in airline costs is less than the initial shadow costs then this implies that the change will only alter the shadow costs available to airlines, and there will be no change in surplus for passengers.

3.2.7 **Freight** - Where possible the impact of aviation policies on air freight should be appraised. For example any policy which changes the shadow costs at particular airports is likely to have an impact on the economic surplus of freighters.

3.2.8 **Travel time savings**- For many interventions on other modes, time savings for users are a significant part of the appraisal. Many aviation interventions may generate time savings to passengers, either in their journey through the airport; their time waiting; or on the plane. Where possible and practical to do so, the time savings associated with an aviation policy intervention should be assessed, taking care not to double-count the benefits referred to in the formulas above. The TAG Data Book contains the values of time to be used in appraisal for surface modes. In the absence of aviation specific values of time, the surface mode values of time can be used for leisure and commuting journeys. Since business values of time are available for various surface modes and distances it is advised that you contact the department for guidance on this matter.

3.2.9 Equations (2) and (3) require GJT to be expressed in monetary terms. If GJT is only available in time units and/or the demand response can only be calculated starting from a change in GJT expressed in time units, the welfare impact of changes in GJT can be calculated separately. As with other impacts, a proportionate approach should be adopted when trying to estimate changes in GJT (and their impact on demand). Information about the individual GJT components will in general be incomplete, in which case the analysis should only include those components for which sufficiently robust evidence is available.

3.2.10 **Treatment of impacts on Non-UK residents** - Where possible and practical to do so, the costs and benefits of aviation interventions to UK and Non-UK residents should be identified and reported separately. Non-UK residents include international to international interliners who simply change planes at a UK airport. These should not be treated differently from any other Non-UK resident affected by aviation interventions. If it is possible to identify all impacts to non-UK residents, then impacts on these residents should be excluded from the central case. However, unless this apportionment can be done robustly for all impacts, in order to ensure internal consistency, the analysis should include all impacts on all affected parties, regardless of origin.

3.2.11 **Costs** - TAG Unit A1.2 – Scheme Costs sets out the methodology for appraising the costs for surface access schemes and the same principles apply to the appraisal of aviation schemes. Since aviation investment is most commonly paid for by the private sector, it is also necessary to include private financing costs in the total scheme costs. The CAA set out the assumed cost of capital for airport operators in their setting of airport charges.[2] The CAA periodically updates their assumptions on the cost of capital for airport operators.

3.2.12 **Surface Access Impacts** – TAG Unit A2.2 – Appraisal of Induced Investment Impacts deals with transport appraisal where significant housing and commercial developments are planned. With respect to surface modes, a major airport development is similar to a housing development for the purposes of appraisal, as it will generate traffic both on the existing network and on any new surface access scheme contingent on the airport development. TAG Unit A2.2 provides guidance that is applicable to the appraisal of contingent surface access schemes. Any airport development that impacts on surface access is likely to require such appraisal. If proportionate any appraisal of surface access schemes should include all impacts, including, for example, transport external costs, impacts on the environment and safety, as well as any potential wider economic impacts.

3.2.13 **Wider Economic impacts** – the A2 TAG Units deal with the wider economic impacts of transport schemes. These impacts are in addition to the transport user benefits identified in conventional appraisal. The Unit focuses on domestic travel schemes, and while some impacts are directly applicable to an aviation context (output change in imperfectly competitive markets, agglomeration), others need adapting (tax revenue impacts) and some are specific to international transport (trade).

3.2.14 To the extent that aviation interventions have little impact on the generalised travel costs of other modes, no static clustering effect is expected to occur. However, if an aviation intervention leads to a redistribution of employment across the country, dynamic clustering effects are likely to take place. In addition, the commuting based tax revenue gains usually generated by transport interventions are unlikely to occur in response to an aviation scheme. This is because commuting by air is virtually non-existent.

3.2.15 On the other hand, there are potential aviation-specific impacts that are not explicitly addressed elsewhere within WebTAG but that may need considering. If an aviation intervention leads to a redistribution of employment across the country from low to high wage areas, tax revenue is likely to increase. An aviation scheme may also lead to an increase in international trade and Foreign Direct Investment – both of which may have wider economic implications, especially for productivity. There is currently no agreed methodology for estimating these aviation-specific impacts in transport appraisal. Novel approaches and/or the use of supplementary economy models may therefore be required to produce an assessment of these impacts.

[2] See "Estimating the cost of capital: a technical appendix for the economic regulation of Heathrow and Gatwick from April 2014: Notices of the proposed licences" (2014) http://publicapps.caa.co.uk/docs/33/CAP%201140.pdf

3.3 Environmental impacts

3.3.1 **Noise** – TAG Unit A3 sets out the methodology for quantifying the disbenefits of noise, providing methods and values for road, rail and aviation schemes. Any appraisal of aviation schemes ought to take into account the impact of the scheme on noise, where these impacts are likely to be significant, such as for a major airport development. Aviation appraisal should use the values set out in that Unit. Where appropriate, supplementary noise metrics such as N70[3] (in addition to $L_{Aeq, 16h}$ and L_{night}) should be considered[4].

3.3.2 **Air Quality** – TAG Unit A3 sets out the methodology for quantifying the air quality impacts in the context of road and rail schemes. Any appraisal of aviation schemes ought to take into account the impacts on local and regional air quality where these impacts are likely to be significant, such as for a major airport development. In the absence of any aviation specific valuation, aviation appraisal should use the values set out in the Unit.

3.3.3 **Greenhouse Gases** –TAG Unit A3 deals with the appraisal of the greenhouse gas impacts of transport interventions for surface modes. However, there are some unusual features of aviation as outlined below.

- From 2012, CO_2 emissions from UK departing flights were included within the EU Emissions Trading System (ETS). The external costs of CO_2 emissions are therefore effectively internalised, as there is a cost associated with each additional tonne of CO_2 emitted by the sector. The calculations in section 3.2.4 account for the EU ETS permit price as a component of other airline costs. Forecast traded appraisal values for carbon can be obtained from BEIS guidance on assessing energy and climate change policies[5].

- In addition to CO_2 emissions, aviation also has other climate change impacts. Lee et al (2010) concluded that the non-CO_2 climate effects could be up to double those of CO_2 emissions. Lee et al use Global Warming Potential (GWP) factors as a CO_2 emissions-equivalence for these non-CO_2 effects. However, whilst scientific advances have reduced key uncertainties, considerable scientific uncertainty still remains. Due to this uncertainty, especially surrounding the effects of different policy levers on non-CO_2 emissions, either a qualitative assessment should be made of the non-CO_2 impacts, or a quantitative assessment can be made as a sensitivity test, drawing on the latest guidance on GWP factors and BEIS guidance on valuing greenhouse gas emissions.

- **Other environmental impacts** - Other environmental impacts of specific aviation policies should be identified where they are likely to be significant. TAG unit A3 sets out the full range of environmental costs associated with transport schemes, including detail on the appraisal of landscape, biodiversity and water impacts, among others. The analysis of these impacts should be proportionate to their potential scale.

3.4 Social and Distributional impacts

3.4.1 TAG Unit A4.1 – Social Impact Appraisal provides guidance on the appraisal of social impacts. Sections on the appraisal of accidents and security are of particular relevance to the effect of an aviation intervention on safety but aviation appraisal should also take into account the other social impacts covered in that unit. Where appropriate and proportional to do so, the social and distributional impacts of aviation policies ought to be assessed using the method described in TAG Unit A4.2 –Distributional Impacts.

[3] A ‘number above’ metric capturing the number of aircraft movements above a certain noise level, in this case 70 dBA
[4] See discussion of supplementary noise metrics in CAA (2016) ‘Survey of Noise Attitudes 2014: Aircraft’
[5] See TAG data book for a link to the latest applicable values.

3.5 Public Accounts

3.5.1 An aviation intervention can affect the public account directly, by changing the tax receipts from taxes directly levied on aviation. It can also affect the public accounts indirectly, by altering indirect taxation receipts from goods consumed across the rest of the economy. If changes to aviation taxation are passed on as changes to air fares, this affects the amount of income leisure passengers have to spend on other goods and services in the economy, thereby affecting indirect revenues. In the leisure market the direct and indirect public account effects partially offset each other as an increase in aviation taxation leads to a fall in consumption of other taxable goods and services, and vice versa. The change in government revenue, split by business and leisure passengers, is calculated using the below formulae, using the notation introduced in section 3.2.2:

Business Passengers

(4) $$(1+t)\sum_{a.m.y}(tax_2 pax_2 - tax_1 pax_1)$$

Leisure passengers

(5) $$(1+t)\sum_{a,m,y}(tax_2 pax_2 - tax_1 pax_1) - t\sum_{a,ukm,y}[(sc_2 + tax_2 + oc_2)pax_2 - (sc_1 + tax_1 + oc_1)pax_1]$$

where *ukm* = UK market segment

3.6 Best Practice Guidance for Airspace Change Proposals

3.6.1 The Air Navigation Guidance[6] outlines what is expected of industry and the CAA during an airspace change proposal. The appraisal guidance here provides a framework for that process to be followed.

3.6.2 The appraisal should include the following impacts:

Noise: see section 3.3.1. The expected noise exposure of the different options, including the “no change” option, should be input into the WebTAG noise workbook[7] for the first and last years of the appraisal period. The tool will calculate the impacts on health and quality of life (acute myocardial infarction, stroke, dementia, sleep disturbance and severe annoyance) in monetary and quantitative terms so that the options can be compared, with regards to noise, on a consistent basis. This tool does not, however, capture all elements of the potential noise impact. Where appropriate, the number of people in noise contours down to 51dB LAeq16hr for day time noise and 45dB LAeq8hr for night time noise should also be recorded, as well as metrics that describe the number of events people will be exposed to, including numbers of overflights and appropriate N-above metrics. The CAA has produced a proposal for defining aircraft overflight for the purposes of noise[8]. Where appropriate, supplementary metrics should also be used, such as N70, and qualitative assessments made to fully describe the impact of changes, informed by consultation with affected communities.

Local Air Quality: see section 3.3.2. This is only applicable for changes affecting traffic below 1,000ft and if the airport is in or near an Air Quality Management Area.

[6] See https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017
[7] See the WebTAG environmental impacts worksheets, available at: https://www.gov.uk/guidance/transport-analysis-guidance-webtag#appraisal-worksheets
[8] CAA (2016), CAP1378, Annex B, available at; http://publicapps.caa.co.uk/docs/33/CAP%201378%20APR16.pdf

Greenhouse Gases: see section 3.3.3. The impacts on CO_2 and non-CO_2 greenhouse gases should be appraised based on estimated fuel consumption where this is expected to change.

Other environmental impacts: in line with the Air Navigation Guidance, consideration should be given to impacts on tranquillity[9] on Areas of Outstanding Natural Beauty or National Parks where changes to flight patterns below 7,000ft occur. It is expected that these impacts will be assessed qualitatively as it is not currently possible to assign them a monetary value. Where the proposal could impact directly on biodiversity, this should be assessed.

Air Transport Movements capacity (ATM): any change in ATM capacity should be captured.

[9] http://www.cpre.org.uk/what-we-do/countryside/tranquil-places

4 References

Archive of DfT technical reports on aviation forecasting:
https://www.gov.uk/government/publications/uk-aviation-forecasts-2013

CAA (2008) 'Economic regulation of Heathrow and Gatwick Airports 2008-2013'

NERA (2010) 'Representing International Business Impacts in Transport Appraisal'

Lee et al (2010), Transport impacts on atmosphere and climate: Aviation, Atmospheric Environment 44, 4678–4734

DfT (2017) Air Navigation Guidance 2017. Available at:
https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017

5 Document Provenance

This TAG Unit is an updated version of the unit published in November 2015.

The main changes concern

- the treatment of UK and non-UK residents, including international to international interliners
- the inclusion of travel time impacts (e.g., delays, frequency) in the cost/benefit calculations of aviation interventions
- the addition of Best Practice Guidance for Airspace Change Proposals

Appendix A Analytical Framework For Examining The Economic Impacts Of Aviation Policies

A.1 The passenger market

A.1.1 DfT, in consultation with external experts, developed an analytical framework of the aviation market. The analytical framework built on the methodology set out in Annex H of the DfT document UK Air Passenger Demand and CO_2 Forecasts 2009. This framework allows the Department to investigate the impact of a range of alternative policies while also taking into account some of the more unusual features of the aviation market. These features include the complex interaction between the key participants in the aviation market as well as the important economic consequences of airport capacity constraints.

A.1.2 In order to appraise the economic impacts of aviation policies using the equations in section 3.2.2, we only need to consider the outcomes in one part of this framework. This is the market between airlines and passengers for seats on airplanes (the passenger market).

A.1.3 Figure A1 below represents this market. In this case the default assumptions hold, that is; (i) the aviation market is perfectly competitive and (ii) there are no capacity constraints. The market considers passenger demand for seats (D_{pax}) at a given generalised cost, and the generalised cost to passengers at which seats are available (GC_{seats}). GC_{seats} is made up of the monetised cost of a flight ticket (the air fare) and the non-monetised costs (the Generalised Journey Time).

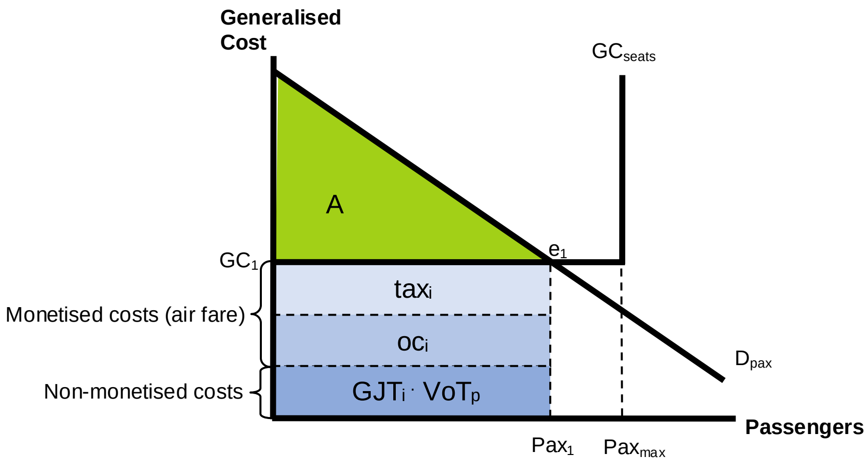

Figure A1 Determining the volume and generalised cost of seats in an aviation market that is competitive and without capacity constraints

A.1.4 Since the market is competitive and there are no constraints the airlines make normal profits, supplying seats at the marginal cost of production. In this case the marginal cost of production is the airline costs plus tax - combined these make up the air fare to passengers. However the equilibrium in the market is also influenced by the non-monetised costs of the trip to passengers. This is captured by the Generalised Journey Time component in Figure A1. In this market the equilibrium is at e_1, whereby the generalised cost of flying to a passenger is GC_1 and at this price demand is Pax_1 – within the airport's capacity constraint Pax_{max}. However a key feature of the aviation market is that certain UK airports are capacity constrained. These constraints provide an upper bound to the number of ATMs or passengers at a given airport. In Figure A1 the capacity constraint, Pax_{max}, has not been reached, and so has no impact on the market clearing conditions. If however the capacity constraint is reached, this allows the possibility for producers to charge consumers more than the marginal cost of production. This economic rent is known as the shadow cost in the equations in section 3.2.2. An example of a constrained market is shown in Figure A2 below.

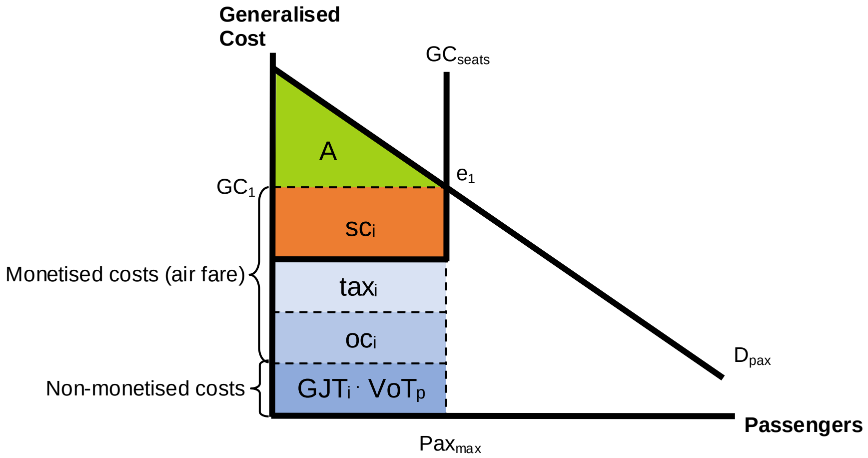

Figure A2 Determining the volume and generalised cost of seats in an aviation market that is capacity constrained and regulated

A.1.5 In this diagram the capacity constraint means that airlines are able to collect fares ($oc_i + tax_i + sc_i$) greater than the marginal cost of production ($oc_i + tax_i$). This opportunity for airlines will only occur in an aviation market in which airports are regulated. Regulation of airports ensures that they are unable collect the economic rents available at a capacity constrained airport through raising aero charges for airlines. In this case the market equilibrium is at e_1, whereby the airport is operating at its capacity constraint Pax_{max}, and passengers fly facing a generalised cost of GC_1.

A.2 Limitations of the approach above

A.2.1 The graphical representations of the passenger market contained in Figure A1 and Figure A2 are highly stylised. It is a graphical representation of the way that DfT carries out appraisal of aviation interventions using its suite of aviation models. There are a number of limitations and assumptions contained in these diagrams. These limitations fall into two categories. There are limitations and assumptions in the diagrams which are simply the result of trying to make the diagrammatic representation simple, and then there are limitations and assumptions which apply to both the diagrams and also the underlying model.

A.2.2 Assumptions and limitations which apply to both the DfT's aviation model as well as the diagrams

- That the supply and demand in the passenger market is linear: This is an assumption contained in the calculations of the areas of economic surplus. In reality, it may be that the actual supply and demand curves in these two markets are curved which would affect the areas of surplus.
- The calculations assume a single market clearing price in each market segment. This is a simplification as it is likely that airlines try to maximise their consumer surplus by using price discrimination. First class tickets are one example of this price discrimination.

A.2.3 Assumptions and limitations which apply to the diagrams but which are captured by the DfT aviation model.

- The diagrams are static, whereas in reality, the adjustment process from one equilibrium point to another will be dynamic. The model employs an iterative process to reflect this.
- There are further impacts not shown in the diagrams; for example, on frequency, delays and public accounts.

A.3 Example of economic appraisal

A.3.1 The analytical framework outlined above is a rich framework which can be used to examine the welfare impacts of a wide range of policies. These include:

- An airport expansion or the creation of a new airport
- A change in aviation taxation
- Any other change to airline costs e.g. an emissions trading scheme or an increase in the price of aviation fuel.

Figure A3 shows how the analytical framework of section 3.2 can be used to capture the impact of an expansion at a regulated, constrained airport. In this example it is assumed that average (per passenger) airline costs are unchanged as a result of expansion.

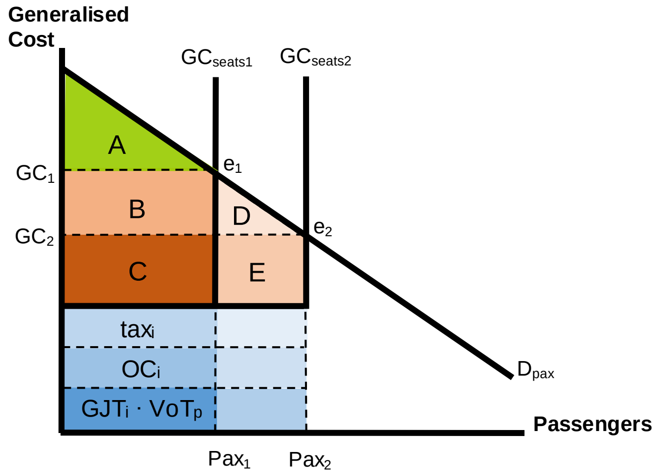

Figure A3 Surplus changes following expansion in an aviation market that is capacity constrained and regulated

A.3.2 Before the expansion the market is at e_1. Airlines use the full capacity of the airport and passengers face a generalised cost of GC_1 and the number of passengers is Pax_1. Expansion of the airport moves the maximum capacity to Pax_2, and as a result of this the equilibrium moves to e_2. The airline is able to fill the new airport to capacity with passengers facing a lower generalised cost of GC_2. This is due to a lower shadow cost per passenger being available to airlines, since now the excess demand is reduced at the point where the capacity constraint is hit. The total producer surplus for the airline changes from area B + C before expansion, to area C + E after expansion. Area B represents a transfer of surplus from airlines to consumers as a result of expansion. New passengers gain area D as surplus. Airlines gain new surplus from new passengers equal to area E. The net benefit is therefore equal to area D + E.

A.4 Calculations

A.4.1 The areas of surplus identified in the diagrams above can be calculated by comparing prices and quantities across two different scenarios. In particular, the calculations for consumers, producers and governments given in section 3.2.2. Note that in calculating the quantity of economic surplus for passengers, producers and government, these quantities must be assessed in a consistent unit of account. See TAG Unit A1.1 for more detail on this. Although the notation differs slightly, these equations are otherwise exactly the same as those given in TAG Unit A1.3.