AIR AND RAIL COMPETITION AND COMPLEMENTARITY

Final Report

Report

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Contents Page

FIGURES

TABLES

APPENDICES

EXECUTIVE SUMMARY

Introduction

1. The opening of high speed lines has enabled rail transport to obtain significant market share on routes where time sensitive passengers would previously have travelled by air, such as Paris-Lyon and Madrid-Seville. However, the expansion of low cost airlines means that on some routes, particularly in Germany and the UK, prices for air transport are now similar to or below prices for rail transport. This could have the potential to reverse the switch in market share. In addition, the construction and maintenance of high speed rail lines requires significant public funding, at a time when there are a number of competing claims on resources.

2. At two European airports, Frankfurt and Paris CDG, there are high speed rail stations at the airport and there is the potential for rail and air services to complement each other rather than compete. Instead of taking a short distance flight to the airport, in order to connect on to a longer distance flight, passengers can travel by high speed rail to/from the airport, and on certain routes can purchase tickets which include both a rail sector and the air sector. However, the attractiveness of this to air passengers is limited if they cannot check-in their luggage at the station and obtain a single electronic ticket for the combined journey. The Commission wishes to investigate if this poses any security risks.

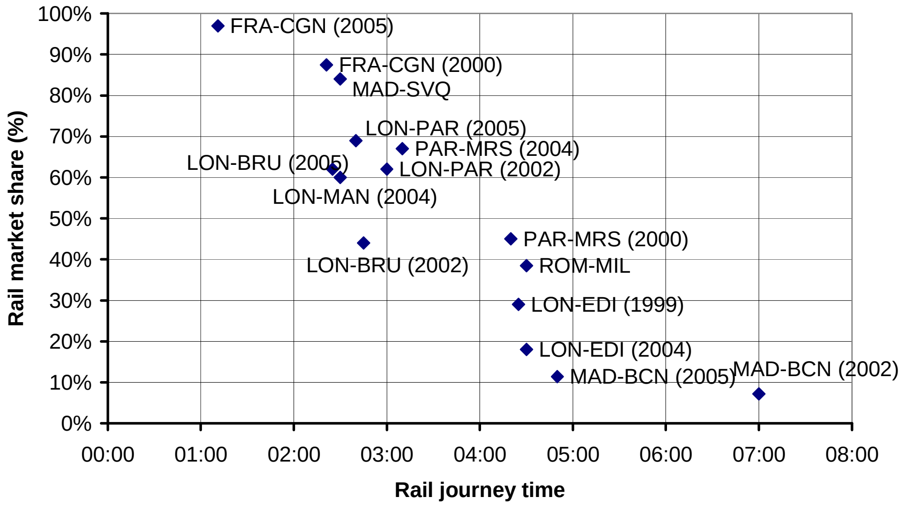
3. Therefore, the purpose of this study is to investigate:

- the factors determining air and rail market share;
- the operating costs of each mode;
- the likely trend in market share and operating costs in the next 5-10 years; and
- whether the introduction of through baggage handling and e-ticketing poses any security risks.

The drivers of market share

4. We undertook case studies of eight European air/rail routes in order to understand the key drivers of market share. These routes were chosen to reflect a range of characteristics, including different journey times, different Member States, and varying degrees of airline competition. Across the routes, we found that rail market share currently varied from a minimum of 11% (Madrid-Barcelona) to a maximum of 97% (Frankfurt-Cologne). The figure below shows rail market share on each of the routes that we studied; where we have data for how market share has changed over time, we show two points.

FIGURE 1: MARKET SHARE AS A FUNCTION OF RAIL JOURNEY TIME



5. We found that the rail journey time was the single most important factor determining market share, but nonetheless there could be significant variation even where the journey times were similar: for example, routes with rail journey times of about 2 hours 30 minutes had rail shares varying from 44% to 85%. This variation arose because:

- Other factors related to the schedule offered or the effective journey time, such as the frequencies offered by each mode and average access times, influence market share
- Other factors not related to the schedule, including price and service quality, also influence market share
- Definitions of the markets varied between routes, and were sometimes different for air and rail on the same route.

6. Other factors which are particularly important in determining market share are:

- **Reliability:** The exceptional reliability of the AVE high speed trains in Spain was a key factor determining the high market share of the Madrid-Seville rail service; in contrast, the poor reliability achieved by domestic rail services in the UK, particularly regular route closures due to engineering works by the rail infrastructure manager, contributed to low market share.
- **Accessibility of terminals:** Although incumbent operators did not appear to think actively about the location or accessibility of terminals, as it generally cannot be changed in the medium term, this was a key factor determining market share. For example, the good location of the airports on the Madrid-Barcelona route contributed to high air market share; in contrast, the relatively poor location of the airports on the Paris-Marseille route contributed to high rail market share.

7. There was some evidence that price was an important factor but the evidence was mixed, and the calibration of our market share model showed that the implicit value of time was quite high for the routes we were studying. In part this reflects relatively high proportions of business traffic on routes of this type. Price can affect the number

of passengers travelling on a route as well as market share: for example, increases in the relative price of London-Paris rail tickets have prompted leisure passengers to travel to other destinations instead, but have not really led to a switch to air travel on this route. Perhaps surprisingly, other factors such as on-board service quality did not seem to be very important in determining market share, although at least in part this was because the routes we studied were relatively short.

Operating costs

8. We researched the operating costs of regular ('classic') air services, low cost air services, and rail operators, and compared the costs of each on the routes that we studied. Our analysis was limited by difficulties experienced in obtaining data from rail operators.

9. We compared operating costs per seat and per passenger on each route, rather than costs per seat or passenger kilometre. This was because of differences in the structure of air and rail costs: rail costs are approximately proportionate to distance, whereas a significant proportion of air costs are incurred in landing, turnaround and takeoff, so are equivalent for all services regardless of length. In addition, route lengths differ for air and rail – air services are usually more direct, but the extent to which this is true varies by route.

10. On all of the routes, even allowing for the effect of subsidies to the rail operators, we found that rail costs per seat were lower than the costs of the 'classic' airlines – although the difference was marginal on the London-Paris route due to exceptionally high infrastructure charges. However, low cost airlines could provide services on five out of the eight routes at lower costs per seat than the rail operator. In addition, as airlines generally achieve higher load factors than rail operators (and low cost airlines achieve higher load factors than classic airlines), air costs per passenger are generally more competitive. Low cost airlines had the potential to undercut rail on a per-passenger basis on all routes we studied, except the shortest route (Frankfurt-Cologne).

11. Air costs have fallen substantially in recent years. Low cost airlines achieve unit costs around 50% of classic airlines, and are continuing to achieve cost savings. Many classic airlines are now seeking to make equivalent cost reductions in order to maintain their competitive position. Airlines are likely to continue to make significant cost savings, through technological change and productivity improvements, in part due to the very strong competitive pressure they face on many routes. In contrast, it has proven difficult for rail operators to make equivalent cost savings, and it is likely to continue to be difficult in the future. In part, this reflects the high proportion of rail costs that are related to fixed infrastructure. There should however be potential for rail operators to reduce per-passenger costs significantly on many routes through increasing load factors, using yield management systems similar to those used by airlines.

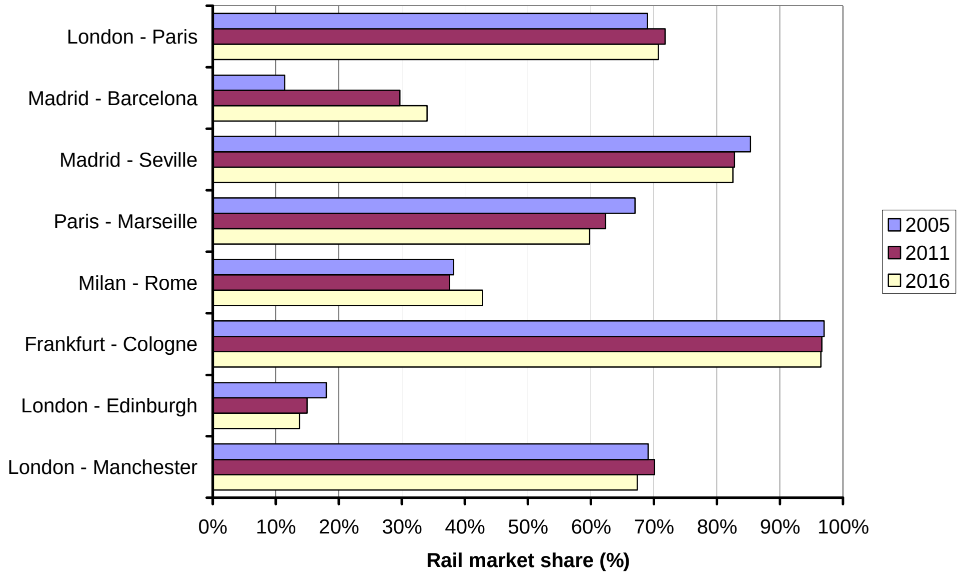
Trends in market share

12. We developed a model of rail/air market share and used this to project trends in market share in the next 5-10 years – both for a base case and for various scenarios.

The base case included expected changes in journey time and frequency (for example due to the construction of high speed rail lines), fares, and other factors which were expected to change on a route-specific basis.

13. In the base scenario, we project that rail market share will increase on three of these routes, decline on three, and remained approximately unchanged on two. The figure shows the change in market share we project over this period.

FIGURE 2: PROJECTED CHANGES IN RAIL MARKET SHARE, BASE CASE



14. The most significant changes in market share will be on the Madrid-Barcelona and Milan-Rome routes, where the opening of high speed lines will significantly reduce rail journey times. However, on both routes, it is likely that low cost air services will be significantly expanded over this period, leading to large reductions in air fares, and this will offset part of the increase in rail market share. Rail share will decline on most of the other routes due to lower air fares. This could have a particularly significant impact on the Paris-Marseille route, as air fares on this route (an Air France monopoly) are relatively high.

Scenario 1: Air fares at low-cost airline levels

15. In this scenario, we take a more optimistic view of the reductions in air fares that might be achieved. This could either come about if classic airlines withdraw their services or (as appears more likely on the types of routes we studied) because they cut their costs and fares to the same level as the low cost carriers. This scenario would have a substantial impact on rail market share, which would reduce by up to 30 points on some routes.

Scenario 2: Environmental transport taxation

16. We found that the introduction of environmental transport taxation, reflecting external costs, could have an impact on market share. We focus on CO_2 emissions as these are the most significant. The effects would depend critically on the level at which the tax

was set: for example, if CO_2 emissions were charged at the current market rate in the EU Emissions Trading Scheme (ETS), for all modes, this would have almost no effect on market share. However if higher values were used, reflecting some assessments of the full economic cost of emissions, this could result in a shift from air to rail – although the change in market share would rarely exceed 10 points, and on some routes the tax would barely offset the switch from rail to air that will result from the underlying projected reduction in air fares. A tax would also result in a reduction in the total size of the air plus rail market, which in some circumstances could have a more significant impact on emissions than the change in market share.

Scenario 3: Limits on slots for short haul routes

17. Some of the airports covered by this study are subject to slot constraints. The most severe constraints are at London Heathrow, Paris Orly and Milan Linate; there are also currently severe constraints at Frankfurt and Madrid but these will be lifted as a result of planned capacity expansion. If slots were limited for short haul services, frequencies would decline and it would be necessary for some passengers to travel from other (less convenient) airports. This would lead to increased rail market share, particularly on the routes to/from Paris and London.

Scenario 4: New airport capacity at higher charges

18. Airport capacity could be expanded, but in order to pay for this, charges might have to rise. This would have two effects:

- Airport charges would rise, which would be passed through to passengers; but
- Low cost airlines would be able to expand services at airports at which they are currently restricted (especially Orly and Linate).

19. The effect of this varies between the routes. On some, the net effect would be that air fares would actually fall, and hence air market share would rise, because the effect on prices from more low cost competition would outweigh any increase in charges necessary to fund investment.

Scenario 5: Higher rail speeds

20. On some of the routes, rail operating speeds could be improved beyond that which we expect in the base case. For example, rail services on both the Madrid-Barcelona and Milan-Rome routes should use almost entirely new high speed infrastructure within the next 5-10 years, but trains are not expected to run as fast on average as on some other routes, such as Paris-Marseille. If trains could run at equivalent average speeds, this would improve rail market share. On the Milan-Rome route, this would increase rail market share by about 15 points.

Scenario 6: Lower rail operating costs

21. In this scenario, we assume that rail operators would be able to make substantial cost reductions, similar to those achieved by low cost airlines (except for infrastructure costs), and that fares are reduced in proportion. This would result in substantial increases in rail market share, generally in the range of 10-15 points.

Scenario 7: Restricted public spending on rail

22. If rail subsidies are reduced and it is not possible to cut costs, fares will have to increase. However, there is a limit to the extent this can be done, because increasing fares on routes where there is strong air competition is likely to lead to a significant reduction in market share and hence net revenue might increase by little if at all. Rail market share would fall significantly on all routes other than Frankfurt-Cologne in this scenario.

Security issues for rail/air travel

23. Frankfurt and Paris CDG airports are currently served by high speed rail services, and through rail/air tickets are available. However, through baggage handling facilities are only available at Frankfurt, and other airports which previously had remote baggage check-in facilities (Heathrow, Gatwick and Madrid) have withdrawn these.

24. We reviewed the existing security requirements and regulations applying to air and rail services in Europe. If through air/rail baggage handling and e-tickets are introduced on more routes, the key priority from a security perspective will be to ensure that aviation security is maintained. There would be little benefit in increasing rail security for air/rail passengers, for example by screening luggage, if this was not to be undertaken for all rail passengers. This would require a change from the current (generally) open rail system to a closed secure system, which would have significant implications both for costs and for the convenience of use of the system.

25. Therefore, the best solution will be for luggage for passengers transferring from rail to air to be subject to standard aviation security screening at the airport as part of the same procedures applying to all other checked luggage. Luggage would have to be conveyed securely from the rail station to the airport, for example in locked containers subject to monitoring/surveillance for the avoidance of theft and/or other interference, but there would be limited benefit from separate security screening at the rail station. For passengers transferring from air to rail, it should not be necessary to undertake further baggage screening prior to loading onto the train – the priority will be to ensure the luggage is kept in a secure environment to prevent theft and to ensure compliance with customs regulations.

26. We found that there are no insurmountable technical difficulties with introducing such a service, but the issue is likely to be one of cost. Air travel is becoming increasingly commoditised, with passengers making decisions on the basis of price more than anything else. The capital and operating costs of through rail/air baggage handling are substantial, and the evidence from when these have been introduced implies that the commercial benefits to participating airlines are unlikely to offset these costs.

1. INTRODUCTION

Background

1.1 The opening of high speed lines has enabled rail transport to obtain significant market share on routes where time sensitive passengers would previously have travelled by air, such as Paris-Lyon and Madrid-Seville. Rail transport had historically offered lower prices than air transport, but where high speed lines opened it could also offer faster city-to-city journey times, as well as a better travelling environment for the passenger. However, the expansion of low cost airlines means that on some routes, prices for air transport are now similar to or below prices for rail transport, and this could have the potential to reverse the switch in market share. Low cost airlines are already providing strong competition for rail operators on short domestic routes in the UK and Germany and they may soon do so in other Member States. In addition, the construction and maintenance of high speed rail lines requires significant public funding, at a time when there are significant competing claims on resources.

1.2 Two major European airports, Frankfurt and Paris CDG, have high speed rail stations, and at these airports there is the potential for rail and air services to complement each other rather than compete. Instead of taking a short distance flight to the airport, in order to connect on to a longer distance flight, passengers can travel by high speed rail to/from the airport, and on certain routes can purchase tickets which include both a rail sector and the air sector. However, the attractiveness of this to air passengers is limited if they cannot check-in their luggage at the station and obtain a single electronic ticket for the combined journey. Therefore, the Commission wishes to investigate whether the introduction of through baggage handling and e-ticketing poses any security risks.

This study

1.3 The purpose of this study is to investigate:

- The factors driving air and rail market share, including journey time and price
- The development of air and rail market share in the future under a range of scenarios
- The operating costs of air and rail transport and future trends in operating costs
- Security issues concerning joint air-rail travel.

1.4 In order to evaluate the trends in market share, we undertook case studies of eight intra-European air/rail routes. The conclusions of our research are explained within this report, and the individual case studies are provided as a separate document (the Case Study Report). At the same time as undertaking the market research, we also researched the operating costs of each mode. We then developed and calibrated a model of air and rail market share on each route, which we used to project how market share could change in the future under a number of different scenarios. Our analysis of security issues arising with joint air-rail services was based on interviews with rail and air operators and airports.

1.5 The study has been carried out by Steer Davies Gleave, supported by ISIS in France, the German Aerospace Centre DLR, and MSP Solutions on security issues.

Note on definitions

1.6 High speed rail is defined in the European Directive on Interoperability as where trains run at a maximum speed of at least 250km/h. However, in determining market share, it is the rail journey time rather than the maximum operating speed that is relevant. The boundary between high speed and conventional rail can also be blurred – for example, some conventional trains in the UK and Sweden achieve better *average* speeds than high speed trains in Germany even though the latter achieve better *maximum* speeds. We have focussed on high speed rail as generally defined, but also include some other fast long distance rail services where the maximum speed is lower, where this has informed the analysis.

1.7 In several points this report refers to low cost and 'classic' airlines (also commonly referred to as network or legacy airlines). However, the distinction between these is becoming increasingly blurred: for example, many traditional European airlines have ceased to provide services such as on-board catering and certain carriers, such as Aer Lingus, are moving very close to a low cost airline business model. For the purposes of this report, we define classic airlines as historic national and regional carriers providing a network service (i.e. handling connecting passengers) and as having alliance/codeshare relationships with other carriers; and low cost airlines as carriers providing simple point to point services only.

Status of this report

1.8 This is the draft final report for the study. Drafts of much of the material in this report were provided to the Commission in the Second Progress Report for the study, and we have taken into account comments provided by the Commission.

Organisation of this report

1.9 The remainder of this document is structured as follows:

- Section 2 sets out our analysis of the drivers of rail and air market share, based on the case studies;
- Section 3 sets out our operating cost analysis;
- Section 4 outlines the model of air and rail market share that we have constructed;
- Section 5 explains the scenarios that we modelled;
- Section 6 explains the results of these scenarios; and
- Section 7 sets out our analysis of security issues for air-rail travel.

1.10 Appendices A and B give more information on the rail and air operating cost models that we have constructed in order to provide the analysis set out in section 3. Appendix C provides a glossary of security terms, to be read in conjunction with section 7.

1.11 Due to the volume of information, the case studies are provided in a separate document (the Case Study Report).

2. THE DRIVERS OF MARKET SHARE

Introduction

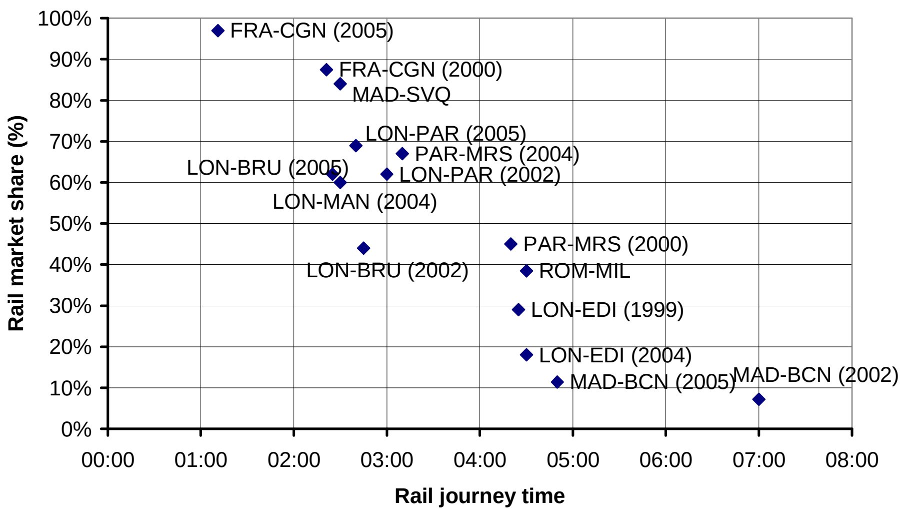
2.1 We undertook case studies of eight European routes in order to understand the drivers of the market share of rail and air on each route. This section explains the conclusions from the case studies. More detail on the factors driving market share on each route is set out in the Case Study Report.

Journey time

2.2 **The main factor which drives market share is the rail journey time.** Air journey times do not vary significantly between the routes that we studied, and in any case for air travel the timetabled journey time can be a relatively small proportion of the total passenger journey time, once check-in and time to access the airport is taken into consideration.

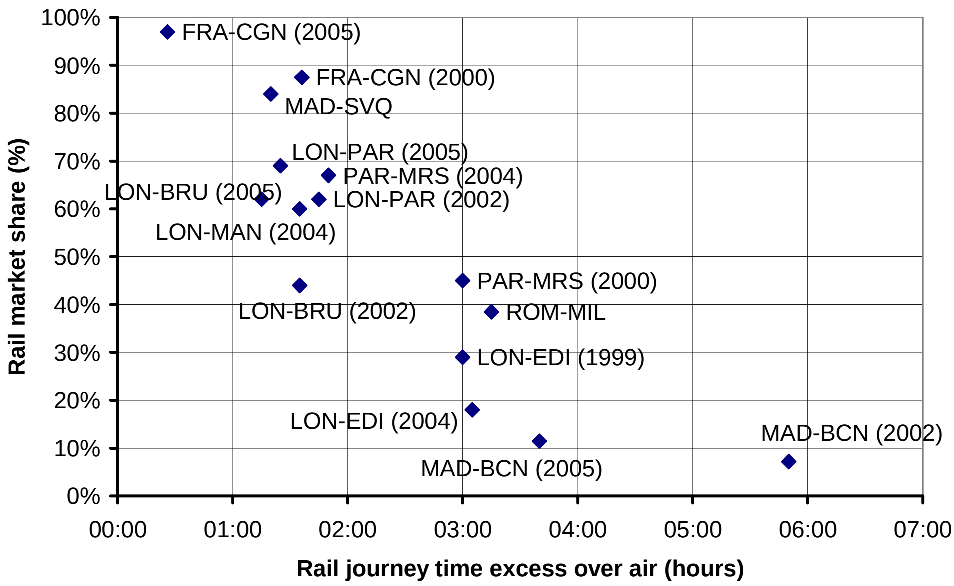
2.3 Figure 2.1 compares rail journey time with the market share of the rail operators on each route in our study. Where we had access to a time series of data for rail market share, and there was a significant change (for example due to the opening of a high speed line), we show the market share both before and after the change. We also show market share data for the London-Brussels route as, although this was not one of the case studies, it was made available to us in the course of our research.

FIGURE 2.1 RELATIONSHIP BETWEEN RAIL JOURNEY TIME AND MARKET SHARE



2.4 The correlation between rail journey time and market share is strong. However, the correlation is slightly better if we relate market share to the excess journey time for rail travel (the difference between the rail journey time and the air journey time), as this allows for the (small) variation in air journey time between the routes. This is shown in Figure 2.2 below.

FIGURE 2.2 RELATIONSHIP BETWEEN RAIL JOURNEY TIME EXCESS OVER AIR, AND MARKET SHARE



2.5 This analysis shows that the difference between the rail journey time and the air journey time explains over 84% of the variation in rail market share between the routes studied. However, it is clear from the figure above that journey time is not the only factor, as there are significant differences in rail market share on routes with approximately the same journey time. For example:

- On routes where the rail journey time is around 4 hours 30 minutes, or 3 hours longer than the air journey time, rail market share ranges from 18% (London-Edinburgh) to around 40% (Rome-Milan, or Paris-Marseille prior to the completion of TGV Med)
- On routes where the rail journey time is around 1 hour 30 minutes longer than the air journey time, rail market share ranges from 44% (London-Brussels in 2002) to over 85% (Madrid-Seville or Frankfurt-Cologne prior to the opening of the HSL)

2.6 There are three reasons for this variation:

- market share can be defined in a number of different ways;
- there are factors other than in-vehicle journey time which affect the attractiveness of the schedules offered by each operator; and
- there are other factors, not related to the schedules offered, which affect the attractiveness of each operator.

2.7 We discuss these three issues in more detail below.

Definition of market share

2.8 Rail/air market share is not always transparent from passenger statistics provided by rail and air operators, as the definitions of the market can be different. There are two issues:

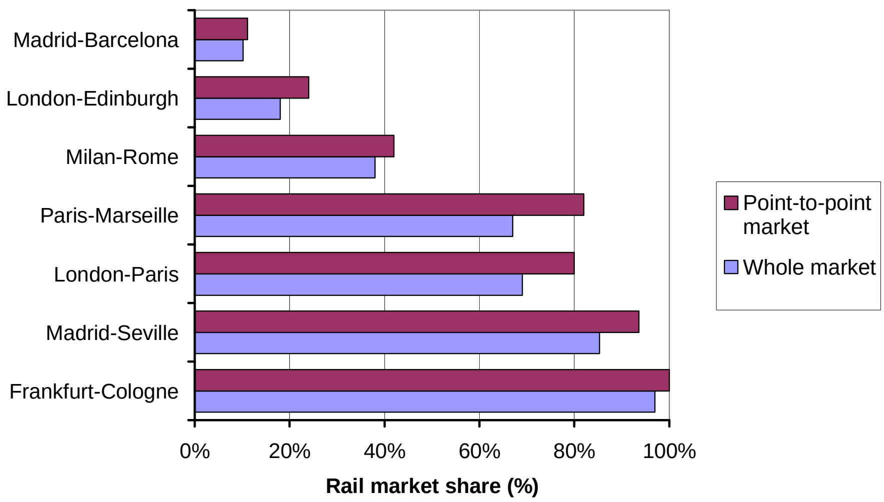
- the treatment of connecting passengers; and
- different definitions of the catchment area.

Connecting passengers

2.9 On short distance air routes, a significant proportion of passengers are often connecting between air services. For example, over half of passengers using the Alitalia service between Rome and Milan Malpensa are connecting to other air services at one of the airports, undertaking journeys such as Rome-Milan-New York or Milan-Rome-Buenos Aires. On the Frankfurt-Cologne route, 90% of all air passengers using the route do so in order to connect to other air services at Frankfurt.

2.10 In most cases, rail travel is not competitive for passengers connecting to air services. Of the case study routes, only Paris-Marseille and Frankfurt-Cologne offer a direct long distance rail service to the airport, and of these, only the Frankfurt-Cologne route offer a rail journey time that was competitive for connecting passengers. If these connecting passengers are excluded from the calculation, in order to calculate the share of the point-to-point market (i.e. the market for passengers whose ultimate origins and destinations are the cities/regions at either end of the route), rail market shares are often significantly higher than shown in the figure above. This is illustrated in Figure 2.3 below.

FIGURE 2.3 COMPARISON OF POINT-TO-POINT AND FULL MARKET SHARE



2.11 The issue of connecting passengers can also affect rail passenger statistics, but to a much lesser extent. Most, although not all, rail operators offer an integrated ticketing system, so a passenger connecting to another train would buy a through ticket and therefore would be shown in the operator’s passenger statistics as making the through journey rather than two separate journeys.

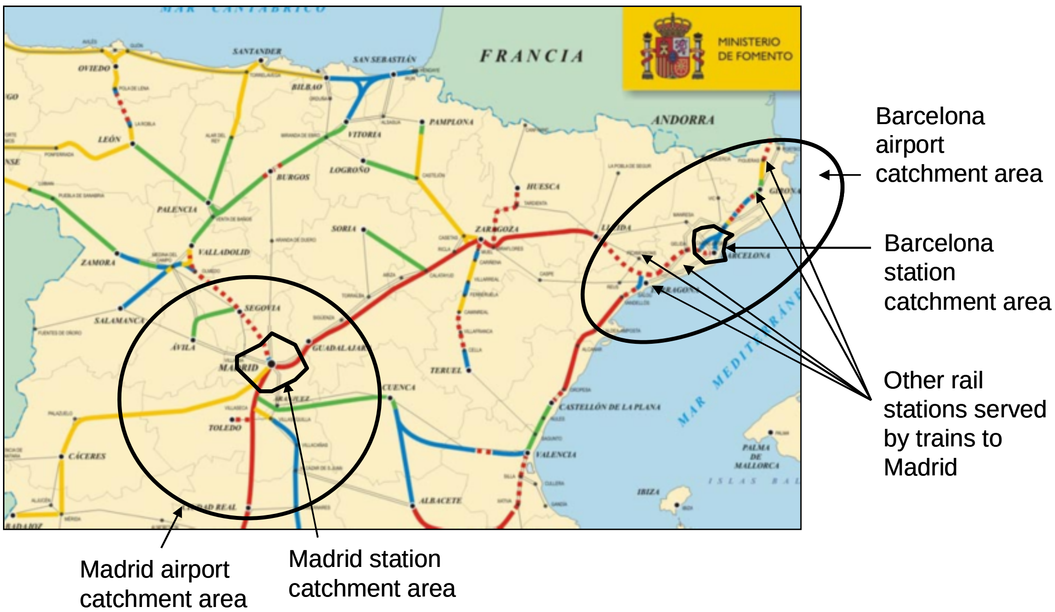
2.12 In our analysis, we have used rail share of the whole market (i.e. including passengers connecting on to other destinations), rather than just the point-to-point market. This was primarily because we generally had reasonable data for the rail share of the whole market, whereas in many cases our figures for rail share of the point-to-point market were estimates based on partial data. Also, one of the objectives of this study was to assess the potential for rail to substitute air for short connecting journeys – which would be excluded if we took the point-to-point market only. We suggest that, as a general principle when modelling rail/air market share, it is better to model connecting passengers separately from point-to-point passengers, provided sufficient and consistent data is available.

Definition of catchment area

2.13 On some routes, market share also depends on the catchment area that is defined, particularly for the rail service. Passengers using airports generally do so in order to access whole regions, not just the city that the airport serves. In contrast, rail passengers travelling from regional destinations can travel from their local station and do not necessarily have to use the main city station.

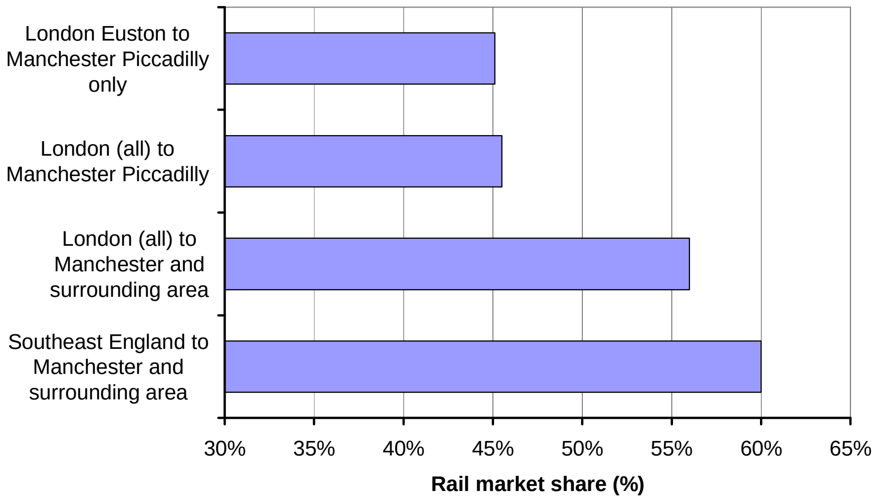
2.14 For example, the fastest way from most parts of the region of Cataluña in Spain to Madrid will be by air from Barcelona airport, as Barcelona is the only Catalan airport with a frequent service to Madrid. A passenger travelling by air from (for example) the city of Tarragona to Madrid would probably drive to Barcelona airport and therefore would be counted in the airport statistics as a Barcelona-Madrid passenger. However, a passenger making the same journey by rail would travel directly from Tarragona station to Madrid – and therefore would be counted in the rail operator's statistics as a Tarragona-Madrid passenger, not a Barcelona-Madrid passenger. Therefore, the Barcelona-Madrid passenger figures provided by the rail and air operator are not comparable because the catchment areas are very different (see Figure 2.4 below).

FIGURE 2.4 MADRID-BARCELONA: DIFFERENT DEFINTIONS OF RAIL CATCHMENT



2.15 An example of this is given in Figure 2.5 for the London-Manchester route (unfortunately we only had access to sufficiently detailed data to make this calculation for the UK routes). The simplest definition of London-Manchester would be from the main station in London to the main station in Manchester only, and this is the data that would be provided for 'London-Manchester' passengers in the rail operator revenue and passenger data system. However, many passengers make journeys from stations in other parts of London, or outside London, to stations around Manchester or to surrounding towns/cities. If we define London-Manchester as all travel from a broad area of southeast England to all of Manchester and the area around it, then rail market share is substantially higher (60% compared to 45%).

FIGURE 2.5 RAIL MARKET SHARE (2004/5), WITH DIFFERENT GEOGRAPHICAL DEFINITIONS OF RAIL CATCHMENT



2.16 As far as possible given the limitations of the data, we have defined the rail catchment area broadly, so that the figures are comparable to the passenger figures available for air transport. In the London-Manchester case, our definition of the rail market includes any trip where the equivalent journey, if made by air, would have used Manchester airport and one of the London airports. Therefore, for example, we include trips such as Brighton to Warrington, as a passenger making this trip by air would fly from London Gatwick to Manchester and therefore would be defined as a London-Manchester passenger in the airport statistics.

2.17 For some routes, there is no equivalent difficulty. Madrid-Seville trains do not make any stops within 100km of either city, so it is not possible to board these at a regional station, and RENFE does not have integrated tickets between different types of train. Any passenger making a journey via the AVE from a regional destination (for example, Toledo to Seville or Madrid to Cádiz) would have to buy two separate tickets and would therefore be counted in the Madrid-Seville passenger numbers.

Other schedule-related factors

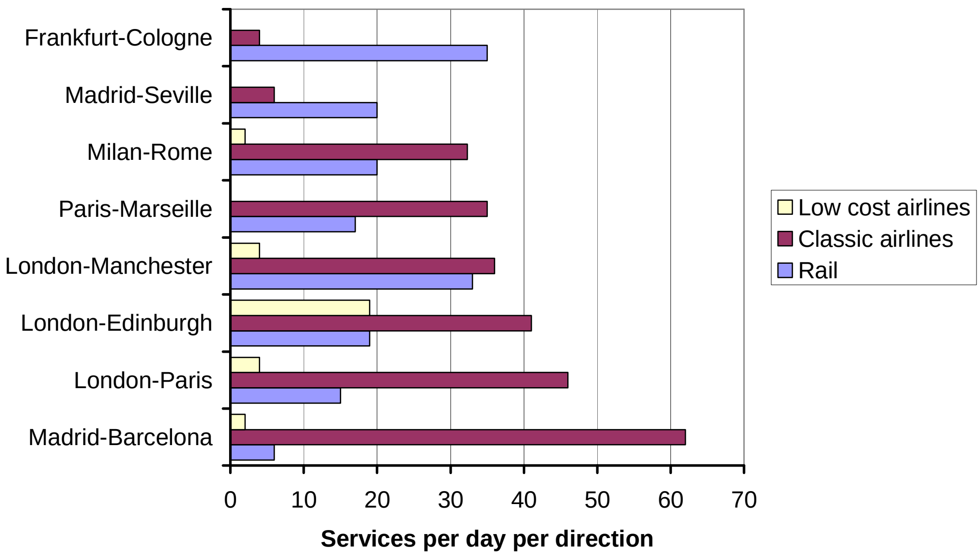
2.18 As well as the published journey time, two other factors affect how attractive the schedule offered by each operator is:

- the frequency; and
- any check-in time.

Frequency

2.19 Figure 2.6 compares the frequency of each of the types of operators on the case study routes.

FIGURE 2.6 FREQUENCY BY OPERATOR TYPE (SERVICES PER DAY) PER DIRECTION



2.20 Frequency is usually treated as being very important in transport modelling – subject to a weighting, intervals between trains or aircraft are treated as equivalent to additional in-vehicle minutes. Typically, an improvement in frequency from a train or plane every 2 hours to every 1 hour is considered as having the same impact on market share as a reduction in journey time of 20-30 minutes. In order to be able to compare the importance of frequency with the importance of journey time, we calculate a **frequency penalty** measured in minutes for each mode and route; a greater frequency penalty indicates a longer average gap between services, and therefore that the mode is less attractive. This is explained in more detail in section 4 below.

2.21 Inclusion of frequency in our calculation of the relationship between rail journey time and market share improved the relationship, but the effect was only significant where one mode is much better or worse than another. On other routes, it did not appear to be a particularly important factor in determining market share. A key factor appears to be that, although the total airline frequency was in most cases higher than the total rail frequency, for many time-sensitive passengers the key factor will be the frequency of the airline with which they have a ticket, rather than the frequency of all airlines.

2.22 The frequency offered by low cost airlines also appeared to be important, in part because this affects other factors, particularly the prices charged. Where low cost airlines have a significant market share (which only includes one of our case study routes, but has been observed on other routes), all operators, particularly the classic airlines, have to reduce their prices. Low cost airlines had a much more significant impact on the London-Edinburgh market than any of the other markets we studied, reflecting the fact that the largest low cost airline, easyJet, now provides around 17 services per day on this route. The introduction of high frequency low cost air services on this route substantially reduced rail market share. In contrast, on the other case study routes, low cost airlines provided low frequencies and appeared not to have had a significant impact on the market.

Check-in times

2.23 In most cases, rail passengers do not need to check-in in advance, whilst air passengers must check-in at least 30-45 minutes before departure. However, this is not always the case. Passengers using three of the rail services covered by our case studies (London-Paris, Madrid-Seville and Madrid-Barcelona) are subject to security screening prior to boarding the train.

2.24 For the Madrid-Barcelona and Madrid-Seville routes, the security check involves all luggage being passed through a baggage screening device at the entrance to the platforms. Passengers themselves are not checked. Passengers only have to arrive at the station a minimum of 2 minutes in advance, although in practice if all passengers did this, it would be impossible for the train to leave on time – the system relies on most passengers arriving longer in advance. However, the fact that individual passengers are not screened means that the process is much quicker than airport security or the security process for Eurostar.

2.25 For the London-Paris Eurostar service, most passengers are required to check-in 30 minutes in advance. Passengers using maximum price business class tickets can check-in 10 minutes in advance, but in practice this is taking a bit of a risk with the time it takes to pass security. The security checks used for Eurostar are equivalent to those used at airports: passengers pass through metal detectors and can be subject to individual searches, and all baggage is screened. The security arrangements are more onerous than those originally used when the Eurostar service was introduced, when only a proportion of passengers were subject to screening, presumably reflecting different assessments of the terrorist threat at the time.

2.26 In addition, although most airports required passengers to check-in between 30 and 45 minutes in advance of departure (sometimes at least 60 minutes if the passenger is travelling with luggage), some airlines and airports have been able to reduce check-in times for certain services:

- **Madrid and Barcelona airports:** The minimum check-in time is 20 minutes in advance for the Puente Aéreo (air bridge) Madrid-Barcelona service, and in practice it is often possible for passengers to board even if they only arrive 5-10 minutes before scheduled departure. This is achieved by using separate check-in and security screening and using gates that are much closer to the check-in area.
- **London City airport:** Passengers without luggage can arrive 10 minutes in advance of departure. This is facilitated by the relatively small size of the airport. The use of internet check-in also helps passengers travel faster through the airport.
- **easyJet:** easyJet has recently started to allow passengers using its online check-in service to arrive at the departure gate 15 minutes before departure. Depending on security queues at the departure airport, this potentially allows passengers to arrive less than 30 minutes in advance – although they are inevitably taking a risk

in doing so, as they would lose their seat without refund if they arrive at the gate after the aircraft has departed.

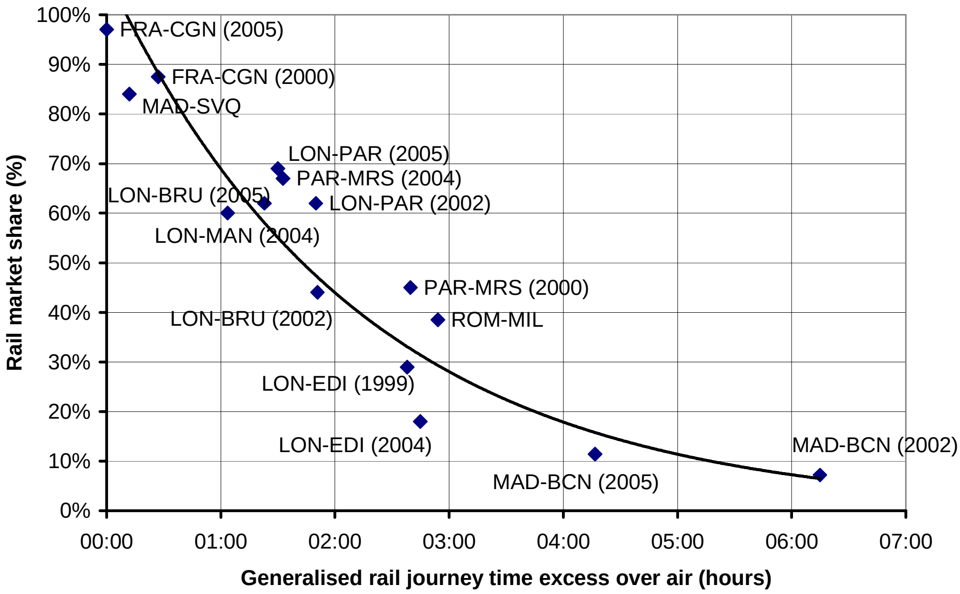
2.27 Requirements for advance check-in for rail services lengthens effective journey times considerably and this factor reduces Eurostar market share. If it was possible to conduct security checks in a way that did not delay passengers, this would effectively achieve a journey time saving of 30 minutes – almost equivalent to that generated by construction of the Channel Tunnel Rail Link high speed line. On the face of it, it is easier to understand the purpose of the security checks used for the Spanish high speed trains (which prevent explosive devices being taken onto the trains) than the more extensive checks used for the Eurostar service.

2.28 At present, on most routes, check-in times affect air transport rather than rail, and accordingly increase rail market share at the expense of air. However, we have seen that some airlines and airports are seeking to find ways to reduce check-in times, in order to improve the commercial attractiveness of their service; in the meantime, some rail services are introducing security checks that will add to journey time. The advantage in this area held by rail transport may therefore diminish in the future.

Conclusion: generalised journey time

2.29 We have estimated rail and air **generalised journey time** for each route. This takes into account check-in time and an allowance for the effect of different levels of frequency, as well as the scheduled journey time. We found that the combination of these three factors, measured in terms of generalised journey time, together explains nearly 90% of the variation in market share across the routes we studied (as stated above, scheduled journey time on its own explains 84% of the variation). Figure 2.7 shows the relationship between generalised journey time and market share.

FIGURE 2.7 DIFFERENCE BETWEEN RAIL AND AIR GENERALISED JOURNEY TIME AND RELATIONSHIP WITH MARKET SHARE



2.30 Nonetheless, even taking into account these other journey-time related factors, there is still significant variation in market share between routes. For example, changes in relative generalised journey time cannot explain the decline in rail market share on the London-Edinburgh route between 1998 and 2004.

Other factors influencing market share

2.31 Our case studies demonstrate that although generalised journey time is the most important factor that influences rail market share, a number of other factors are also important and account for significant variations in market share on particular routes. These factors are:

- Time and cost involved in access to terminals
- Price and ticket conditions
- Reliability and punctuality
- Service quality on-board and at terminals
- Availability of alternative (lower cost) modes

2.32 All of these issues are important, but a number of operators emphasised that punctuality/reliability was exceptionally important. The other two factors which were cited were ticket price and the time/cost involved in access to terminals, although as access to terminals is not a factor within the medium term control of the operators, it was generally not something they considered, except (in the case of airlines) when planning new services. Perhaps surprisingly, many operators thought that on-board service quality characteristics were less important in determining market share. We discuss these factors in more detail below.

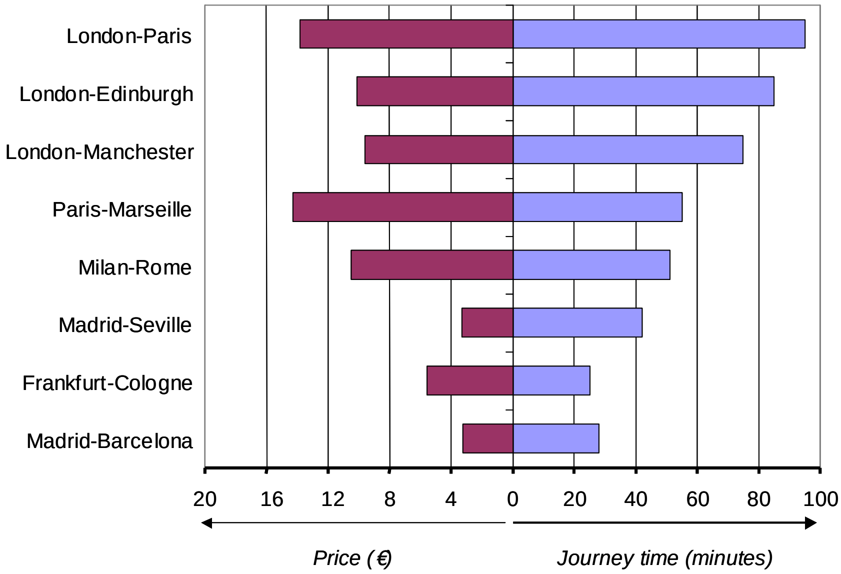
Access to terminals

2.33 One of the most important factors, other than rail journey time, in determining market share is the accessibility of each mode.

2.34 Rail stations are almost always in or close to city centres, but airports generally are not. Figure 2.8 below shows the public transport access times and prices for travel from the city centre to the airports on each route. The bars show the total of the access times / prices for the airports in each city. Price is shown by the bar to the left of the axis and journey time is shown by the bar to the right of the axis. Where there is more than one airport in a city, we use the main airport for each route[1], and where there is more than one mode of public transport, we use the main mode. The narrower the bar is, the more attractive air travel should be, relative to rail travel.

[1] For example, we use Orly for the Paris-Marseille route but CDG for the Paris-London route, as these airports are the most used on each route.

FIGURE 2.8 CITY CENTRE TO AIRPORT PUBLIC TRANSPORT JOURNEY TIME AND COSTS

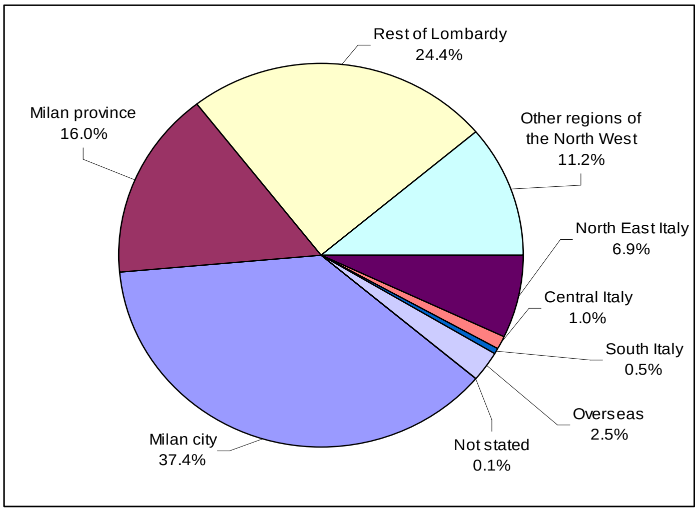


2.35 This analysis shows that the time and cost involved in access to the airports make air travel significantly more attractive on a route such as Madrid-Barcelona than on a route such as London-Paris, if the passenger is travelling to/from the city centre. On the London-Paris route, the price of public transport to/from the airports is 4.3 times greater than on the Madrid-Barcelona route, and the total surface journey time is 3.4 times longer. This helps to explain why air market share is so high on the Madrid-Barcelona route. However, access times/costs cannot explain all of the routes on which the market share is significantly different from what we would expect based purely on journey time. For example:

- Rail market share was high on the Frankfurt-Cologne route even prior to the opening of the HSL – despite the convenient location of the airports
- Rail market share is much lower on the London-Edinburgh route than we would expect based on the generalised journey time, even though the main airports are inconveniently located for the city centre.

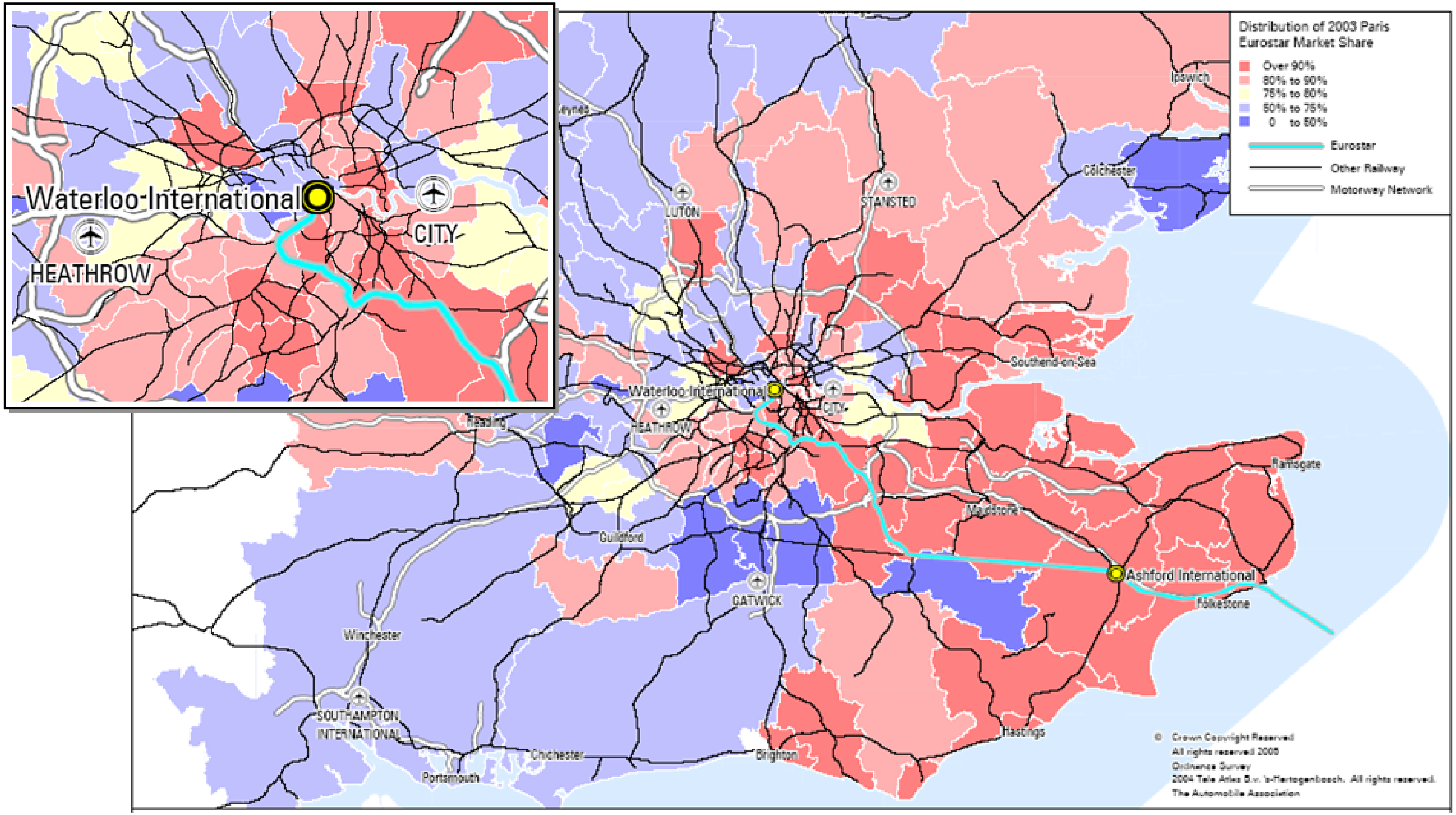
2.36 Analysis of accessibility is not as simple as just the journey time from the city centre, as many passengers travel from either the suburbs or the area around a city. Figure 2.9 below shows an example of this for the Milan airports: only 37% of Milan airport terminating passengers (excluding connecting passengers) actually travel to/from the city of Milan. The proportion is likely to be higher for a short distance route such as Milan-Rome, as a passenger would not use a Milan airport to make a journey from (for example) Bologna to Rome – whereas a passenger from Bologna might well use Milan airport if travelling internationally. No route-specific figures are available, but even taking this into account, based on this data it appears likely that less than half of passengers using the Milan-Rome air service, excluding those connecting onto other flights, actually have their destination in central Milan.

FIGURE 2.9 MILAN MALPENSA AND LINATE PASSENGER ORIGIN (2005)



2.37 The importance of the location of terminals for market share is illustrated in Figure 2.10 below, which shows the rail market share, by origin area, for the London-Paris route. Rail has a market share of over 90% amongst passengers travelling to/from Kent (the region southeast of London) and the parts of London that are close to the current terminal at Waterloo International. From many parts of Kent, the airport surveys show that there are almost no air passengers on this route. For travel from these areas, rail travel would be far quicker than travel by air. However, rail has a much lower share amongst passengers travelling from the western parts of central London and amongst passengers travelling from most areas west of London, for whom travel via Heathrow airport would be relatively more convenient.

FIGURE 2.10 LONDON-PARIS RAIL MARKET SHARE BY ORIGIN AREA (2003)



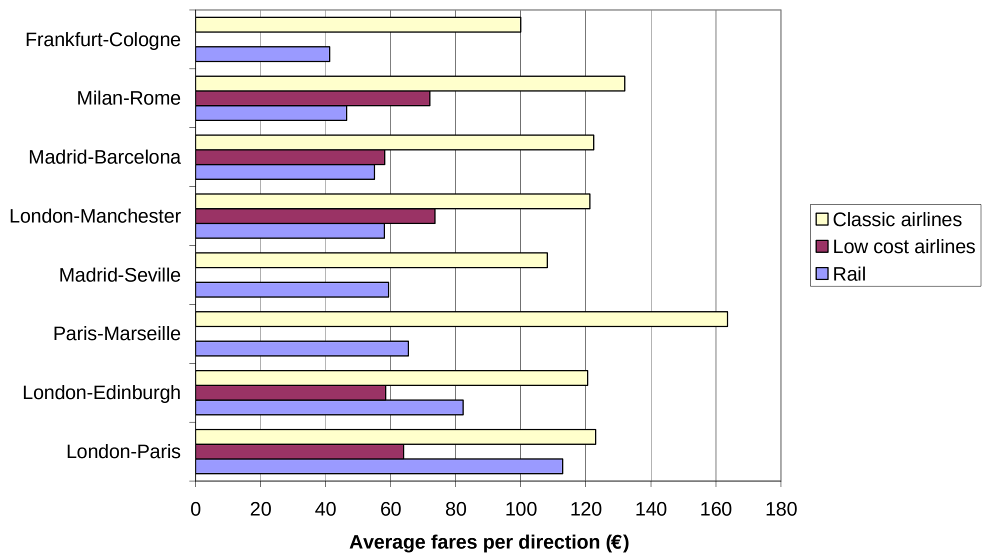
2.38 The airlines we consulted with, particularly the low cost airlines, emphasised that the accessibility of terminals was a key factor that they would take into consideration when deciding whether to launch services on a new route. This was more important for short routes where there might be stronger competition from rail and other forms of surface transport than for longer routes where air transport would always be the fastest mode.

Price and ticket conditions

2.39 Price can be an important issue in determining market share. The relatively low price of rail transport appears to be one of the main reasons why rail market share is so much higher on the Rome-Milan route than, for example, the Madrid-Barcelona route, which has a similar rail journey time. Low cost air operators emphasised that the prices charged by incumbent airlines and surface operators (bus as well as rail) were one of the key factors that they would look at when deciding whether to launch services on the route. However, in some cases where the rail operator offers a superior product (London-Paris or Madrid-Seville), high market share has been achieved despite relatively high prices.

2.40 In order to estimate average prices, we collected a large sample of prices on each route. Our sample is intended to be reasonably representative of the types of tickets that passengers will buy, although it is unlikely to be exactly right. Figure 2.11 compares average sampled fares for the rail and air operators on the case study routes. The lowest rail fares were levied for the Frankfurt-Cologne route, reflecting the fact that it is much shorter than any of the other case study routes; apart from this, the lowest fares were levied on Milan-Rome. The highest rail fares were levied on London-Paris. Classic airline fares were much more similar across all of the routes, with the highest being on Paris-Marseille and Milan-Rome. Where there were low cost airlines operating on a route, these provided a much lower priced option.

FIGURE 2.11 SAMPLED AVERAGE RAIL AND AIR FARES, BY ROUTE[2]



2.41 On all but two of the routes (London-Paris and London-Edinburgh), rail travel was on average the cheapest option. On the London-Edinburgh route, low cost airlines undercut the rail operator on average, and on London-Paris, rail fares were nearly as high as those levied by the main classic operator. The relatively lower fares offered by airlines on the London-Edinburgh route appears to be one of the main reasons for the low rail market share on this route.

2.42 However, although it is helpful to examine average fares in order to compare price levels across routes, actual fares vary substantially as a result of the yield management systems applied by the various operators. Few, if any, passengers actually pay an 'average' fare. This means that, even when one operator is cheaper on average, another operator may be cheaper under certain circumstances.

2.43 All of the airlines used yield management systems to vary the price of the fares, as did all of the rail operators except RENFE, although the yield management systems used by Trenitalia and Deutsche Bahn are much simpler than the airline systems and (unlike for airlines) a large proportion of their passengers buy standard priced tickets. The lack of any yield management system is a key weakness of the RENFE pricing system, especially on the Madrid-Barcelona route where it faces strong airline competition, as:

- For travel booked well in advance, air travel can often be cheaper than rail travel. As leisure passengers are likely to be the key market for rail travel on a route such as this, and they tend to book longer in advance, rail prices are much higher in what should be the key market.
- For travel booked at the last minute, rail travel is comparatively good value, but trains can often be fully booked well in advance, because the operator has no

[2] Note: This figure shows averages across all of the ticket types which we surveyed, without any weighting. For modelling purposes, adjustments were applied to reflect the ticket types that passengers would commonly buy.

means of encouraging passengers to travel outside the main peaks. Therefore, although theoretically the price is low, it is not always possible to buy a ticket.

2.44 Yield management systems primarily vary ticket price in relation to how busy the train or plane is, and how long in advance the ticket is booked. However, some operators impose additional rules, such as requiring that passengers buy return tickets and stay over a Saturday night in order to purchase a discounted ticket. We noted that a number of rail operators appeared to have adopted these rules for some fares – but that airlines were tending to abandon them. Where an operator applies a rule such as this, its prices can be disproportionately high in a particular subsection of the market, and this will impact market share. For example, on the London-Paris route, the cheapest one-way fare offered by Eurostar to UK residents is £149 (€220), almost seven times more than the cheapest easyJet fare and five times more than the cheapest BMI or British Airways fare. This means that, for passengers needing to buy a single ticket, rail travel is very expensive – even though it is no more expensive than air travel on average.

2.45 It should also be emphasised that price will determine the size of the market as well as market share. Low cost airlines are increasingly offering lower fares than were available in the past on longer routes, and journeys with a flight time of 2-3 hours now often cost little more than journeys with a flight time of 1 hour. The result is that for holiday passengers, who are generally flexible about their destination, longer distance travel has become relatively more attractive. Although analysis of longer distance routes was not within the scope of this study, the trends that we observed on the routes we studied were consistent with this. On many of our case study routes, the rate of growth of passenger numbers has been slower than for the total intra-European travel market, which has typically grown by 4-5% per year. This was particularly the case for the London-Paris market (which historically has had a high volume of ex-UK holiday traffic). These results imply that passengers are taking advantage of low air fares to take their holidays at more distant destinations. **As average journey length increases, this inevitably results in a shift towards more air travel, even if rail market share on short distance routes does not change, as air will always dominate the longer routes.**

Reliability and punctuality

2.46 We define reliability and punctuality as follows:

- Reliability: how often the service is subject to severe disruption, for example due to strikes or engineering works
- Punctuality: when the service does run, the proportion of services that run on time.

2.47 A number of operators suggested that reliability and/or punctuality were very important in determining rail market share. In some cases this has served to increase rail market share:

- On the London-Paris route, Eurostar achieved a substantial improvement in the proportion of trains arriving within 15 minutes of the scheduled time, from 79% to 89%, after the opening of stage 1 of the Channel Tunnel Rail Link high speed line. It considers that the improvement in punctuality was as important as the improved journey times in improving its market share. Eurostar has also managed to avoid many of the strikes which have affected other parts of the French rail system.

- On the Madrid-Seville route, RENFE achieves far better punctuality than is achieved by any operator on any other comparable route, with over 99.5% of trains arriving within 5 minutes of the scheduled time.

2.48 The relatively high rail market share on the Milan-Rome route may also be related to the poor punctuality achieved by Alitalia, the main airline. However, in other cases, poor reliability or punctuality has damaged rail market share:

- The decline in Eurostar's market share between 2001 and 2003, prior to the opening of the Channel Tunnel Rail Link, was at least in part due to poor punctuality at the time and a number of periods of severe service disruption (poor reliability).
- The punctuality of UK domestic rail services declined significantly after the Hatfield rail accident in October 2000, as speed restrictions were imposed across the network. Although punctuality has subsequently improved, long distance routes are subject to regular severe disruption at weekends (usually replacement of trains with buses for part of the route), as the infrastructure manager closes the line to undertake engineering works. Rail operators have publicly attributed poor passenger levels to this "5 day per week railway".

2.49 Rail lines are susceptible to strikes, particularly by train drivers and signallers. However, this did not appear to be a particularly important issue in determining market share on any of the case study routes. In part, this was because the rail systems which had suffered most from strikes (Trenitalia and SNCF) were in competition with air operators that also suffered from strikes (either by their own staff or by air traffic control staff). In addition, SNCF has generally tried to keep TGV services operating during strikes – urban and regional services have been worst affected. RENFE, the Spanish rail operator, has suffered from a number of strikes, but this did not appear to have affected market share at least on the Madrid-Seville route. This is at least partly because Spanish law requires a minimum essential service to be provided during strikes, usually set at 50-75% of the timetabled service, and therefore the impact of rail strikes in Spain is much less significant than in other countries. Improvements in Eurostar market share since 2003 have coincided with a number of strikes affecting competing airlines (British Airways staff strikes in summer 2005, and a number of strikes by French air traffic control); Eurostar has managed to continue to operate even during times when other rail services in France are on strike.

2.50 Table 2.1 summarises the differences in performance (in terms of reliability and punctuality) by rail and air operators on the selected routes.

TABLE 2.1 SERVICE PERFORMANCE

Route	Air		Rail	
	Punctuality	Reliability	Punctuality	Reliability
London-Paris	Congestion at Heathrow and CDG causes delays	Service has been affected by a number of strikes	Good	Good, but severe problems in 2001-3 reduced market share
London-Manchester	LCC more punctual because they do not operate out of Heathrow	Good	Good	Track closures and engineering works leads to severe service disruptions
London-Edinburgh	LCC slightly more punctual because they do not operate out of Heathrow	Good	Good	Track closures and engineering works leads to severe service disruptions at weekends
Madrid-Barcelona	Better on LCCs	Good	Comparable to LCCs	Good
Madrid-Seville	No route specific data	Good	Very good – almost perfect	Very good
Paris-Marseille	No route specific data	Susceptible to strikes	Good	Susceptible to strikes
Frankfurt-Cologne	Slightly worse than rail	No route specific data	Good	No route specific data
Rome-Milan	Average	Susceptible to strikes	Good	Susceptible to strikes

Service quality

2.51 Service quality, either on-board or in terminals, does not appear to be a particularly important factor in determining market share. One rail operator said that they thought there would be no material impact on their market share if they removed all on-board services, provided journey time and punctuality remained unchanged.

2.52 Although rail travel generally offers passengers more space and privacy, there is little difference between the level of on-board service quality provided to passengers in standard class on the routes we studied (also referred to as second class, economy or tourist). Rail operators do not include catering in the price of a standard class ticket and no low cost airline does, except Air Berlin. Most classic airlines, including Alitalia, Air France, British Airways and Lufthansa, still provide catering in economy class, but it is minimal on routes as short as those we have studied. Other classic carriers including SAS, Iberia and BMI no longer provide free catering. Iberia informed us that, when they withdrew catering from economy class, they undertook market studies of routes where they were in direct competition with other airlines that still provided it, and they had found that there was no impact on their market share.

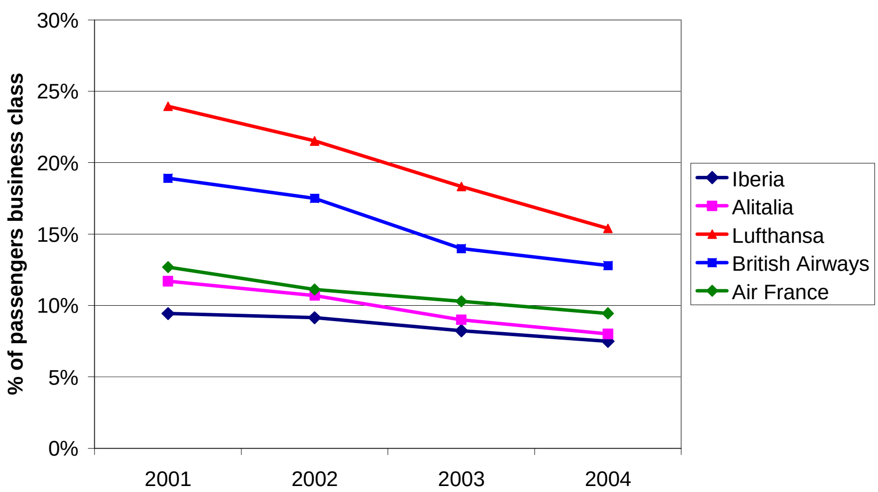
2.53 There is also little difference in quality between airport and long distance rail terminals for the routes we studied. Large rail stations provide a range of shops and catering facilities, similar to airports. The two main differences we found were:

- Airports all provide a heated / air-conditioned and secure waiting area. Many of the biggest rail stations also do, but not all. At some rail stations, waiting rooms are very basic.
- Airports provide toilet facilities free of charge, whereas most rail stations charge passengers (in some cases around €1).

2.54 There is more difference in service quality in first or business class. Some rail operators, such as the London-Paris operator Eurostar and RENFE on board its AVE and Altaria trains, provide a vastly superior service in first class, including a fairly high quality at-seat meal with drinks, free newspapers, as well as more space. No intra-European airline provides a service equivalent to this. Other rail operators, including Deutsche Bahn on the ICE and SNCF on domestic TGV services, provide little or no difference other than a larger seat.

2.55 The view that on-board service quality is of diminishing importance is supported by the fact that the proportion of passengers on short haul air routes that are willing to pay for business class travel has declined significantly, driven by reductions in company travel budgets. Figure 2.12 shows the proportion of short haul passengers on the five largest 'classic' European airlines that travel business class. This has declined significantly across all operators since 2001.

FIGURE 2.12 SHORT HAUL AIR PASSENGERS TRAVELLING BUSINESS CLASS



Source: AEA, SDG analysis

2.56 However, at least part of this trend is due to the increased price differential between economy and business class. Until recently, it was common for airlines to require all passengers on short haul routes not staying over a Saturday night to buy a fully flexible economy ticket – which is typically close to the price of a business class ticket. For many business travellers, there was therefore little difference between the price of a business or economy ticket. Many airlines have dropped Saturday night stay restrictions, in response to low cost airline competition, but have not reduced their business class prices. As a result, the price saving obtained through economy class travel has increased. We note that rail operators (such as Eurostar) that have maintained high-quality first class services at a moderate price differential do not appear to have seen a decline in the proportion of passengers travelling first class.

2.57 Overall, on-board service quality does not appear to have a significant impact on market share. However, this is at least partly because there is no significant difference in the on-board service quality provided by any of the operators on most short distance routes, except for first/business class passengers, which are usually less than 20% of the total.

Availability of alternative modes

2.58 On some of the routes, there were alternative lower price rail operations and rail could capture very price-sensitive traffic even if most other passengers were less price-sensitive. On other routes, the lower priced option was bus or potentially car travel (where a group is travelling together). Table 2.2 compares the lower cost options available on each of the routes.

TABLE 2.2 ALTERNATIVE LOWER COST MODES

Route	Lower priced rail	Bus	Car
London-Paris	×	✓	✓
London-Manchester	×	✓✓	✓✓
London-Edinburgh	×	✓✓	✓✓
Madrid-Barcelona	✓ (night train)	✓✓✓	✓✓
Madrid-Seville	✓	✓✓	✓✓
Paris-Marseille	✓	×	✓✓
Frankfurt-Cologne	✓✓	×	✓✓✓
Rome-Milan	✓✓	×	✓✓

Key:

× Not an alternative ✓ Weak competition

✓✓ Moderate competition ✓✓✓ Strong competition

2.59 The routes on which the availability of lower-cost options appeared most to affect on market share were:

- **Madrid-Barcelona:** The availability of a bus service that is much cheaper and more frequent than the rail service probably reduced rail market share on this route, even though the bus is 25% slower than the train. Buses, rather than trains, have historically been the main mode of long distance public transport in Spain.
- **Rome-Milan:** The availability of a number of lower cost alternative rail services (TrenOK and the slower InterCity and night trains), and the lack of any feasible bus competition, probably increased rail market share on this route.
- **London-Manchester:** Strong competition from – and between – bus operators has resulted in very low bus fares on this route (as little as €2 one way). As the rail service is prone to disruption, bus travel can be little slower at certain times.

This probably reduced the market share of the rail operator, but also of low cost airlines, on this route.

Market share of low cost airlines

2.60 We also sought to investigate whether there were any clear factors which determined the relative market share of low cost airlines, as opposed to the share of classic or network airlines. However, in practice we found that this was not a useful distinction. There are two main reasons for this, which we discuss in more detail below:

- convergence in the nature of services provided; and
- market share being determined by artificial barriers to entry.

2.61 The presence of low cost carriers often appears to stimulate fare reductions amongst all carriers operating on a route – including in some cases the rail operator. In the case of airlines, this has forced reductions in operating costs, as high-cost operators cannot effectively compete. In the case of rail, low cost competition may have resulted in greater subsidy requirements for long distance routes, although some operators have also been spurred to improve their yield management systems and increase load factors, resulting in lower per passenger costs even where total costs are unchanged.

Service level convergence

2.62 Historically, there have been a number of service quality factors which have distinguished low cost airlines:

- use of secondary airports;
- higher seating density and load factors;
- no business class;
- charges for catering on-board;
- no handling of connecting passengers; and
- no pre-allocation of seats.

2.63 These factors account for part of the difference in cost between low cost and full service carriers, although there are also cost differences which do not relate to an obvious corresponding difference in service quality. The cost differentials obtained by low cost airlines are discussed in Section 4.

2.64 If these service quality differences were significant and sustained, this might help explain the market share of low cost airlines on each route. However, in practice, we found that many of the service quality differences between full service and low cost airlines have been eroded, and therefore that service quality is converging:

- many classic airlines have increased seating density, and are improving their yield management systems in order to improve load factors;
- the proportion of passengers using business class on short haul routes has declined significantly and many airlines no longer offer it for domestic routes;
- several classic carriers including Iberia have introduced charges for on-board catering; one low cost carrier (Air Berlin) provides it free of charge;

- some classic carriers, including BMI, now discourage connecting passengers, and one low cost carrier (Air Berlin) does handle them;
- a number of European low cost carriers, although not Ryanair or easyJet, pre-allocate seats at check-in in the same way as classic carriers.

2.65 The other main service-related difference is the use of secondary airports. Two of the main European low cost carriers, Ryanair and Wizzair, use mostly secondary airports, such as Brussels Charleroi or Paris Beauvais, but the other main European low cost carriers including easyJet, Vueling, DBA, Germanwings and Air Berlin use main airports. In practice, carriers that use secondary airports are not really relevant in a study such as this which is focusing on what are, by airline standards, very short routes where rail travel is an alternative. Use of secondary airports, with relatively long surface access times, is not a viable alternative to surface transport on these routes, because the time and cost required in accessing the airports are so high. Consistent with this, we note that the only very short European routes on which Ryanair operates are routes where either:

- There is a sea crossing, so surface transport is unattractive: for example routes between the UK and Ireland or between mainland Italy and Sardinia; or
- The airports it uses are equivalently convenient to the main airports. For example, on the Rome-Milan route, the total access times from the city to Ciampino and Bergamo (Ryanair's airports) are little worse than the total access times for Fiumicino and Malpensa (the main alternative airports accessible to a new carrier).

Barriers to entry

2.66 In some cases we found that at least part of the reason that low cost air services had not developed on a route was due to barriers to entry, primarily the lack of airport capacity.

2.67 There are no low cost air services on the Paris-Marseille route primarily because of the difficulty in obtaining slots at Orly airport, and the non-availability of any attractive alternative airport. Some low cost carriers (primarily easyJet) have obtained slots at Orly, but the majority of slots are still held by Air France, which has actually increased its share in recent years. easyJet did operate a Paris Orly-Marseille service in 2004-5, but withdrew this. If slots are limited, low cost airlines are likely to find that the potential profits that they can obtain per-flight are higher on longer distance routes with less surface competition.

2.68 Similarly, the key reason that there is no frequent low cost service on the Madrid-Barcelona route (Europe's second largest air route measured by passenger numbers) is that Madrid airport has long been subject to extensive slot constraints, affecting both runway and terminal capacity. Vueling, the Spanish low cost airline, informed us that it would operate more frequent services on the route if slots were available. More slots will be available at Madrid from October 2006, due to the opening of a new terminal and two new runways, and we expect that a more frequent low cost air service will be operated from then on.

Conclusions: market share

2.69 The case studies show that rail journey time is by far the most important factor determining rail/air market share. In principle, it is better to examine the difference between rail and air journey time rather than just the rail journey time, although in practice this may not make much difference to the results, because air journey times do not vary as much between routes as rail journey times do. The correlation is improved if we look at generalised journey time rather than purely at scheduled in-vehicle journey time. Generalised journey time takes into account whether each mode offers a high or low frequency service and also any check-in time. We found that generalised journey time explained most of the difference in rail market share across the routes that we studied.

2.70 However, we found that even allowing for generalised journey time variations, there were still significant variations in market share across the routes that we studied. There were a number of reasons for this. Punctuality and reliability appeared to be very important factors in determining market share, and a number of the operators with whom we consulted emphasised that these were as important as journey time. The accessibility of terminals is a very important factor in determining market share on individual routes but as this is not within the control of the operators within the short term, it is not a factor that they emphasised. In contrast, the service quality available on board and in terminals did not seem to be a particularly important factor determining market share. However, this was in part because there was not much difference in the service quality offered by the different operators, except in first/business class which represents a small proportion of passengers.

2.71 Although there was some evidence that price was an important factor in determining market share, this was less clear than might have been expected. Rail achieved a high market share on some routes (such as London-Paris) despite relatively high prices. The main route on which price seemed to have had a significant effect on market share was the London-Edinburgh route, where the existence of a high frequency low cost airline service had caused significant switch from rail. In evaluating the affect of price variations, we also need to consider the existence of alternative lower cost modes of transport. For example, the high market share achieved by rail on the Rome-Milan route is the result of both relatively low rail fares and the lack of any lower priced alternative to rail transport (such as a bus service).

2.72 Price affects the number of people that chose to travel on a route as well as the market share. Low cost air services are making longer distance travel attractive for passengers that are flexible about their destination (particularly holiday travellers), relative to travel on shorter routes for which rail is an alternative. For example, the relatively high rail fares levied on the London-Paris route partly explain why passenger levels on this route have grown very slowly since the mid-1990s: holiday passengers have taken advantage of the low fares offered by low cost airlines and switched to more distant destinations, particularly in Southern and Eastern Europe.

3. OPERATING COST ANALYSIS

Introduction

3.1 Operating costs are a key factor determining the prices that can be offered by rail, low cost carriers and classic airlines, although prices are also affected by taxes, subsidies, and the profit margins the operators require.

3.2 In this section, we set out our analysis of airline and rail operating costs. We have developed models of air and rail operating costs, with the objective of estimating the costs of carrying one passenger, or providing one seat, by air or rail.

3.3 In order to undertake this analysis, we have set up airline and rail operating cost models. An explanation of these models, including detailed data sources, methodology and assumptions, can be found in Appendices A and B. This section should be read in conjunction with these, as it is important to understand the limitations of the analysis that we have been able to undertake and the assumptions that we have had to make.

3.4 The rest of this section is structured as follows:

- overview of airline operating costs;
- overview of rail operating costs;
- comparison of air and rail operating costs;
- comparison of classic airline and low cost airline operating costs; and
- future trends in rail and air operating costs.

Airline operating cost overview

Our approach

3.5 We have constructed an airline operating cost model. Analysis of airline operating costs is simpler than analysis of railway operating costs, for two main reasons:

- airline costs are largely generic, whereas rail costs differ significantly between operators and routes; and
- airline operating and financial data is often publicly available, whereas rail data generally is not.

3.6 The costs of operating an air service on two routes of equivalent length in two different EU states are very similar. The same two types of aircraft (the Boeing 737 and the Airbus 319/320) are used for the vast majority of significant intra-EU routes; fuel consumption is a function of distance but otherwise does not vary by route. Even staff costs tend to be similar, because the most expensive staff (flight crew) can easily transfer between states and airlines, partly as by international convention all air traffic communications take place in the same language. As a result of this mobility, salaries tend to equalise. The only item that can vary significantly is airport and en-route air navigation charges and passenger taxes, which are published by airports and air navigation service providers, and collated by IATA. Therefore, we have created a generic airline cost model, which we have adjusted for each route using these route-specific inputs.

3.7 We model the costs of operating "classic" and "low cost" air services separately. We break airline operating costs down into the cost items in Table 3.1. We have also allocated a cost driver to each of these factors: most costs are either a function of number of passengers, aircraft hours, flight hours, or are route-specific. Breaking down airline operating costs into these components enables us to project the operating costs incurred by each airline on each route, taking into account the route length and load factor, and route-specific factors such as airport and en-route charges.

TABLE 3.1 AIRLINE COST DRIVERS

Cost item	Cost driver
Aircraft costs	Aircraft operating hours
Flight crew / cabin crew costs	Aircraft operating hours
Handling charges	Passengers
Sales and reservations	Passenger hours
Advertising and promotion	Passenger hours
Other costs	Varies
Commission	Revenue
En route ANS charges	Route, aircraft type
Landing charges	Route, aircraft type
Passenger service charges	Route specific
Aircraft fuel and oil	Route distance

3.8 In estimating airport charges, we take published schedules of airport charges and further assume that low cost carriers on all of the selected routes are able to negotiate a 20% discount on passenger service charges. In reality, low cost carriers are able to negotiate higher discounts at certain airports (for example, the Ryanair arrangements at Charleroi) but at some airports low cost carriers will not be able to negotiate a discount at all (for example, we understand that low cost airlines do not receive any discount at Paris CDG, despite using a low service terminal). As these discounts are results of confidential agreements, the true discount levels are unknown to us. "Classic" airlines may also negotiate lower charges, but as the size of the discount would be smaller and often zero, we do not assume any discount for these carriers.

3.9 A key input to estimating airline operating costs is the flight time on each route, which is partly a function of route length, but is not directly proportional. By extracting timetable data, we have adopted a simple function relating route length to average flight time. We are then able to examine how operating costs differ on routes at different lengths.

3.10 As a base for modelling classic airlines, we have used the operating costs of franchise airlines that operate short-haul services on behalf of British Airways and some other short haul carriers. This enables us to examine the costs of airlines providing a service similar to that provided by the large full service network carriers, but without the distorting effect caused by the operation of some long-haul services on that cost base. Most European network airlines operate a significant number of long haul services and do not publish separate cost data for short and long haul services; analysis of their operating costs is of limited use for a study such as this, which requires modelling of short haul services only. The cost structure for long haul services differs significantly from the cost structures for short haul services, for the following reasons:

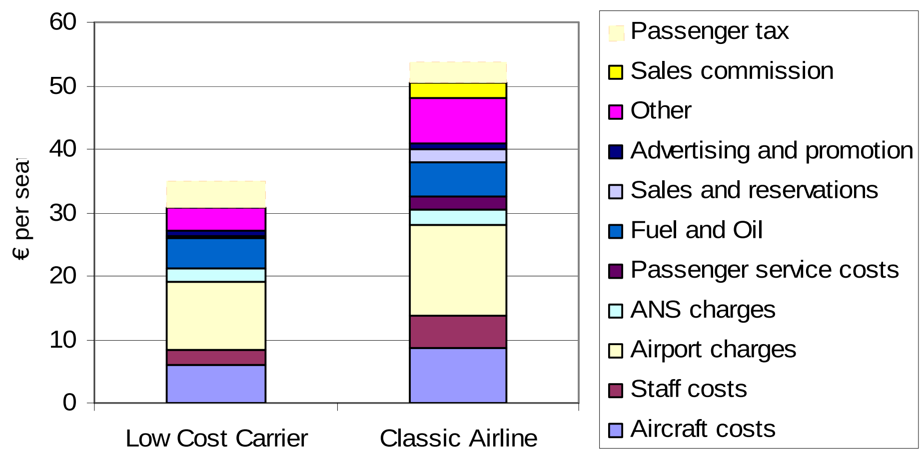
- Many airline costs are associated with takeoff and landing rather than level flight, and are therefore a higher proportion of the costs incurred on short haul routes
- Aircraft size tends to be larger for long haul flights, which leads to different levels of staffing requirements
- Staff pay and expenses are different (usually higher) for long haul flights
- Classic airlines' aircraft utilisation and load factors are significantly higher on long haul routes.

3.11 For the low cost airlines, we have used easyJet as our base. This is because of the major low cost airlines, easyJet currently serves two of the routes being analysed for this study and has also operated on the Paris-Marseille route in the past. Although Ryanair has significant effect on medium distance European travel, they generally do not serve very short routes (by airline standards) such as those being evaluated for this study, because the access/egress times to the secondary airports served means that air travel is not time competitive.

Results

3.12 Figure 3.1 illustrates the breakdown of operating costs into its components for low cost and classic carriers. We use the London-Edinburgh route as an example here, but the cost structure is similar on all routes. Airport charges are the most sizeable component, constituting 34% of LCC costs and 24% of 'classic' airline costs. Aircraft costs (depreciation and lease charges) are the next most important, accounting for 21% and 19% of total costs respectively. In the future, aircraft costs may be surpassed by fuel costs, which currently account for 15% and 10% respectively.[3]

FIGURE 3.1 AIRLINE OPERATING COSTS, LONDON-EDINBURGH ROUTE

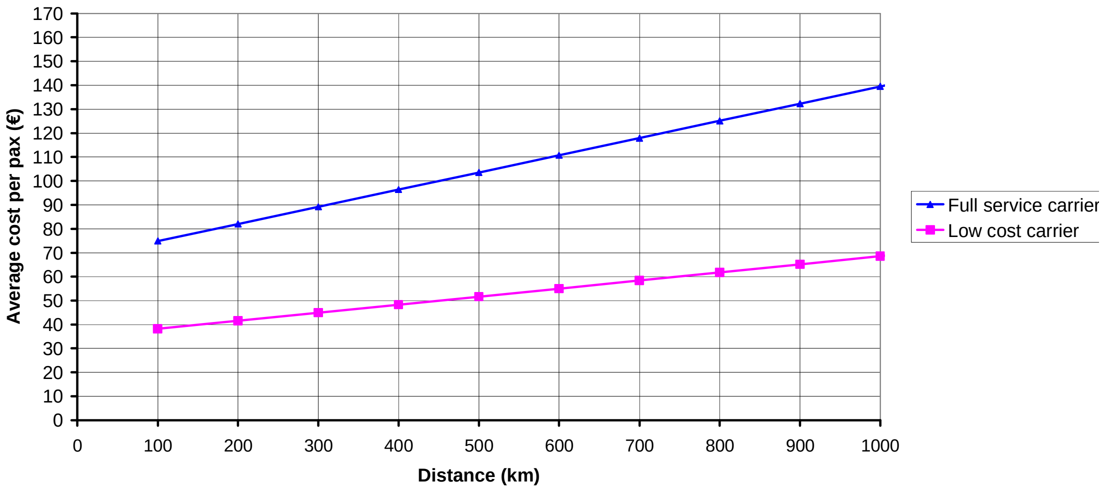


[3] Note: The exact amounts vary by carrier depending on the extent to which fuel has been hedged.

3.13 The effective operating costs on this route include a passenger tax that goes to the UK government, and as such is not a "true" cost of operating flight service.

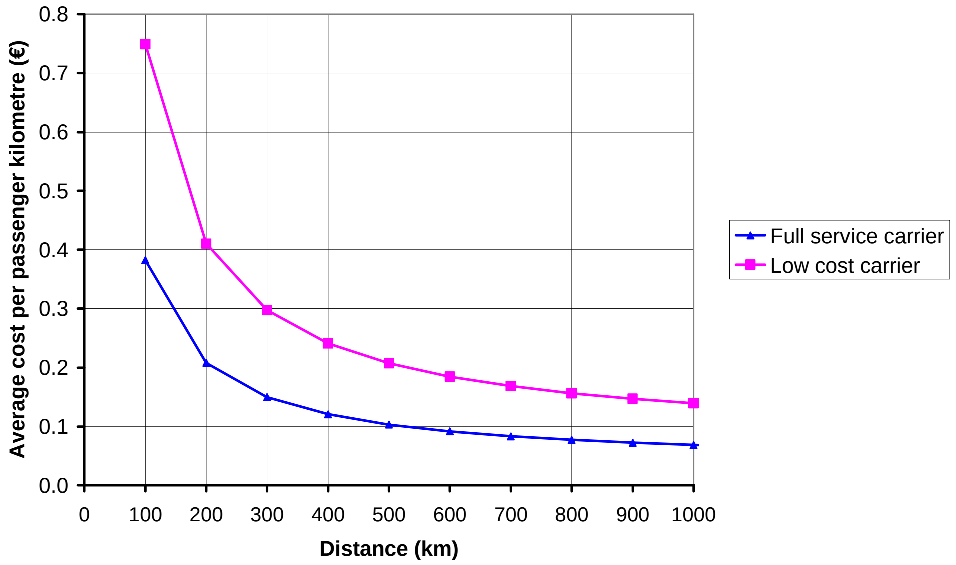
3.14 Figure 3.2 shows our estimate of airline operating costs per passenger, depending on route length, using typical levels of airport charges and average load factors achieved by major low cost and classic carriers. This shows that the operating costs of the low cost airlines are approximately 50% less than the operating costs of the full service airline, and that this relationship is maintained regardless of route length. The difference will be greater where low cost airlines are able to use lower-cost secondary airports or negotiate a significant discount on airport charges.

FIGURE 3.2 RELATIONSHIP BETWEEN AIRLINE COSTS AND DISTANCE



3.15 Figure 3.3 shows the equivalent results expressed per passenger kilometre.

FIGURE 3.3 AIRLINE COSTS PER PASSENGER KILOMETRE



Rail operating cost overview

3.16 Unlike airline operating costs, rail operating costs are specific to the country in which the service is operated, the geography of the route and the type of infrastructure and rolling stock used for the specific service. Therefore we have adopted a "bottom-up" approach to estimating rail operating costs. We have constructed cost models for operators based on our understanding of the cost components, and the rail regulatory regimes and regulations in the selected routes.

3.17 Our analysis of rail operating costs has been constrained by the data that we were able to obtain. Even where operators were willing to discuss market issues with us, in most cases they were not willing to discuss operating costs.

Summary of approach

3.18 We have sought to break rail operating costs down into the cost items in Table 3.2. We have also allocated a cost driver to each of these factors: most costs are either a function of number of passengers, train kilometres, train hours, or are fixed. In practice, the analysis we have been able to undertake of the operating costs on each route have been constrained by the availability of data. Note that single cost drivers have been selected for modelling purposes, but in practice some cost items are a function of multiple cost drivers.

TABLE 3.2 RAIL COST DRIVERS

Cost item	Description	Cost driver
Infrastructure	Fixed access charge	Fixed
	Maintenance and renewal	Train km
Energy	Electricity or fuel costs	Train km
Stations costs	Use of stations/ depots	Train hour
Rolling stock charges	Leasing charges	Train km / hours
	Maintenance and servicing	Train km / hours
Passenger service costs	E.g., catering	Passenger km
Staff costs	Operating staff wages	Train hour
	Management and administrative staff wages	Train hour
General administration	e.g., overheads	Train hour
Passenger compensation	Refunds or compensation to passengers in the event of delays, cancellations etc	Passenger km
Other costs	e.g., industry and professional services, marketing and advertising, and overheads (such as pension contributions)	Train hour

3.19 The largest single cost item for most rail operators is infrastructure. However, most European infrastructure managers only cover part of their costs through access charges. Therefore, the operators' expenses may not reflect the full costs of operating the rail service. The ownership and subsidy structures vary across countries and routes, and subsidies and grants to infrastructure companies are usually given in lump sums. It is therefore almost impossible to identify the extent to which the infrastructure charges on any *individual* route are subsidised. Therefore, we have estimated the subsidies infrastructure operators receive on average. As far as possible, the infrastructure costs we cover are maintenance and renewal of infrastructure only, rather than capital costs, but given data limitations, we cannot verify that this is always the case.

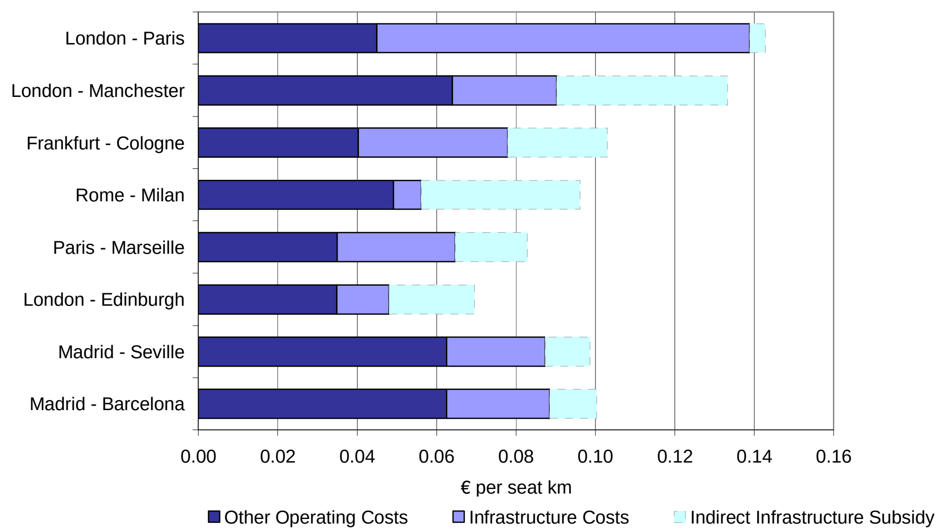
Results

3.20 Figure 3.4 compares our calculations of rail operating costs, per seat kilometre, for each of the case study routes. We divide costs into:

- The direct costs incurred by the operator, which would include energy, rolling stock, staff, ticket sales, marketing and overheads
- The infrastructure charges the operator pays, in most cases based on the network statements
- An estimate of the 'real' infrastructure costs if these charges were not reduced by subsidy to the infrastructure manager.

3.21 The analysis shows that the highest costs per seat kilometre (pre-subsidy) are incurred for the London-Paris route and the lowest costs are incurred for London-Edinburgh and Rome-Milan.

FIGURE 3.4 COMPARISON OF RAIL OPERATING COSTS PER SEAT KILOMETRE



3.22 A key factor here is the extent to which infrastructure is subsidised. We have calculated this by comparing the proportion of the costs of the infrastructure manager that are covered through access charges with the costs that are covered through subsidy, in most cases based on the accounts of the infrastructure manager (more details on a route-specific basis are provided in the appendix). In order to verify that our estimates for the proportion of the cost that is covered through subsidy are correct, we have validated these estimates against the those provided in the report produced for the European Conference of Ministers of Transport (2005)[4]. This confirms that our calculation of the coverage ratios are broadly correct although it should be noted that, in common with our analysis, this report was not route specific; it also did not include Spain.

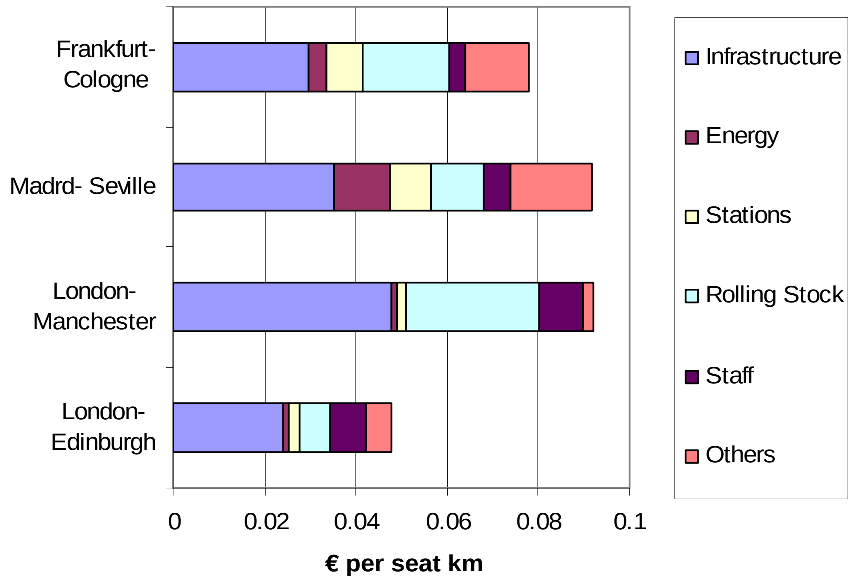
3.23 Operating costs per seat kilometre vary significantly between the operators. However, much of this variation is due to differences in infrastructure charges. Infrastructure charges are highest for the London-Paris route due to the very high charges that Eurostar has to pay for access to the Channel Tunnel and for use of the UK Channel Tunnel Rail Link; the lowest infrastructure charges are for the Rome-Milan route. The direct costs incurred by the operators range from €0.035 to €0.064 per seat kilometre, the highest being for the London-Manchester route and the lowest being for the London-Edinburgh and Paris-Marseille routes.

3.24 It should be emphasised that rail operating costs can be opaque due to the limited information disclosed by some operators. In some cases, almost no disaggregate cost information is available. Therefore, we cannot necessarily verify that the figures shown above are exactly comparable. In particular, we believe that the relatively high costs shown for the two Spanish routes, compared for example to Paris-Marseille, at least partly reflects the fact that we had access to more data and could therefore make a better estimate of the full costs incurred by the operator.

3.25 The distribution of other costs also varies: infrastructure is consistently the largest cost item, but rolling stock costs can also be significant. Figure 3.5 illustrates the costs of providing one seat-kilometre on four of the routes in the study, for which sufficiently detailed information is available.

[4] Railway reform and charges for the use of infrastructure, ECMT, April 2005

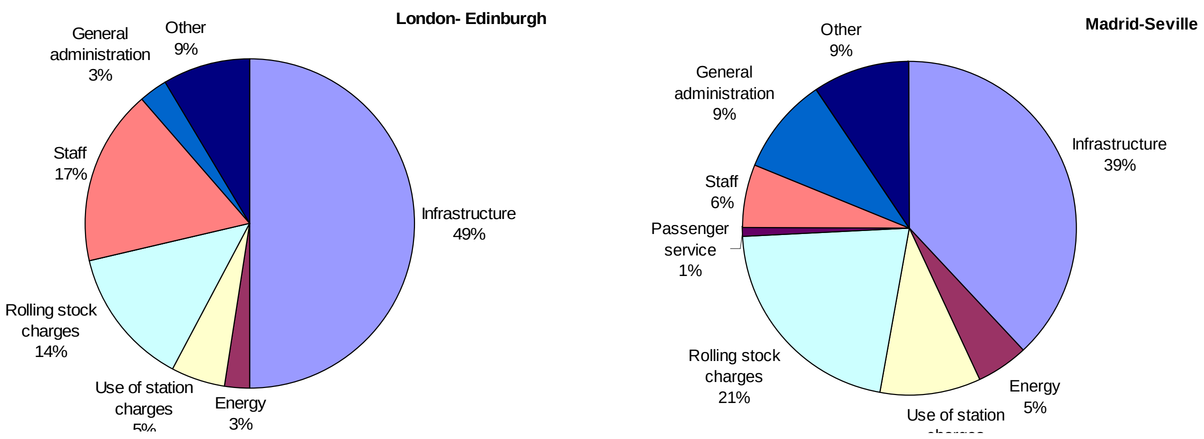
FIGURE 3.5 COMPARISON OF RAIL OPERATING COST COMPONENTS



3.26 The analysis demonstrates that there are significant differences in operating costs between routes, even where in principle these should be comparable, for example if they are within the same Member State and hence exist within the same general regulatory framework. The London-Edinburgh and London-Manchester services are in the UK, but their unit costs and cost components differ hugely. Costs are much higher on the London-Manchester services due to higher infrastructure charges (to recover the costs of recent upgrades) and much higher lease charges for rolling stock, as the rolling stock used on the London-Edinburgh route is significantly older.

3.27 Figure 3.6 shows a more detailed breakdown of the unit cost of providing one km of train service on two routes, where we have sufficient information to do this: London-Edinburgh and Madrid-Seville. Infrastructure charges, followed by rolling stock costs, are the most significant cost items on both routes.

FIGURE 3.6 BREAKDOWN OF RAIL OPERATING COSTS



Comparison of air and rail operating costs

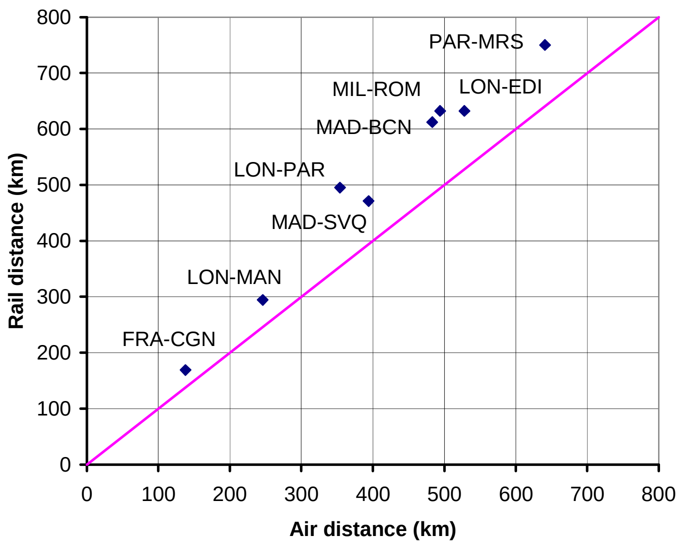
3.28 Using the models we have developed to estimate airline and rail operating costs, we are able to compare the different costs per seat on the case study routes. We compare costs per seat, rather than total costs or cost per seat kilometre. There are two reasons for this:

- differences in the structure of costs between rail and air operators; and
- the fact that rail and air distances vary, even on the same route.

3.29 The structure of rail and air costs are different. Rail operating costs are approximately proportional to route length: all other things being equal, operating costs per seat on a 500km route should be twice operating costs on a 250km route. However, as discussed above, airline operating costs are not proportional to route length, as a significant proportion of costs are associated with each takeoff and landing. Airport charges account for a high proportion of costs on short routes, and these are independent of route length. Airline costs per seat kilometre are therefore higher for very short routes than for longer routes. As a result of this, it is not useful to compare costs per kilometre between rail and air: air per kilometre costs will always be much higher than rail on a very short route, but not on a longer one.

3.30 In addition, the per kilometre costs are not comparable across operators because the operating distances for each route vary. This is because trains inevitably have to use less direct routes than aircraft do, as the location of railway lines is more geographically constrained than the routes taken by aircraft. Figure 3.7 compares the air and rail route lengths for the case study routes. On average, the rail route length is 24% longer than the air route length. The variation ranges from a minimum of 17% (Paris-Marseille, as the TGV line takes a relatively direct route) to a maximum of 40% (London-Paris, due to the location of the Channel Tunnel).

FIGURE 3.7 RAIL AND AIR ROUTE DISTANCE COMPARISON

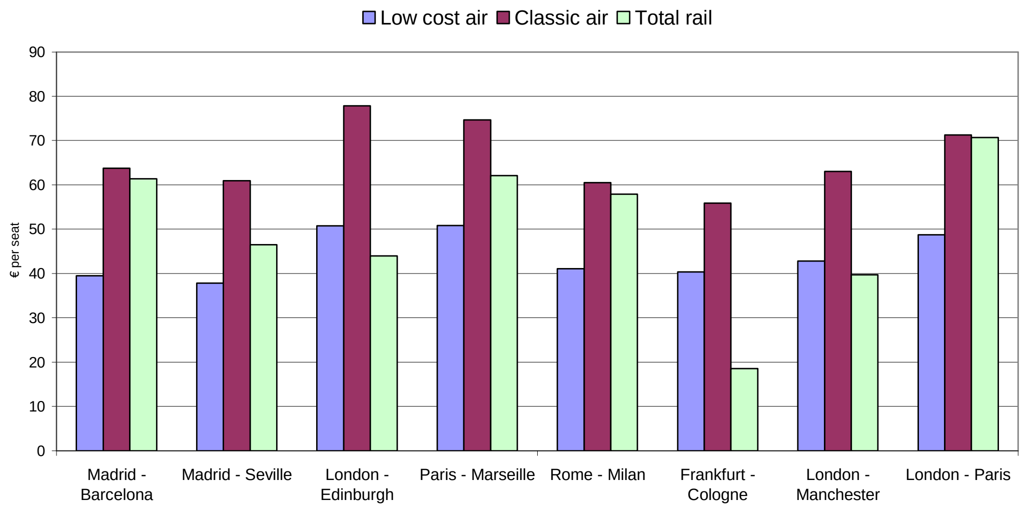


3.31 It should also be noted that the rail and airline operating costs are not necessarily directly comparable due to taxes and subsidies. Airline operating costs cover the full costs of services used whereas the rail costs do not cover the capital costs of high speed lines and may not necessarily cover the capital costs of rolling stock. We have, however, attempted to estimate the 'true' rail operating costs by adding to the rail operating costs our estimates of indirect infrastructure subsidies. We have also tried to minimise the distorting effect of taxes on our analysis, so we have not counted VAT, levied on domestic rail and air tickets in some Member States, as a cost.

Costs per seat

3.32 Figure 3.8 shows a comparison of the costs per passenger seat km for the routes selected for this study.

FIGURE 3.8 AVERAGE OPERATING COSTS PER SEAT



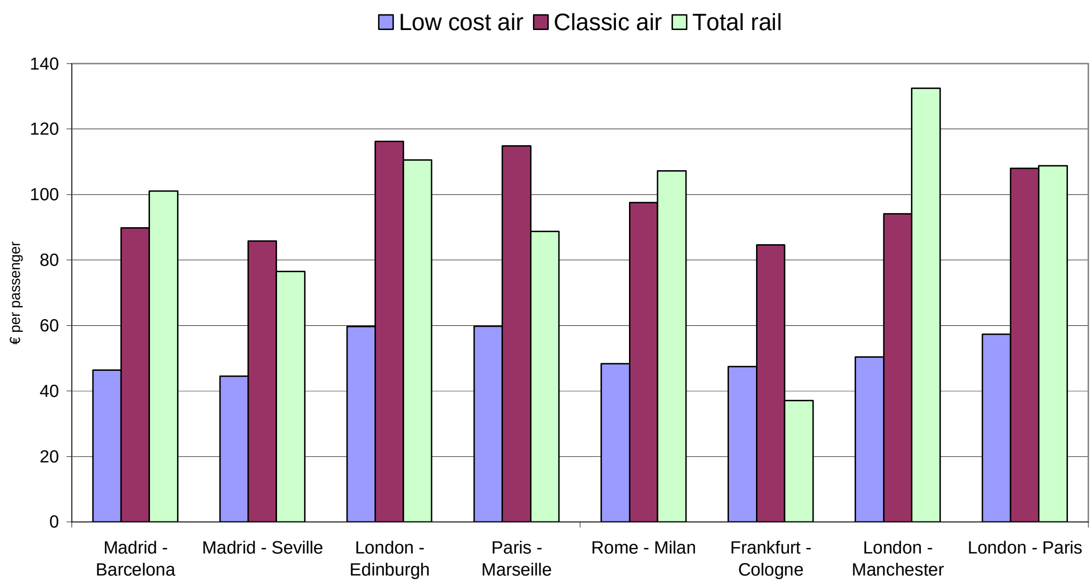
3.33 On every route, rail operating costs per seat are lower than 'classic' airline operating costs per seat, although the difference is marginal on the London-Paris route. However, on five out of the eight routes, rail operating costs per seat are higher than low cost airline operating costs per seat. This applies particularly on routes where the infrastructure charges are especially high, such as London-Paris, or routes that are particularly long, such as Madrid-Barcelona.

3.34 Rail operating costs appear low relative to air travel on London-Edinburgh, Frankfurt-Cologne, and London-Edinburgh. On the Frankfurt-Cologne route, this is a result of the relatively short distance: rail is likely to be more cost efficient for very short routes than for longer routes. For London-Edinburgh and London-Manchester, the relative high air operating costs include a passenger tax. There is no equivalent tax on rail travel (although VAT is applied to both rail tickets and domestic air tickets in some Member States).

Costs per passenger

3.35 The comparison changes if we compare costs per passenger, because the load factors that the operators achieve are different. The highest load factors are usually achieved by low cost airlines (85-90%) followed by classic airlines (55-75%). The lowest are achieved by rail operators (as low as 35% on some routes). Figure 3.9 below compares the operating costs per passenger journey.

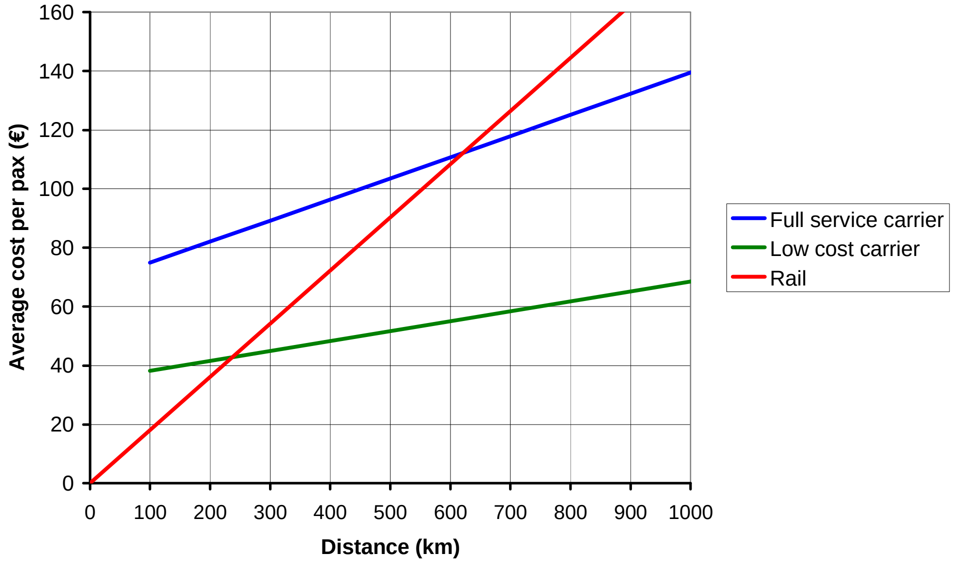
FIGURE 3.9 AVERAGE OPERATING COSTS PER PASSENGER



3.36 Measured in terms of costs per passenger, rail costs are higher than low cost airline costs, except for the Frankfurt-Cologne route, due to the fact that this route is shorter than any of the others. On three of the routes, rail costs are also higher than ‘classic’ airline costs. Rail costs are generally higher relative to airline costs if measured on a per-passenger basis because the load factors achieved by rail operators are usually lower than the load factors achieved by airlines. The difference between ‘classic’ and low cost airline operating costs is also greater if measured in terms of costs per passenger, because the load factors achieved by low cost airlines are higher.

3.37 Figure 3.10 compares average rail and air operating costs, for classic and low cost airlines, by route length. As air transport incurs a significant proportion of costs regardless of route length, rail is always lower cost for short journeys. However, the threshold at which air transport becomes lower cost than rail varies significantly depending on the type of carrier: rail transport is lower cost than classic air transport for routes up to around 600km in length, but the costs of rail transport are only below the costs of low cost air transport for routes up to 250km in length. These thresholds will vary on a route-by-route basis taking into account local factors such as airport charges and topographical constraints.

FIGURE 3.10 RAIL AND AIR COSTS PER PASSENGER, BY ROUTE LENGTH



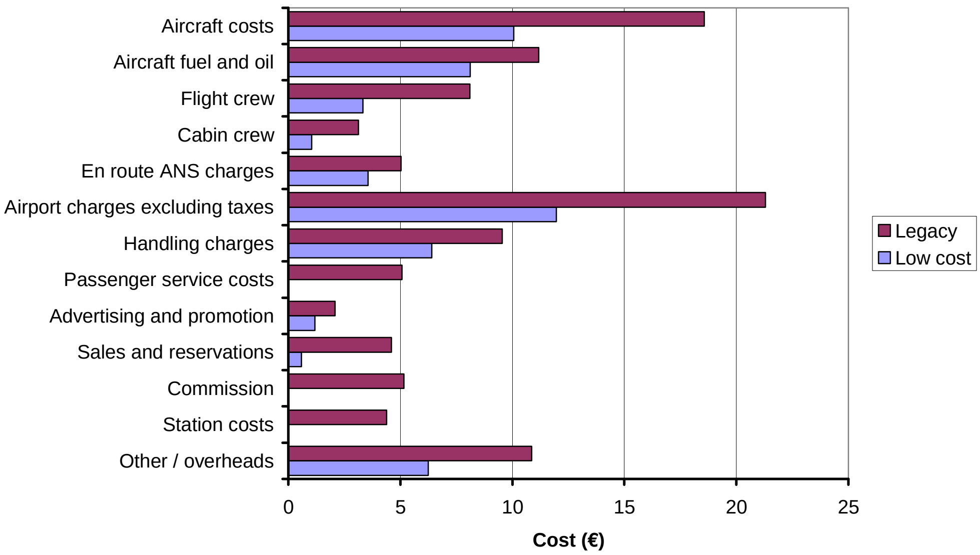
Comparison of low cost and classic airlines

3.38 As illustrated above, the operating costs of low cost carriers (LCCs) are substantially less than the operating costs of classic carriers. On average, low cost carriers can achieve operating costs that are 50% lower per passenger even than relatively efficient classic carriers. There are two types of reason why this is the case:

- Low cost airlines have lower unit costs – for example, as a result of higher aircraft utilisation and lower overheads. The differences in unit costs are discussed in detail below.
- Low cost carriers convey more passengers in the same aircraft, both due to higher seating densities and higher load factors. For example, easyJet has 156 seats in an Airbus A319 and operates with an average load factor of 85%. In contrast, a typical classic airline would have about 140 seats in the same aircraft, and European classic airlines achieve load factors of only 55-70% on short intra-European routes.

3.39 In aggregate, we estimate that around 70% of the cost saving made by low cost carriers is due to lower unit costs, and the remaining 30% is due simply to carrying more passengers in the same aircraft. The remainder of this section explains the cost savings that low cost carriers make, by type of cost. The differences in cost per passenger are summarised in Figure 3.11 below.

FIGURE 3.11 COMPARISON OF LOW COST AND CLASSIC AIRLINE COSTS PER PASSENGER



Source: SDG analysis. Costs shown are for the London-Edinburgh route.

Aircraft costs

3.40 Aircraft costs are lower both on a per-passenger basis, due to higher seating density and load factors, and on a unit cost basis. There are several reasons why unit airline costs are lower for the LCCs:

- LCCs achieve much better aircraft utilisation. easyJet's aircraft fly for 10.8 hours per day; typical classic carriers achieve 7-8 hours per day on short haul routes, although their average aircraft utilisation is higher as long haul utilisation is much better.
- Low cost carriers achieve shorter turnaround times. Ryanair turns round its aircraft in 25 minutes and easyJet in 30-35; in contrast, classic carriers achieve 45-55 minutes. Part of the reason for the differential is that, on the LCCs, cabin crew are responsible for cleaning the cabin between flights, rather than dedicated cleaning staff boarding to do so.
- By avoiding the most congested hub airports where possible, LCCs avoid the need for aircraft to queue to takeoff and wait in 'stacks' before they land.

3.41 In addition, the LCCs may have paid less on average for the aircraft that they use. Many LCCs placed large numbers for new aircraft during the industry crisis period after 2001. During this time, prices were low because total orders had fallen: LCCs were able to arrange very good deals with the two main manufacturers. Aircraft prices have subsequently risen as demand is now exceeding supply, but the LCC's contracts with the manufacturers have locked in prices at the lower rates.

Fuel

3.42 Fuel costs are basically equivalent for both LCCs and classic carriers. However, by carrying more people in the same aircraft, the fuel cost per passenger is lower for the

LCCs. Many European LCCs also fly newer aircraft which are more fuel efficient.

Flight crew (pilots)

3.43 Pilots can easily transfer between carriers and are in relatively high demand. As a result, their salaries tend to be similar for LCCs and classic carriers. However, LCCs do not operate a seniority system, which results in significantly reduced costs for older crews, and associated employment costs (particularly pensions) are often lower. In addition, LCCs usually do not keep aircraft away from their home base overnight, avoiding the need to keep pilots in hotel accommodation and pay for other expenses (transport to the airport, meals etc), which are significant costs for classic carriers.

3.44 As LCC aircraft achieve much better turnaround times, pilots can operate more flights during the same working hours, and as load factors are higher, the costs of the pilots are distributed between more passengers.

Cabin crew

3.45 The LCCs have shown that there are people willing to work as cabin crew on much lower wages than historically paid by the classic carriers. In addition, the number of cabin crew can be reduced as there is no business class service, and (as for pilots) the fact that aircraft are used more intensively and are not based away overnight reduces per-flight cabin crew costs. LCC cabin crew are also required to undertake more duties, including cleaning the aircraft between flights.

En-route ANS (navigation charges)

3.46 These are set by the national air navigation service providers (ANSPs) and collected through EUROCONTROL; therefore, they do not vary between carriers. However, as these are related to the maximum takeoff weight of the aircraft rather than the number of passengers, the LCCs reduce the charges per passenger by carrying more passengers in aircraft of the same size.

Airport charges

3.47 Airport charges are the most significant individual category of cost for LCCs. Some LCCs, including Ryanair and Wizzair, reduce airport charges by using secondary or tertiary airports, such as Charleroi or Beauvais, where airport charges may be 70-90% lower. Others, including easyJet and Air Berlin, use major airports, but still avoid the most expensive airports such as London Heathrow. Other than use of secondary airports, LCCs airport charges may be reduced by:

- **Use of different facilities:** By using remote aircraft stands and less well located check-in desks, and in some cases secondary terminals, LCCs may be able to agree lower charges, whilst still being cost-reflective.
- **Negotiating power:** LCCs may use their negotiating power to agree discounted charges. This is most significant at the very small airports used by Ryanair, but some discount can often still be obtained at medium sized airports. Even at major airports, discounts are often given for new direct routes – and many LCC services are new.
- **Per-aircraft charges:** Some airport charges, such as Passenger Service Charge,

are per passenger, but others (including landing charges and terminal ANS charges) are per aircraft, and therefore the higher load factors achieved by the LCCs reduce per-passenger charges.

3.48 At many other airports, classic carriers complain that they are forced to cross-subsidise the facilities used by the LCCs, although it is impossible to determine the extent to which this occurs. In most cases, LCCs cannot obtain discounts at large congested airports unless they use secondary facilities; for example, we would not expect that easyJet pays significantly lower charges for its base at London Gatwick than other airlines using Gatwick pay. However, discounts can more often be achieved at airports where there is substantial spare capacity, such as Berlin Schonefeld. In one case (Paris CDG), the LCCs are required to use low-cost secondary facilities in terminal 3 but also to pay higher total charges than the classic carriers (as they are required to pay to take their passengers by bus to the aircraft, and do not receive discounts for transit passengers). However, this situation is unusual – probably unique.

Handling charges

3.49 Ground handling charges tend not to vary as much between carriers, although LCCs may have lower service level agreements and use new entrant ground handling operators, enabling them to reduce costs. Recently, several LCCs have increased the weight limits for hand baggage, reducing the requirements for hold baggage, and therefore reducing ground handling costs.

Passenger service costs

3.50 Some classic carriers provide on-board catering; these costs are avoided by most LCCs which usually treat catering as a profit centre. However, it should be noted that this does not apply to all LCCs or all classic carriers: Air Berlin, an LCC, provides on-board catering, whilst several classic carriers including Iberia, SAS and Aer Lingus, do not.

Advertising costs

3.51 Although per passenger advertising costs are lower for the LCCs, advertising represents a higher proportion of costs for the LCCs than for the classic carriers. LCCs undertake substantial advertising activity, but often use lower cost mediums, generally avoiding television advertising. There is also some evidence that advertising focused almost entirely on price, such as that undertaken by the LCCs, is more effective than traditional advertising – further enabling per passenger advertising costs to be reduced.[5]

Sales / reservation costs and commission

3.52 easyJet and Ryanair take more than 95% of their bookings through their websites. Although some classic carriers also take 50% or more, this varies by market: in some Member States, including Italy and Spain, a substantial proportion of classic carrier

[5] Source: Operator interviews

bookings are made through travel agents. Direct bookings via the website or via the airlines' call centres enables them to avoid paying either travel agent commissions or fees to the Global Distribution Systems.

Station costs

3.53 Classic airlines often maintain a network of offices in the destinations that they operate to, often in expensive city centre locations, although the number of these offices is generally being reduced. LCCs often have no staff at all at the destinations they serve – in some cases not even at the airport.

Overheads

3.54 As start-up companies, LCCs generally have much lower overheads and administrative costs. There are a number of ways that this is achieved, including more basic administrative offices in lower cost locations, and automation of key functions such as yield management, which still require substantial staffing levels at classic carriers.

Operating cost trends

3.55 The recent trend has been that air travel has become cheaper relative to rail transport. In principle, this might be reversed, due to:

- Significant investment in airport infrastructure being required in some countries;
- Airlines being required to contribute more towards the environmental costs they cause (for example, through an aviation fuel tax);
- Aircraft fuel costs continuing to increase;
- The rate of technological improvement slowing down, and there is less room for aircraft to become more fuel efficient.

3.56 However, there are two key factors which offset this:

- Airlines are under permanent competitive pressure to cut their costs. The least efficient may go out of business, or at least, their expansion should be slower than that of the more efficient carriers.
- It is very difficult for rail operators to cut costs, as infrastructure and rolling stock typically account for 60-75% of total operating costs, and these are outside the direct control of the operator. Staff accounts for much of the remainder, but railways have historically experienced difficulties in making reductions in staff costs.

3.57 This section explains our analysis of future trends in airline and rail operating costs.

Airline operating costs

3.58 This section explains the trend we project in airline operating costs. We focus on low cost airlines because they have pioneered most cost reduction strategies in the aviation sector; other airlines have followed their lead. The key trend expected in the operating costs of the classic airlines is that they will copy parts of the business model of low cost carriers in order to remain competitive; however, there are limits on the extent to which they can do this, however, because of constraints imposed by the need to have high frequency operations to major airports in order to provide 'feeder' traffic for long haul flights. Our analysis of classic airlines focuses on the extent to which they will be able to copy the low cost airlines.

3.59 The low cost airline business model allows significant cost savings relative to classic airlines, for the reasons discussed above. In principle, a switch to this business model should lead to a large cost reduction, but this should be largely one-off. For example, it is not practical to reduce seat pitch by more than low cost airlines have done, and most consider that, even with the best yield management systems, it is not possible to increase average load factors beyond 90%, as there are inevitably some flights that are difficult to fill even if the fare was zero (for example, midweek winter flights). However, despite this, low cost airlines are continuing to make significant cost savings:

- in December 2005, Ryanair announced that it expected to make a 4% annual reduction in nominal non-fuel per-seat costs (implying a 6% reduction in real non-fuel per-seat costs)
- in May 2006, easyJet announced a 6% annual reduction in nominal non-fuel per-seat costs

3.60 Part of these cost reductions have been obtained from opening new routes to destinations where airport charges are lower, and therefore the figures do not necessarily imply that comparable costs are falling at the same rate. However, this can only account for a proportion of the reduction. Significant cost reductions were also obtained by:

- Lower maintenance costs: easyJet has recently signed a new maintenance contract which will lead to substantial unit cost reductions
- Reductions in airport handling costs by moving to internet check-in and (in the case of Ryanair and a smaller low cost carrier Flybe) discouraging passengers from carrying hold baggage by introducing separate charges
- Savings in sales and administration costs as more functions, such as changing flights, are undertaken via the internet
- Reductions in insurance costs: insurance charges paid by airlines (and to a lesser extent other transport operators) increased substantially prior to 9/11 but are now falling.

3.61 In addition, although airlines often voice objections that other costs that they do not directly control are increasing, particularly airport charges and navigation charges, in practice these are rarely increasing by more than inflation, and usually they are increasing by less:

- Average unit rates for en-route charges in the western EU states have increased by only 0.2% per year since 1997 – approximately 2% less than inflation. In large part this is due to economies of scale (charges temporarily increased during the downturn after 9/11)
- Of the major European airports where increases in airport charges are planned in advance and published, only the charges at the Paris airports and London Heathrow are planned to increase by more than inflation in the next few years.

3.62 The main cost that has increased is fuel, which accounted for around 15%[6] of low cost airline operating costs on medium length routes in 2005 (the year for which our model is calibrated) and has increased further since, in part because hedging arrangements agreed earlier at lower prices have now run out. Futures markets indicate that it is expected that fuel prices will remain high and the airlines with which we consulted also expected fuel prices to remain at current levels at least in the short term. Rapid growth in demand, particularly from India, China and other emerging economies, is expected to support high oil prices for the foreseeable future. Unlike for other modes of transport, there is currently no alternative fuel available.

3.63 However, in the long term, there are constraints on the extent to which air ticket prices can reasonably be expected to rise as a result of fuel costs, for three reasons:

- Alternative sources of oil, such as Canadian tar sands, will become an economically viable alternative to existing oil producing countries, if prices remain at current levels.
- For some uses of oil, alternative fuels such as corn-based ethanol will also become economically viable if prices remain high. Although these are not suitable for aviation, they will mitigate demand for oil for other purposes and limit price increases.
- In the longer term, there will be greater incentive for airlines to purchase more fuel efficient aircraft, although this will be partly offset by higher capital costs.

3.64 The table below sets out our assumptions for the future development of airline costs. We project that the airlines will make annual savings on many cost items and in a few areas will be able to make substantial one-off savings: for example, many airlines are currently making large one-off savings by moving towards internet check-in. Classic airlines will make a number of large one-off savings by copying elements of the low cost airline business model in order to remain competitive.

[6] The exact proportion varies between carriers due to different degrees of hedging and for different types of airline – it would be higher for Ryanair, as their other costs are lower.

TABLE 3.3 TREND IN AIRLINE COSTS

Cost item	Low cost airlines: Annual change (%)	Low cost airlines: One-off change (%)	Classic airlines: Annual change (%)	Classic airlines: One-off change (%)	Explanation / notes
Aircraft costs	-2%	-	-2%	-	Savings on aircraft costs due to technological change key factor which has driven cost savings, expected to continue to do so
Maintenance	-3%	-	-3%	-	Significant productivity gains implied by recent long term contracts signed by major airlines
Flight crew	-0.5%	-	-1%	-	Limited potential to make savings but costs are still rising by less than inflation due to productivity gains. Classic airline costs will move towards low cost airline costs.
Cabin crew	-0.5%	-	-2%	-	
En route ANS charges	-2%	-	-2%	-	Costs have increased by 2% less than inflation since mid 1990s, assumed to continue
Airport charges	0%	-	0%	-	Assumed to remain unchanged
Handling charges	+1%	-25%	+1%	-25%	One-off saving due to move to internet check-in. Ground handling is labour intensive and potential productivity gains probably already made, so will increase above inflation
Passenger services	0%	-	0%	-	No change expected (already zero for many carriers)
Aircraft fuel and oil	-0.5%	-	-0.5%	-	Slight decline as new aircraft are more fuel efficient. No change in fuel prices.
Sales and reservations	0%	-	0%	-75%	One-off saving by classic airlines as they follow low cost airlines and move towards internet bookings
Advertising	-2%	-	-2%	-50%	Classic airline switch to internet advertising, following low cost airlines
General	-2%	-	-2%	-25%	Economies of scale; classic airlines close gap with low costs
Station costs	0%	-	0%	-100%	Classic airlines eliminate these costs
Commission	N/A	N/A	0%	-100%	All travel agent commissions to be eliminated

3.65 In addition to these changes in operating costs, which should apply on all routes, the classic airlines should be able to make two significant changes to their business practices which will bring their costs per passenger closer to those of the low cost airlines, the proportionate impact of which will vary by route:

- **Load factors:** By improved yield management, load factors should come closer to those of the low cost airlines, which are typically around 85% compared to 55-70% on classic airlines on European domestic routes. We assume that classic airlines should be able to achieve 75%, less than low cost airlines, but reflecting the fact that they need to run high frequency services in order to 'feed' their hubs.
- **Aircraft utilisation:** There is no reason why classic airlines should not achieve the same turnaround times that major low cost airlines do when they use the same airport, by following similar strategies (for example, requiring cabin crew to clean the aircraft). This should enable them to achieve significantly better aircraft utilisation and thereby reduce per-flight costs.

3.66 These changes will result in even greater reductions in per-passenger costs, without any major changes to underlying unit costs. The overall reductions in costs are likely to be greater on the routes where airport charges form a smaller part of the operating costs of the airlines. Table 3.4 shows the changes in airline costs that we project may be possible based on the aggregate effects of the cost changes set out in Table 3.3 above.

TABLE 3.4 PROJECTED CHANGE IN AIRLINE COSTS

	5 years		10 years	
	Low cost airlines	Classic airlines	Low cost airlines	Classic airlines
London-Edinburgh	-7%	-17%	-10%	-25%
Madrid-Seville	-8%	-17%	-12%	-27%
Madrid-Barcelona	-8%	-17%	-12%	-27%
Paris-Marseille	-7%	-20%	-10%	-28%
London-Paris	-6%	-17%	-9%	-24%
Rome-Milan	-8%	-23%	-12%	-32%
Frankfurt-Cologne	-6%	-17%	-9%	-24%
London-Manchester	-6%	-17%	-9%	-24%

3.67 Cost reductions by classic airlines are expected to bring their costs closer to the low cost airlines. As a result, we project that the difference in costs per passenger between classic and low cost airline operating costs may decline, from around 50% now to 40% within 5 years and 35% within 10 years.

3.68 It is important to emphasise that airlines, acting in response to very strong competitive pressures on many routes, have consistently achieved significant cost reductions, many of which have been secured through tactics which could not have been predicted 5-10 years ago. If this trend continues, there is a significant possibility that the cost reductions that airlines achieve will be greater than those described here.

Rail operating costs

3.69 Unfortunately, none of the rail operators were willing to talk about future cost trends in any detail. Combined with the difficulty of obtaining any underlying cost data, this limits the cost analysis that it is possible to undertake.

3.70 Generally, rail operating costs were viewed as being difficult to reduce. This is because the three biggest cost categories are infrastructure, rolling stock and staff, and it is difficult to reduce any of these.

3.71 Typically, rail infrastructure accounts for around half of total operating costs (subsidies to infrastructure managers mean that these account for 20-40% of operator costs). Infrastructure costs are not within the direct control of the rail operator and the infrastructure managers are viewed by some rail operators as not having a direct incentive to reduce costs. It is notable that in the aviation sector as well, the unit cost of providing fixed infrastructure (airports and air traffic control) has not fallen at the same rate as other costs, or in some cases at all; however, this has a bigger impact in the rail sector, as infrastructure costs are a much higher proportion of total costs for rail operators than for airlines.

3.72 Rolling stock costs have also proved difficult to reduce. Rail operators often buy rolling stock in small numbers: for example, RENFE has bought 16 dedicated trains for the Madrid-Barcelona service. Non-standard rolling stock increases unit costs because the costs of design and setting up production lines are recovered over a small number of vehicles. In contrast an A320/B737 is basically identical whoever buys it. One rail operator criticised rolling stock manufacturers for not trying to reduce costs in the same way as Boeing/Airbus have sought to do. In part, this may be due to a lack of real competition. For example, it appears highly unlikely that SNCF would buy high speed trains from anyone other than Alstom, manufacturer of the TGV, and therefore there is little incentive to reduce production costs. Ryanair suggested that if they bought trains, they would negotiate a price half that which a rail operator would.

3.73 Some airlines have been able to improve staff utilisation, reduce headcount, and cut wages for certain staff (especially cabin crew). Rail operators generally have not, even privatised operators in the UK with a strong commercial incentive to do so. At least in part, this has been due to the fact that the rail sector is unusually – perhaps uniquely – susceptible to strikes; a relatively small number of workers (drivers or signallers) are able to stop any operations. For example, between 2000 and 2003 (the most recent years for which data is available), SNCF accounted for 25% of the all of the working days lost in France due to strikes[7]. Although airlines are also susceptible to strikes by pilots and cabin crew, as they operate in a more competitive market, a strike often just leads to passengers transferring to another carrier.

3.74 Some general productivity savings should be expected from rail operators. However, as wages and other staff-related costs are likely to rise by more than inflation, we do not assume any net reduction in rail operating costs, except in the following three areas:

- Load factors: By increasing load factors through improved yield management, it should be possible for rail operators to reduce per-passenger costs significantly.

[7] Source: French Ministry of Labour, Department of Statistics; Inspection générale du travail des transports

This is the most significant potential cost saving and is discussed in more detail below.

- Ticket sales: Airlines have eliminated most of these costs, which are typically in the range of €3-5 per passenger, by switching to internet sales and e-tickets. Some rail operators are beginning to follow and we expect that more might do so in the future.
- Marketing and advertising: Airlines have also reduced these costs by switching to internet advertising and using advertising which focuses on price above anything else. This has been shown to be much more effective in transport advertising. In principle we could expect rail operators to follow.

3.75 In addition, innovations such as ERTMS may reduce costs for some rail services in the long term. This could also improve line capacities. However, the benefits from this are not clear as yet and therefore we do not include them.

3.76 The view that costs are likely to be difficult to reduce significantly in the medium term is supported by details published from recent UK rail franchise bids. Although the information published about these by the UK government is limited to the subsidy profile required by the operator, by using sensible assumptions about revenue and profit margins, it is possible to infer the approximate level of costs projected by the operator. Our analysis of recent bids shows that bidders expect costs to increase at close to the rate of inflation. As the number of journeys typically increases by 2-3% per year, the projected cost per journey does decline. This is generally through increases in load factors rather than any additional trains being operated.

3.77 However, rail load factors are much lower than airline factors. There are some reasons why this is unavoidable (for example, a train that stops at several stations en route cannot maintain a high load factor unless demand is evenly balanced along the line – which it rarely is). Despite this, we suggest that there is significant potential for rail operators to increase load factors on some routes, which should enable railways to achieve reductions in costs per passenger. We would expect that this could be achieved through improvements in yield management, which would allow the railways to handle more passengers with little or no increase in the number of seats provided. RENFE currently undertakes no yield management, and Trenitalia and Deutsche Bahn’s yield management systems are very limited; no rail operator yet has a yield management system that is comparable to airline best practice, although SNCF’s yield management on domestic TGV services comes closest.

3.78 Table 3.5 compares load factors on each of the routes that we studied and illustrates the increases in load factor that we estimate may be achievable within the medium term.

TABLE 3.5 PROJECTED CHANGE IN RAIL LOAD FACTORS

	Load factors		Explanation/notes
	2005	5-10 years	
London-Edinburgh	40%	50%	Load factor limited by large number of stops – trains often full on departure from London but largely empty on arrival in Edinburgh
Madrid-Seville	61%	70%	Fairly high load factor should be achievable as only one stop (Córdoba)
Madrid-Barcelona	61%	75%	Load factor equivalent to airlines should be achievable as most trains likely to run nonstop or with only one stop when HSL complete
Paris-Marseille	70%*	75%	Load factor equivalent to airlines should be achievable as most trains run nonstop
London-Paris	65%	75%	Load factor equivalent to airlines should be achievable as most trains run nonstop
Rome-Milan	54%	65%	Load factor limited by major intermediate stops (Bologna and Florence)
Frankfurt-Cologne	50%	60%	Load factors limited by high-frequency turn-up-and-go network service
London-Manchester	30%	60%	Load factors currently unrepresentative due to large recent capacity expansion

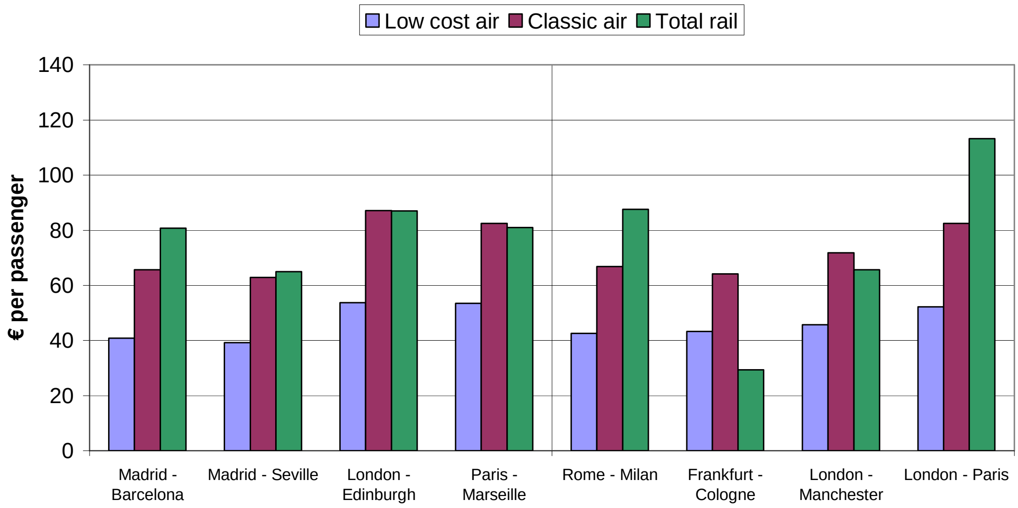
* Estimate – no data available

3.79 In addition, the costs of operating the London-Paris Eurostar service will increase from the time of completion of the Channel Tunnel Rail Link (CTRL) in 2007, as the infrastructure charges that will have to be paid will be even higher. Exact figures are not available for this, but based on the infrastructure charges paid currently paid and the relative costs of construction of CTRL phases one and two, we assume that the infrastructure charges paid to CTRL will double.

Conclusions: Future air and rail operating costs

3.80 Figure 3.12 compares our projection of air and rail operating costs in 2016. The rail operators may be able to achieve significant reductions in operating costs per passenger, as a result of improved load factors and switching ticket sales and marketing to the internet. However, the classic airlines are likely to achieve greater reductions in operating costs, in part due to the competitive pressure to bring their costs into line with the low cost carriers.

FIGURE 3.12 OPERATING COSTS PER PASSENGER (2016)



3.81 We project that, in 2016, operating costs per passenger will be higher for rail than classic airlines on three of the routes, approximately equivalent on three, and lower on two. Low cost airline operating costs will be below rail operating costs on all routes apart from Frankfurt-Cologne.

3.82 These results should be of concern to rail operators. However, the conclusions are consistent with the trend in rail and air operating costs since the early 1990s. Relatively recently, it was cheaper (although slower) to make relatively long trans-European journeys, such as Paris-Berlin or Amsterdam-Munich, by rail rather than air. Rail fares now often exceed air fares for these types of journeys. In the UK and Germany, the same has occurred in the last 2-5 years on shorter domestic routes, as a result of the entry of low cost airlines. These trends have occurred even though rail transport is subsidised and air transport usually is not.

3.83 These results are also consistent with the trend shown in Figure 3.10 above, which showed that the threshold beyond which the costs of air transport are lower than the costs of rail transport has declined from around 600km to potentially around 250km where low cost airlines have entered the market; this may fall further in the future.

4. THE MARKET SHARE MODEL

Purpose of the model

4.1 The ultimate objective of the model is to be able to test scenarios for the development of short haul transport over the next 10 years. This includes both external factors, such as trends in airline operating costs; and policy options, such as investment in new airport capacity. This section outlines the model that we have produced.

Approach

4.2 The model itself is relatively simple, but as there are a large number of different factors which influence market share on different routes, the key task was to calibrate it. The model uses four main types of input, discussed in more detail below:

- **Schedule related factors:** These include journey time, check-in time, time required to leave the rail station or airport, and frequency.
- **Price:** We have estimated average one-way ticket price for each mode on each route, based on a large sample of fares collected from the operators.
- **Access time and cost:** The average time required to access the terminals and the cost of journeys to/from the terminals.
- **Other factors:** We have also taken into account other factors such as reliability, service quality and connections to airports.

4.3 Schedule related factors are very important, accounting for most of the variation in demand between routes. However, as discussed in section 2 above, on their own these are not enough to predict market share – this varies significantly on routes with similar levels of rail and air scheduled service quality. For this reason, we have also taken into account price, access time and cost, and other factors.

4.4 We use a logit model to predict passengers' choices between air and rail transport. We have calibrated the model using data for each of the routes obtained through the case studies. Logit models assume that travel always incurs negative utility, mostly in terms of time and cost – passengers would rather not make the journey, but the positive benefit from doing so (for example, attending a business meeting) offsets the disutility of the journey. Passengers have to pay for their tickets and spend a considerable amount of time travelling; they could do other things with their income or with their time. The model works by calculating the relative disutility of travel on each mode. This is a weighted sum of each of the factors identified above.

4.5 The logit model that we have developed does not separately identify low cost and classic airlines. We considered whether to do this, but concluded that we should not, because as discussed above the boundaries between these types of carriers are breaking down. On most of the routes we studied, there is little fundamental difference between the services offered by the different types of airline. Therefore, it is not useful to distinguish between different types of airlines when modelling market share.

Key inputs

Schedule related factors

4.6 The main schedule related factor is the timetabled journey time. The current journey times for rail and air on each route are shown in the table below.

TABLE 4.1 JOURNEY TIME BY MODE AND ROUTE (HOURS)

Route	Rail	Air
Frankfurt - Cologne	1:10	0:45
London - Edinburgh	4:30	1:25
London - Manchester	2:20	0:55
London - Paris	2:40	1:15
Madrid - Barcelona	4:50	1:10
Madrid - Seville	2:30	1:10
Milan - Rome	4:30	1:15
Paris - Marseille	3:10	1:20

4.7 In addition, we add two factors to timetabled journey time in order to calculate the total effective journey time of each mode (often referred to in transport modelling as the *generalised journey time*):

- Check-in time; and
- Frequency.

4.8 Airlines require passengers to check-in in advance; rail operators generally do not. Check-in time and an allowance for time to exit the airport are included in our estimates of the total journey time on each route. The current check-in times for rail and air on each route (including an allowance for time to exit the terminal) are shown in the table below. The time for the London-Paris route is considerably longer than for other routes because it is necessary for passengers to pass through customs and immigration on leaving the terminal, and because the main airports used (CDG and Heathrow) are unusually big and require unusually long walks.

TABLE 4.2 CHECK-IN AND TERMINAL EXIT TIME BY MODE AND ROUTE (MINUTES)

Route	Rail	Air
Frankfurt - Cologne	0	45
London - Edinburgh	0	45
London - Manchester	0	45
London - Paris	30	75
Madrid - Barcelona	5	30
Madrid - Seville	5	45
Milan - Rome	0	45
Paris - Marseille	0	50

4.9 We also include a frequency penalty for each mode on each route. The point of the frequency penalty is to enable us to take into account that a low service frequency makes a mode relatively unattractive even if the journey time is faster, and vice versa. The frequency penalty is not directly proportional to the time gap between services, but uses an inverse power rule – so the impact on market share of an improvement from a frequency of one train every 60 minutes to one every 30 is greater than the impact on an improvement from once every 120 minutes to once every 90.

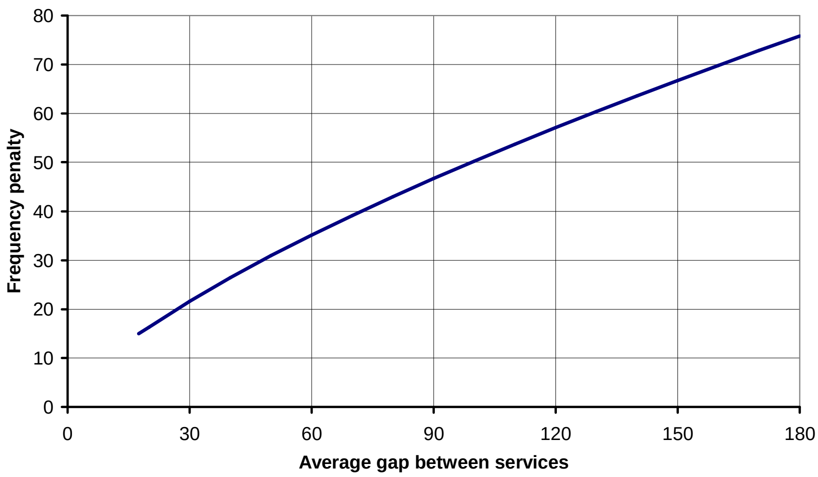
4.10 We calculate frequency penalties, measured in minutes, using the following formula, which we calibrated using the data available and which is also in line with formulae used for frequency penalties in other transport models:

frequency penalty = c * (average minutes between services)$^{0.7}$

where c is a constant which we have calibrated.

4.11 The frequency penalty translates differences in frequency into differences in journey time. In effect, the frequency penalty we have calculated implies that, if the frequency of a service increases from every 2 hours to every 1 hour, this has the same impact on market share as an improvement in journey time of 20-25 minutes. The frequency penalties we have used are shown on Figure 4.1 below.

FIGURE 4.1 FREQUENCY PENALTY (MINUTES)



4.12 The current frequency penalties for each route, and the number of services per day, are shown in Table 4.3 below. We have applied a minimum frequency penalty of 15 minutes on all routes because, where frequency is very high, it is usually divided between several airlines; passengers perceptions of frequency are based primarily on that offered by the airline with which they have a ticket.

TABLE 4.3 BASE YEAR FREQUENCY PENALTIES, BY ROUTE

Route	Rail		Air	
	Trains per day	Frequency penalty (minutes)	Flights per day	Frequency penalty (minutes)
Frankfurt - Cologne	32	20	4	108
London - Edinburgh	19	29	79	15
London - Manchester	33	20	40	17
London - Paris	15	35	54	15
Madrid - Barcelona	7	59	64	15
Madrid - Seville	22	26	7	59
Milan - Rome	20	28	36	18
Paris - Marseille	24	25	26	23

4.13 The generalised journey time is then translated into a cost, using an appropriate value of time. There is no common value of time used for use in European appraisals, reflecting the fact that the characteristics of passengers vary significantly between routes. We have used values of €59/hour for business passengers and €7/hour for leisure passengers, reflecting typical values used in other appraisals. In most cases, we do not have data for the proportion of business and leisure passengers on each route, so this is weighted on each route as follows:

- On most of these routes, we assume 50% of passengers are travelling on business. This is relatively high compared to other air and rail routes but reflects the fact that many of these routes are quite short and therefore many leisure passengers, particularly those travelling with families or in groups, would travel by car. Where we do have figures for the proportion of passengers travelling on business, they are consistent with this assumption.
- On the London-Paris route, car does not represent a realistic alternative due to the time and cost involved in crossing the Channel, and therefore we assume that 67% of passengers are travelling for leisure purposes.

4.14 The values of time we have used are relatively high compared to those used, for example, in appraisals of other European high speed rail projects. However, this is consistent with the high proportion of business travellers on these routes. It is also consistent with the data that we have obtained: the market share model does not calibrate well if a lower value of time is used.

Price

4.15 As explained in section 3 above, we have collected a large number of prices for each operator on each route. We have weighted these by the share of frequencies provided by each operator in order to estimate current average prices on each route by air and rail. This is shown in Table 4.4 below.

TABLE 4.4 AIR AND RAIL FARES BY DIRECTION

Route	Rail (€)	Air (€)
Frankfurt - Cologne	42	72
London - Edinburgh	66	88
London - Manchester	19	84
London - Paris	90	96
Madrid - Barcelona	55	97
Madrid - Seville	58	100
Milan - Rome	46	104
Paris - Marseille	63	108

4.16 It should be noted that as most of the operators apply yield management systems, their prices vary considerably, and because there is often more than one airline and prices vary between them, the average price for each mode is a rather nebulous concept. The prices quoted above do not necessarily reflect the prices that are actually offered to the types of passenger who would be choosing between air and rail travel. For example, if there are four airlines operating on a route and three offer prices higher than rail but one offers a price that is lower, the *average* price of air travel is probably higher than rail travel, but the passenger looking for the *cheapest* price would still travel by air. In order to reflect this, we have introduced a separate variable for the variability and competitiveness of prices (discussed below).

Access times and costs

4.17 The time and cost involved in accessing terminals is a key factor in determining market share. In general, the time and cost involved in accessing rail stations are less than those in accessing airports, because rail stations tend to be in the city centres. However, there is some variation between routes:

- On routes from London where air services are available from all five airports, access can be as good as a rail service from the city centre, because many passengers travel to/from the suburbs or surrounding towns.
- On routes from Paris for which the only air service, or at least the main one, is from CDG, air is particularly unattractive. This is because CDG airport is some way from the city, and as Paris is a relatively concentrated city, a high proportion of passengers do wish to travel to/from the city centre (more so than in London).

4.18 The information that we have for access times and costs varies between routes, depending on the characteristics of the services available. The averages depend on the mix of passenger origin/destinations (for example the proportion that travel to the city centre) and the different modes they use to get to the airport. We have therefore estimated these based on the material collected for the case studies. As a default, we have used a rail access time of 30 minutes and an airport access time of 45 minutes, with higher or lower values on particular routes reflecting individual characteristics.

TABLE 4.5 ACCESS TIME AND COSTS

Route	Rail		Air	
	Access time (minutes)	Access cost (€)	Access time (minutes)	Access cost (€)
Frankfurt - Cologne	30	5	45	10
London - Edinburgh	40	10	45	20
London - Manchester	25	10	55	20
London - Paris	30	10	75	35
Madrid - Barcelona	30	5	30	10
Madrid - Seville	30	5	45	10
Milan - Rome	30	10	30	10
Paris - Marseille	30	10	45	15

4.19 In accordance with other transport models, we have weighted access time by a factor of 2 when calculating its impact on market share. This reflects evidence that passengers tend to prefer a short access time even at the cost of a longer in-vehicle time.

Other factors

4.20 The inputs to the model discussed above are either absolute numbers, such as the journey time or check-in time, or are estimates of average numbers obtained from sampling, such as fares. However, other factors are important as well, such as reliability and punctuality. These often cannot be quantified in the same way, because:

- There is no data available: For example, we had no route-specific data on punctuality or reliability for certain routes.
- The structure of the data varies between routes/operators: For example, on some routes punctuality data collected is on the basis of proportion of trains that are less than 5 minutes late, on other routes less than 15 minutes late. These figures cannot be compared directly and a degree of judgement must be used.

4.21 In these cases, it is necessary to use judgement to interpret the limited or inconsistent data that are available. We therefore developed a series of metrics on which scores were assigned for each route:

- Price variability: As discussed above, a key input is the average price of each mode, but this is not necessarily the price that will determine market share. This score reflects the likelihood of passengers purchasing a ticket at a price that is lower than the average.
- Reliability, reflecting the proportion of trains/flights that actually run, and punctuality, reflecting the proportion of those that do run that arrive at their destination on time.
- Airport links: Reflecting whether there is a direct link to other air services, for passengers that wish to make connections, and if there is, how integrated this is.

- Service quality: Reflecting whether there is a premium class service and the quality of this, the catering facilities available, and the quality of standard class premium and terminal facilities

4.22 Having developed scores for each route, we finalised the calibration of the model using different values for these metrics. The scores that we used are shown in Table 4.6 below.

TABLE 4.6 "OTHER FACTORS" SCORES (10 IS BEST)

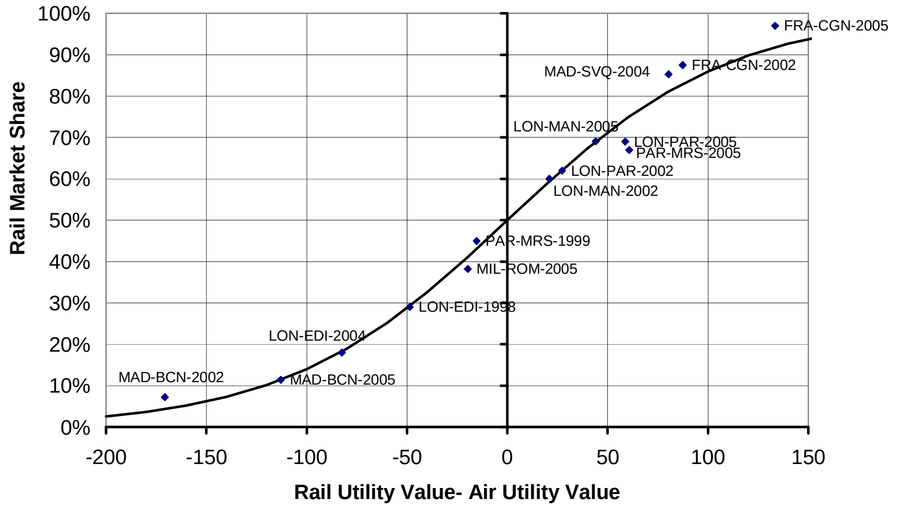
Route	Reliability		Airport links		Price variability		Service quality	
	Rail	Air	Rail	Air	Rail	Air	Rail	Air
Frankfurt - Cologne	9	8	6	10	7	9	6	5
London - Edinburgh	2	5	0	10	5	10	7	5
London - Manchester	2	5	0	10	5	9	6	4
London – Paris	8	2	0	10	6	9	9	4
Madrid - Barcelona	8	6	0	10	0	6	8	5
Madrid – Seville	10	6	0	10	0	5	9	5
Milan – Rome	9	6	0	10	7	7	7	4
Paris - Marseille	6	5	2	10	5	5	7	3

4.23 On most routes, the application of these scores tends to improve the relative performance of air relative to rail transport, largely because air is preferable for passengers connecting on to other flights, and because (on many routes) there are several airlines but only one rail operator, so it is more likely for passengers to possible to obtain a lower ticket price on at least one of the airlines. However, this is not always the case: on the Madrid-Seville and London-Paris routes, the advantages of air travel, in terms of offering better connections, appear to be offset by the relatively high service quality and reliability of the rail services.

Results

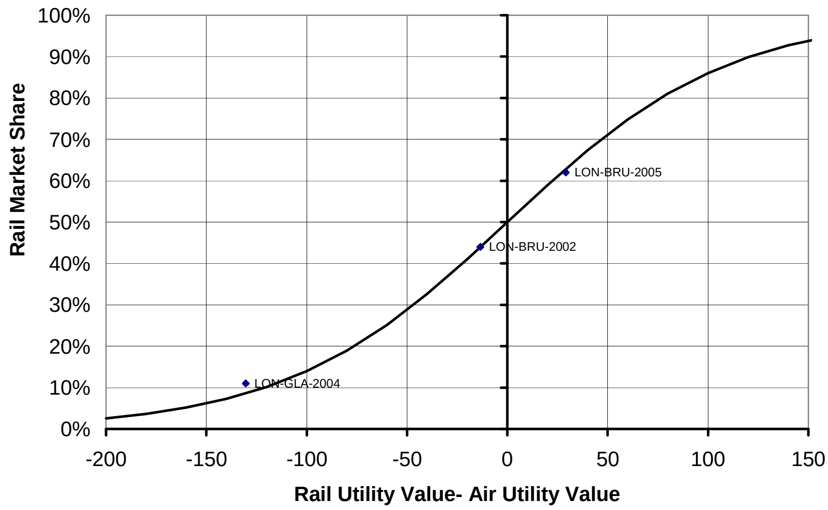
4.24 The model calibrates well. The results of the model, and the logit curve with the best fit, are shown in Figure 4.2 below, which shows the market share of air/rail services against the relative utility of travel by each mode. As explained above, the utility value represents the true cost of travel faced by the average passenger by a particular mode on a particular route. It is a weighted average of generalised journey time (converted into a monetary cost using value of time assumptions), fares, access costs, and quality factor scores.

FIGURE 4.2 MARKET SHARE MODEL: RESULTS



4.25 In order to validate the model, we have added points for routes other than the case study routes but for which we had data: London-Brussels both before and after the opening of the Channel Tunnel Rail Link, and London-Glasgow. These routes, as shown in Figure 4.3 below, validate well.

FIGURE 4.3 MARKET SHARE MODEL: VALIDATION



Emerging issues

4.26 Logit models are by definition symmetric – meaning that if the model projects a rail share of 20% for a relative utility of +*n*, it will project a rail share of 80% for a relative utility of –*n*. However, the market share curve implied by the case studies is not entirely symmetric, and as a result, the model slightly under-predicts rail market share on routes where the service is either very good or very poor relative to air. This reflects the relative positions of the modes of transport on these routes:

- On the routes in our sample where rail is very good relative to air, even taking into account factors such as access to airports, there is little reason for anyone to travel by air – rail is faster and the fares are lower.
- On the routes in our sample where rail is very poor relative to air, there is a large journey time difference between rail and air, but rail fares are still lower on average. Therefore, some passengers who are quite price-sensitive but not very time-sensitive would still travel by rail. On these routes, low cost airlines could have a substantial effect, because there would no longer be a reason for anybody to travel by rail if air was price competitive.

4.27 In principle, there are a number of ways in which these extreme cases could be addressed. For example, the fit could be improved by the use of separate logit curves for business and leisure passengers. However, we do not have enough data to do this –in addition to knowing the proportion of business and leisure passengers accurately, it would be necessary to divide all inputs between business and leisure passengers. Another alternative would be to use a different type of curve that was not constrained to be symmetric.

4.28 To avoid any variation between actual and modelled market share impacting on the scenario projections, we apply the model **incrementally** rather than in absolute terms; changes are calculated relative to the current actual level not the modelled level. This means that, if the rail market share on a particular route is currently higher or lower than is implied by the logit curve, therefore the model will continue to project rail share that is higher or lower than the logit curve would indicate.

5. MARKET SHARE IN 2011 AND 2016

Introduction

5.1 This section sets out our base case projection of market share on each route in 2011 and 2016. The base case scenario reflects the changes in key factors, influencing market share, that we expect to happen in any event. For example, market share on some of the routes will be affected by the opening of new high speed rail routes and/or additional airport infrastructure that is currently under construction. The scenarios that are discussed in section 6 below are all modelled relative to this base case scenario.

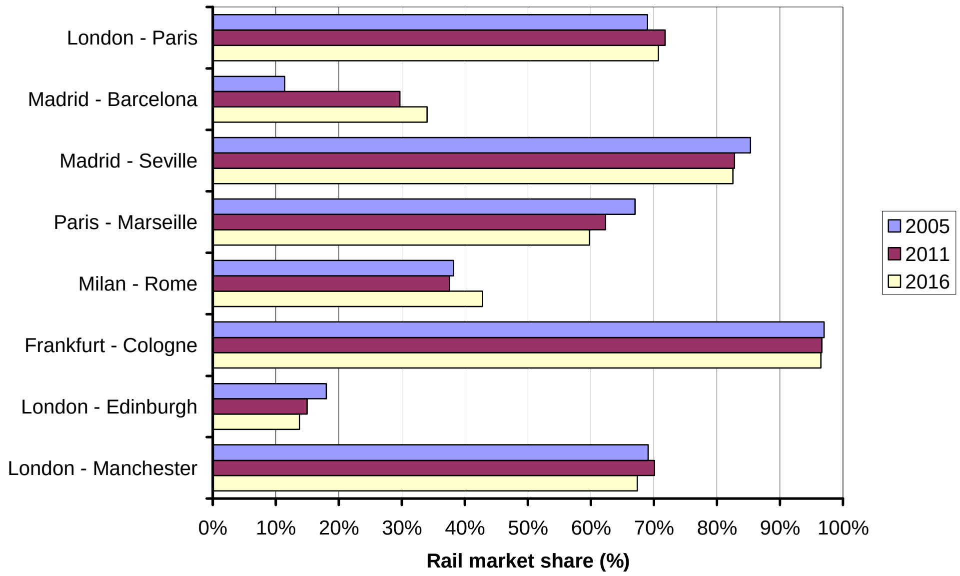
5.2 In order to project future trends on each route, we have estimated changes in market demand. It should be emphasised that these trends are indicative: it is not the purpose of this study to produce precise demand forecasts for the case study routes. Where we have data on the trend in total market demand in recent years, we have assumed that this trend continues; on other routes, we assume that demand increases in line with GDP.

5.3 On most of the routes we project changes in air fares consistent with the results of the operating cost analysis, but we assume that a proportion of any operating cost saving is retained by the airline as an increased margin (as several European network carriers are loss-making or only marginally profitable at current price levels). On some routes, we project greater changes in fares, due to expected expansion of low cost carriers; this is explained in the text. Although there are some opportunities for rail operating cost reductions, generally we assume that any that are achieved result in lower subsidies rather than lower fares, except when there are route-specific reasons to expect that rail fares might be reduced.

Summary of results

5.4 Figure 5.1 shows our base case projections for rail market share in 2011 and 2016. By 2016, we project that rail market share will have increased on three of these routes, declined on four, and remained unchanged on one.

FIGURE 5.1 RAIL MARKET SHARE PROJECTIONS, BASE CASE



5.5 The remainder of this section describes the base case scenario for each route in more detail.

London-Paris

Assumptions

5.6 The main change expected on this route is the opening of phase 2 of the Channel Tunnel Rail Link in late 2007, which will reduce rail journey times by 20 minutes, and will also improve station access times, as the stations will be better located. Air fares should decline as competition improves efficiency, but as the route is relatively short, airport charges limit the impact of this, and in any case this is limited by a lack of low cost airline competition in the base scenario. We expect that rail fares will decline in real terms as a response, but by a lower amount. Increases in total market demand on this route are expected to be modest; traffic levels have not grown significantly since the late 1990s, in part because holiday passengers have diverted to longer routes due to the availability of lower cost air services.

5.7 The frequency offered by air services on this route is expected to remain approximately unchanged; the frequency offered by rail may increase slightly, to accommodate additional demand after completion of the Channel Tunnel Rail Link, but given the relatively low load factors achieved by the rail service, this increase need not be substantial.

TABLE 5.1 BASE CASE SCENARIO LONDON - PARIS

	Today	2011	2016
Journey time air	1:10	1:10	1:10
Journey time rail	2:40	2:20	2:20
Price air Euros per direction	96	88	84
Price rail Euros per direction	90	86	85
Frequency air per day	40	40	40
Frequency rail per day	15	18	19
Growth in demand per annum		1%	1%

Results

5.8 The completion of the Channel Tunnel Rail Link will improve rail journey times and improve the accessibility of the rail service, but this will be partly offset by the fact that the rail service will face stronger price competition from the airlines on the route. If relative prices did not change, rail market share would increase from 69% to around 75%, but fares changes will limit this increase to 71-72%.

Madrid-Barcelona

Assumptions

5.9 Demand on this route has increased significantly in recent years and we project that this trend will continue. A significant reduction in rail journey time is expected when the new Madrid-Barcelona high speed line becomes operational in 2008. However, due to a series of technical problems, it is currently thought unlikely that the originally planned journey time of 2 hours 25 minutes will be achieved in the medium term, and in the base case we assume a journey time of 3 hours in 2011 and 2 hours 45 minutes in 2016.

5.10 Air fares on the Madrid-Barcelona route are currently quite high. However, the opening of new capacity at Madrid airport will alleviate slot constraints and therefore enable low cost airlines to enter the market; in the long run, we expect that low cost carriers might capture one third of the air market on this route. This will force the other airlines, especially Iberia, to cut fares significantly.

5.11 There is a possibility that the price of rail tickets could increase: further to completion of the high speed line, fares might be set equivalent to those levied for the Madrid-Seville route. However, if there are significant reductions in air fares as we assume in the base case scenario, it seems unlikely that the rail operator would seek to increase fares. We also assume that RENFE introduces a yield management system which improves the competitiveness of its fares even if not the average level.

TABLE 5.2 BASE CASE SCENARIO MADRID - BARCELONA

	Today	2011	2016
Journey time air	1:10	1:10	1:10
Journey time rail	5:00	3:00	2:45
Price air Euros per direction	97	75	71
Price rail Euros per direction	55	55	55
Frequency air per day	65	60	60
Frequency rail per day	6	15	25
Growth in demand per annum		5%	5%

Results

5.12 The completion of the high speed rail line will increase rail market share, but this will be partly offset by the effect of much lower air fares, due to the expected expansion of low cost airlines after the capacity expansion at Madrid airport. We project that rail market share will rise to 34% by 2016, assuming a journey time of 2 hours 45 minutes. Market share will remain lower than some routes with similar rail journey times because of the very high frequency (Puente Aéreo) air service and the good location of the airports in the two cities.

5.13 The Madrid-Barcelona high speed line will serve important intermediate cities, particularly Zaragoza. The market share projections here only include Madrid-Barcelona traffic, not traffic to/from intermediate stations. Rail will gain a much higher share of this traffic.

Madrid-Seville

Assumptions

5.14 Demand on this route has grown significantly in recent years and this trend is projected to continue. This will be absorbed primarily by the existing high speed rail service.

5.15 There is some room for reductions in air fares further to the opening of new capacity at Madrid airport: the route is currently monopolised by Iberia and fares are relatively high. However, due to the high quality of the rail service, we do not assume any entry by low cost carriers in the base case. Air frequency is expected to remain unchanged; rail frequency will increase slightly, but by less than the increase in demand, as at least part this will be accommodated by running double length trains and increasing load factors.

TABLE 5.3 BASE CASE SCENARIO MADRID - SEVILLE

	Today	2011	2016
Journey time air	1:00	1:00	1:00
Journey time rail	2:30	2:30	2:30
Price air Euros per direction	98	90	85
Price rail Euros per direction	59	59	59
Frequency air per day	7	7	7
Frequency rail per day	22	25	28
Growth in demand per annum		4%	4%

Results

5.16 Rail market share may decline slightly on this route, as air fares are likely to fall, but the effect of this will be relatively limited; rail market share will remain at around 83%.

Rome-Milan

Assumptions

5.17 A significant reduction in rail journey times will occur as a result of the completion of the high speed line: part of this reduction will have occurred by 2011 and it will be complete by 2016. However, air fares will become significantly more competitive on this route due to the expansion of low cost carriers in the Italian domestic market. As for the Madrid-Barcelona route, we assume that low cost carriers could capture one third of the air market on this route. As rail fares in Italy are currently low but have tended not to increase in recent years, we assume that these will be changed only in line with inflation. This will substantially reduce the differential between air and rail fares. However, as new low cost air services will not be able to use Linate, we assume that there will be some increase in average airport access times.

TABLE 5.4 BASE CASE SCENARIO ROME - MILAN

	Today	2011	2016
Journey time air	1:10	1:10	1:10
Journey time rail	4:30	3:40	3:15
Price air Euros per direction	104	78	75
Price rail Euros per direction	46	46	46
Frequency air per day	63	63	63
Frequency rail per day	25	27	30
Growth in demand per annum		1.5%	1.5%

Results

5.18 The completion of the high speed line will increase rail market share, but the journey time expected by 2016 (3 hours 15 minutes) will still be quite high, limiting the appeal of rail to business travellers. In addition, low cost airlines should achieve a substantial market share on this route, resulting in considerable reductions in air fares. As a result, the rail market share will be limited to 43% in 2016, compared to 38% now.

Paris-Marseille

Assumptions

5.19 The recent completion of TGV Mediterranean, allowing trains to run at high speed throughout the Paris-Marseille route, coupled with the lack of competition from any airline other than Air France, has had a significant impact on air market share. There is unlikely to be any significant further reduction in journey times by rail in the next ten years but, in our view, there is also unlikely to be significant change in the air offer, as slots will continue to be restricted at the Paris airports.

5.20 Air France is likely to reduce its fares slightly, following industry-wide productivity improvements, but as it faces little competition from other airlines, we assume that only a small proportion of any reduction in operating costs is passed to passengers in the form of lower fares. In addition, air fares will be increased due to higher taxes. We project limited market entry by low cost carriers resulting in some further fare reductions, but this is constrained to 5% of slots after 5 years and 10% after 10 years, as a result of the capacity constraint at Orly and the unattractive nature of CDG as an alternative for low cost carriers. We presume that SNCF will be keen to protect its market share and therefore will also reduce rail fares in real terms, although its potential to do this will be constrained by high costs; we assume a reduction in rail fares at half of the percentage rate of the reduction in average air fares, and therefore the gap between rail and air fares will narrow considerably.

TABLE 5.5 BASE CASE SCENARIO PARIS - MARSEILLE

	Today	2011	2016
Journey time air	1:10	1:10	1:10
Journey time rail	3:10	3:10	3:10
Price air Euros per direction	108	95	89
Price rail Euros per direction	63	61	60
Frequency air per day	20	22	25
Frequency rail per day	25	26	29
Growth in demand per annum		2%	2%

Results

5.21 Although we assume in the base case that the market share that low cost airlines can achieve on this route will be limited by slot constraints, *any* low cost air service or other air competition could trigger significant reductions in air fares, which are high compared to other similar routes. We assume that SNCF will reduce its fares as well in order to protect its market share, but the extent to which it can do this will be limited as it will be difficult to cut costs. As a result, rail market share could decline from around 67% in 2005 to 60% by 2016.

Frankfurt-Cologne

Assumptions

5.22 This route is already high speed throughout and therefore we do not project any further reductions in rail journey times. We do not project any change in either air or rail frequencies in the base case; additional demand can be handled by running a higher proportion of double-length ICE units, without changing the current basic service pattern. We project that Lufthansa fares will decline partly in line with projected improvements in airline productivity, but as most of the fares on this route are 'add-ons' to long haul ticket prices, we do not project a substantial change. As rail fares will still be much lower than air fares, we do not project any real change in rail fares.

TABLE 5.6 BASE CASE SCENARIO FRANKFURT - COLOGNE

	Today	2011	2016
Journey time air	0:40	0:40	0:40
Journey time rail	1:10	1:10	1:10
Price air Euros per direction	72	68	67
Price rail Euros per direction	42	42	42
Frequency air per day	4	4	4
Frequency rail per day	46	46	46
Growth in demand per annum		1.5%	1.5%

Results

5.23 We project almost no change in market share on this route.

London-Edinburgh

Assumptions

5.24 In the base case, we do not assume any significant change in air or rail journey times. Air fares are expected to fall as a result of general gains in efficiency, although as low cost carriers already have a high share of the market on this route, the potential for air fares reductions is less than on some of the other routes. Air frequencies will increase more slowly than demand, due to airport constraints, and any increases in frequencies will occur at secondary airports in the London area, rather than Heathrow. We do not expect any change in rail frequencies.

5.25 We also assume that the current reliability issues experienced by the rail service, particularly the regular engineering works at weekends, will have been resolved from 2011 onwards.

TABLE 5.7 BASE CASE SCENARIO LONDON - EDINBURGH

	Today	2011	2016
Journey time air	1:30	1:30	1:30
Journey time rail	4:30	4:30	4:30
Price air Euros per direction	86	76	73
Price rail Euros per direction	66	66	66
Frequency air per day	59	61	64
Frequency rail per day	19	19	19
Growth in demand per annum		2.5%	2.5%

Results

5.26 Rail market share will continue to decline due to strong price competition from airlines. In the medium/long term, the rail service will become more reliable, as the impact of the current engineering works, which often result in the rail line closing at weekends, should reduce; this could partly offset the reduction in rail market share. However, it will still decline, to about 14% by 2016.

London-Manchester

Assumptions

5.27 Rail services will be further accelerated due to the completion of the upgrade of the West Coast Main Line, with journey times falling to an average of 2 hours 10 minutes. Rail frequencies are already high and load factors are quite low, so we project that this growth in demand will be accommodated without any further increase in frequencies. UK rail fares are regulated at 1% above inflation and we assume that fares increase by this amount; as air fares will continue to fall, the gap between air and rail fares will narrow considerably. Improvements in rail service quality are likely to lead to some passengers transferring from air, and therefore we assume no further increase in air frequency.

5.28 The rail service on this route should also become significantly more reliable after completion of engineering works on the West Coast Main Line in 2008. This should enable trains to run without significant delays at weekends, as well as on weekdays.

TABLE 5.8 BASE CASE SCENARIO LONDON - MANCHESTER

	Today	2011	2016
Journey time air	1:00	1:00	1:00
Journey time rail	2:20	2:05	2:05
Price air Euros per direction	84	74	71
Price rail Euros per direction	49	51	54
Frequency air per day	39	39	39
Frequency rail per day	32	32	32
Growth in demand per annum		2.5%	2.5%

Results

5.29 The completion of the upgrade of the West Coast Main Line should lead to better journey times and improved reliability, but this will be offset by the narrowing of the price difference between rail and air. Without changes in relative fares, rail market share could increase to around 80%, but with the changes in fares we expect in the base case, rail market share is projected to remain approximately unchanged.

6. SCENARIOS

Introduction

6.1 We have tested a number of different scenarios for future changes in market share. These scenarios reflect a mixture of commercial strategies that could be adopted by operators and policy measures. The scenarios are:

- Scenario 1: Air fares reduced to low-cost airline levels
- Scenario 2: Environmental transport taxation
- Scenario 3: Limits on airport slots for short haul routes
- Scenario 4: Airport capacity expanded but with higher airport charges
- Scenario 5: Higher rail speeds
- Scenario 6: Reduction in rail operating costs
- Scenario 7: Constrained public spending on rail

Scenario 1: Air fares reduced to low-cost airline levels

Assumptions

6.2 Our base case assumes some growth in low cost carrier market share on routes where these are currently weak and there appears to be significant potential for their market share to be increased. Growth in low cost carriers is consistent with recent trends and with recent aircraft orders: the existing low cost carriers are expected increase their activity substantially. However, they are constrained by difficulties in accessing major airports, such as Paris Orly. The classic carriers are likely to respond by reducing their fares and, if they are to survive, also by cutting costs.

6.3 In this scenario, we take a more aggressive view of the potential growth that could be achieved by low cost carriers and the response of the classic carriers. We assume that the operating costs and fares of all carriers are reduced to the levels of the low cost carriers, except to the extent that airport charges and turnaround times are likely to remain higher at major airports and therefore fares will be slightly higher for flights from these. It should be noted that this reduction in fares could be caused by either, or some combination of:

- very extensive efficiency measures by classic airlines so that their costs (but also their service quality) equals that of the low cost airlines; or
- classic airlines withdrawing in response to low cost competition.

6.4 It is unlikely that some of the classic carriers would withdraw from the hub-to-hub routes evaluated here. However, the classic carriers reducing their fares to the level of low cost carriers would have much the same effect on the market. As well as reductions in fares, we also assume a reduction in the service quality offered by air carriers in this scenario.

6.5 Table 6.1 shows the changes in air fares we project in this scenario.

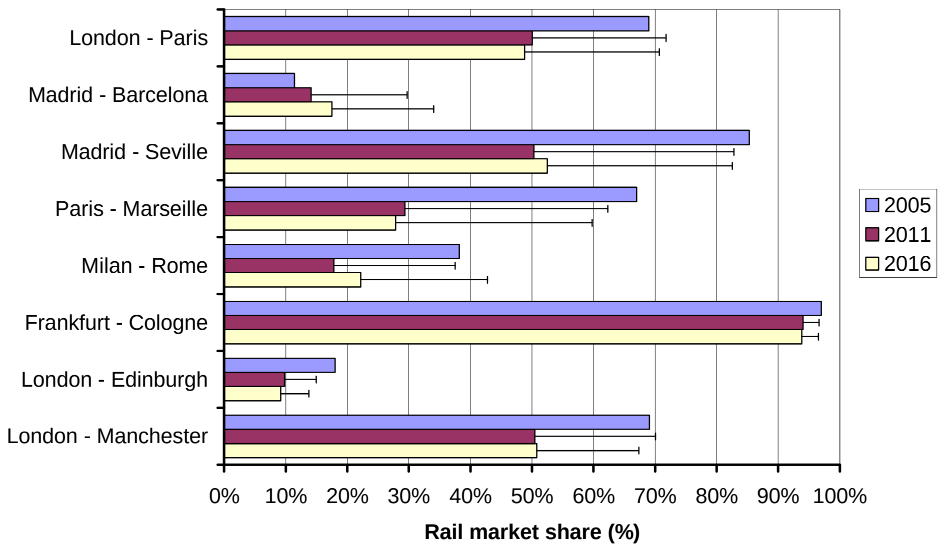
TABLE 6.1 AIR FARES REDUCED TO LCC LEVELS

Route	Air fares today per direction	Air fares 2011	Air fares 2016
London-Paris	96	58	56
Madrid-Barcelona	97	47	45
Madrid-Seville	98	45	43
Rome-Milan	108	60	58
Paris-Marseille	104	49	47
Frankfurt-Cologne	72	49	47
London-Edinburgh	86	60	58
London-Manchester	84	51	50

Results

6.6 Figure 6.1 shows our projection for rail market share in this scenario. The figure shows rail market share in 2011 and 2016; for reference, it also shows the base case projections.

FIGURE 6.1 RAIL MARKET SHARE PROJECTIONS, SCENARIO 1[8]



6.7 In this scenario, rail market share would reduce on all of the routes relative to current levels, except Madrid-Barcelona where the reduction in air fares would be offset by the effect of the completion of the high speed line; the impact would also be minimal on Frankfurt-Cologne as air travel would remain slower than rail for most point-to-point passengers on this route, and because the proportionate reduction in fares would be much less. The reduction in rail market share would be most significant on the

[8] The 'error bars' (the thin black lines) show the projected rail market share in 2011 and 2016 on each route in the base case scenario.

Paris-Marseille route, as air fares on this route are currently quite high and there is no low cost airline competition.

6.8 Our scenario assumed no further reductions in rail fares than we had assumed in the base case. In practice, it is likely that some rail operators would reduce fares under these circumstances, in order to protect their position. However, the extent to which they could do this would be limited because, as discussed in section 3 above, it is difficult for them to cut costs. This might therefore result in the rail operators requiring increased subsidy in order to retain services at current levels.

Scenario 2: Implementation of environmental transport taxation

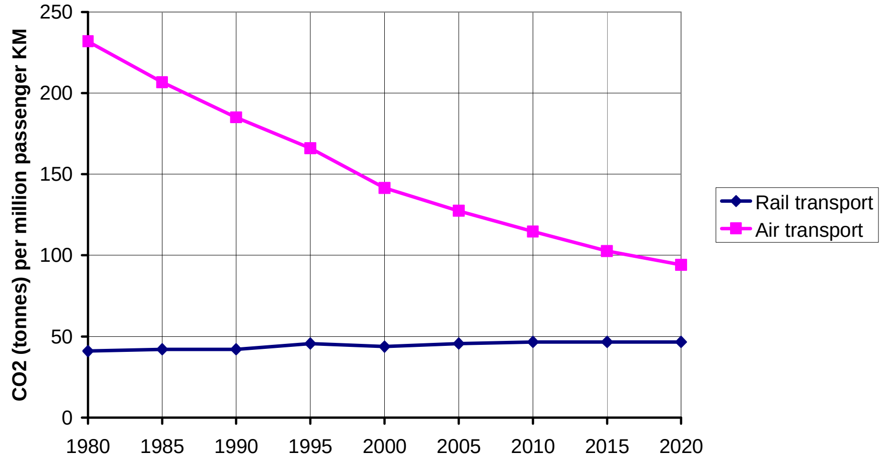
6.9 In this scenario, we calculate the results of imposing charges for CO_2 emissions on both air and rail transport. This would result in changes to market share. In addition, total market demand would fall, reflecting the increase in the price of travel by both modes, as some passengers would decide not to travel or to travel by car or bus. We also investigate whether charges for other environmental effects would impact market share.

Assumptions - CO_2

6.10 A number of airlines and other sources provide tools to calculate the CO_2 emissions associated with particular flights and the associated costs. However, there is little consensus about the appropriate price that should be applied for each unit of CO_2. In addition, the Intergovernmental Panel on Climate Change has suggested that that the impact of air transport on global warming is 2-3 times greater than implied merely by CO_2 emissions, because emissions at high altitude have a greater impact and because aircraft contribute to the formation of clouds. A further complication is that air transport emissions are not uniform per kilometre, as so much energy is consumed in takeoff and landing.

6.11 Rail transport also produces CO_2 emissions. These are lower per kilometre than for air transport, but high speed rail produces greater emissions than other types of long distance rail transport. Rail emissions also depend on how electricity is generated. Although air emits more CO_2 per passenger kilometre, the difference between rail and air is falling and is expected to continue to do so (Figure 6.2 below).

FIGURE 6.2 TREND IN AIR AND RAIL EMISSIONS PER PASSENGER KILOMETRE



Source: TRENDS database

6.12 Different studies include different values for the relative emissions of high speed rail and air transport and we have tested the values estimated in the following three sources:

- The report by CE Delft 'To shift or not to shift, that is the question - The environmental performance of the principal modes of freight and passenger transport in the policy-making context', undertaken on behalf of RIVM (Dutch National Institute of Public Health and the Environment)
- The European Environment Agency TRansport and ENvironment Database System (TRENDS) database
- The TREMOVE model, developed by KU Leuven and Transport & Mobility Leuven on behalf of the European Commission

6.13 Of these studies, the CE Delft study is most useful for our purposes, as it provides emissions for different types of air and rail transport; the other two studies provide one value for air and one for rail only. The emissions of rail transport, relative to air transport, are shown in Table 6.2 below.

TABLE 6.2 RAIL CO_2 EMISSIONS, AS % SHORT HAUL AIR CO_2 EMISSIONS

Study	High speed	Other long distance
CE Delft	45%	23%
TRENDS	36%	
TREMOVE	21%	

6.14 We have therefore tested five scenarios:

- Scenario 2.1: a CO_2 price of €20 per tonne, towards the middle of the range at which it has traded in the European Emissions Trading Scheme, using relative emissions levels from the CE Delft study but no multiplier effect on the emissions from aviation

- Scenario 2.2: a CO_2 price of €100 per tonne, equivalent to that used for some economic appraisals, using relative emissions levels from the CE Delft study but no multiplier effect on the emissions from aviation
- Scenario 2.3: as scenario 2.2 but with the value for air transport increased by a factor of 2.7 to allow for the impact of emissions being at higher altitudes
- Scenario 2.4: as scenario 2.3, but with the relative emissions levels from the TRENDS database
- Scenario 2.5: as scenario 2.3, but with the relative emissions levels from the TREMOVE model

6.15 Table 6.3 give the values of the tax that would apply in scenario 2.1.

TABLE 6.3 ENVIRONMENTAL TAX SCENARIO 2.1 - CO_2 €20/TONNE

Route	Environmental tax (€ per single journey)			
	Air		Rail	
	2011	2016	2011	2011
London-Paris	0.95	0.86	0.49	0.50
Madrid-Barcelona	1.08	0.97	0.55	0.56
Madrid-Seville	0.98	0.88	0.50	0.51
Rome-Milan	1.35	1.21	0.69	0.70
Paris-Marseille	1.08	0.97	0.55	0.57
Frankfurt-Cologne	0.65	0.58	0.33	0.34
London-Edinburgh	1.15	1.03	0.30	0.30
London-Manchester	0.81	0.72	0.21	0.21

6.16 Table 6.4 gives the values of the tax that would apply in scenario 2.2.

TABLE 6.4 ENVIRONMENTAL TAX SCENARIO 2.2 - CO_2 €100/TONNE

Route	Environmental tax (€ per single journey)			
	Air		Rail	
	2011	2016	2011	2011
London-Paris	4.77	4.28	2.44	2.50
Madrid-Barcelona	5.40	4.83	2.76	2.82
Madrid-Seville	4.91	4.40	2.51	2.57
Rome-Milan	6.73	6.03	3.44	3.52
Paris-Marseille	5.42	4.86	2.77	2.83
Frankfurt-Cologne	3.24	2.91	1.66	1.70
London-Edinburgh	5.77	5.17	1.48	1.51
London-Manchester	4.04	3.62	1.03	1.06

6.17 Table 6.5 gives the values of the tax that would apply in scenario 2.3.

TABLE 6.5 ENVIRONMENTAL TAX SCENARIO 2.3 - CO_2 €100/TONNE, AIR MULTIPLIER 2.7

Route	Environmental tax (€ per single journey)			
	Air		Rail	
	2011	2016	2011	2011
London-Paris	12.89	11.55	2.44	2.50
Madrid-Barcelona	14.57	13.05	2.76	2.82
Madrid-Seville	13.25	11.87	2.51	2.57
Rome-Milan	18.18	16.29	3.44	3.52
Paris-Marseille	14.64	13.12	2.77	2.83
Frankfurt-Cologne	8.75	7.84	1.66	1.70
London-Edinburgh	15.57	13.95	1.48	1.51
London-Manchester	10.91	9.77	1.03	1.06

6.18 Table 6.6 gives the values of the tax that would apply in scenario 2.4.

TABLE 6.6 ENVIRONMENTAL TAX SCENARIO 2.4 – TRENDS VALUES

Route	Environmental tax (€ per single journey)			
	Air		Rail	
	2011	2016	2011	2011
London-Paris	12.89	11.55	1.94	1.99
Madrid-Barcelona	14.57	13.05	2.20	2.25
Madrid-Seville	13.25	11.87	2.00	2.04
Rome-Milan	18.18	16.29	2.74	2.80
Paris-Marseille	14.64	13.12	2.21	2.26
Frankfurt-Cologne	8.75	7.84	1.32	1.35
London-Edinburgh	15.57	13.95	2.35	2.40
London-Manchester	10.91	9.77	1.64	1.68

6.19 Table 6.7 gives the values of the tax that would apply in scenario 2.5.

TABLE 6.7 ENVIRONMENTAL TAX SCENARIO 2.5 – TREMOVE VALUES

Route	Environmental tax (€ per single journey)			
	Air		Rail	
	2011	2016	2011	2011
London-Paris	12.89	11.55	1.13	1.15
Madrid-Barcelona	14.57	13.05	1.27	1.30
Madrid-Seville	13.25	11.87	1.16	1.18
Rome-Milan	18.18	16.29	1.59	1.62
Paris-Marseille	14.64	13.12	1.28	1.31
Frankfurt-Cologne	8.75	7.84	0.76	0.78
London-Edinburgh	15.57	13.95	1.36	1.39
London-Manchester	10.91	9.77	0.95	0.97

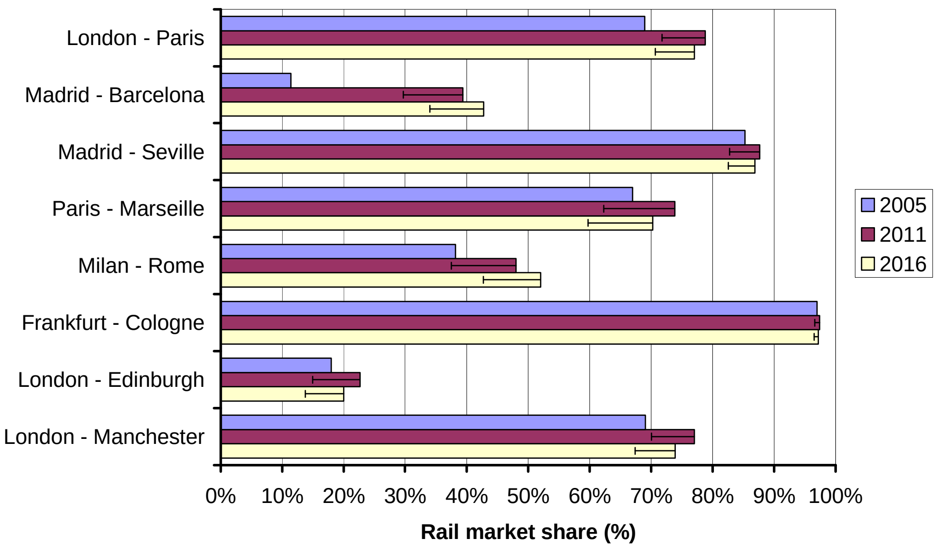
Results

6.20 Scenario 2.1, in which the price of CO_2 is equivalent to its current traded in price in the European Emissions Trading Scheme, resulted in negligible changes to market share (less than 1 point on any route). It also results in negligible change in the total size of the air plus rail market. **This indicates that inclusion of transport in the Emissions Trading Scheme would have negligible impact on short haul market size or share, at least at current traded carbon prices.**

6.21 Scenario 2.2, in which the CO_2 price is higher, resulted in slightly greater changes to market share. Rail market share would increase by 1-2 points on most of the routes studied, except Frankfurt-Cologne where rail market share is already very high and is hard to increase further. The greatest effect is on the Paris-Marseille route (as it is longest and therefore emissions are the greatest) and on the UK routes (as the rail service on these routes is not high speed and therefore generates lower emissions). However, the tax would still have less impact on market share than the reduction in air fares projected in the base case, and therefore on some routes rail market share would still be lower than at present. The tax would also reduce total market size by 2-3% on most routes, as both air and rail would become more expensive and therefore some passengers would opt not to travel or to use other modes; on some routes, this would have more effect on the quantity of CO_2 emissions than the change in market share.

6.22 Scenario 2.3, in which the tax applying to air transport is increased to allow for the greater impact of emissions at high altitudes, resulted in substantial changes in market share. Rail market share would increase by up to 10 points, with the effect being greater on the longer routes: for example, on the Paris-Marseille route, rail market share would increase to 70% instead of dropping to 60% as projected in the base case. This tax would more than offset the effect of the projected reduction in underlying air fares and would lead to rail market share increasing on all routes. The results of this scenario are shown in Figure 6.3 below. In addition to the change in market share, the total size of the air plus rail market would decline, by 6-8% on some routes. This change in market size could have an impact on emissions at least as significant as the change in market share on some routes.

FIGURE 6.3 RAIL MARKET SHARE PROJECTIONS, SCENARIO 2.3



6.23 Scenario 2.4 uses the TRENDS values for relative levels of rail emissions, and otherwise the same parameters as scenario 2.3. This does not give a separate value for high speed rail emissions but uses a standard value for all routes. This is lower than the value for high speed rail estimated in the CE Delft study used for scenarios 2.1-3 above although higher than the value for conventional rail. As a result, the increase in rail market share is greater in this scenario for all routes except the UK domestic routes. However, the difference between this scenario and scenario 2.3 is marginal on all routes.

6.24 Scenario 2.5 uses the TREMOVE values for relative levels of rail emissions, and otherwise the same parameters as scenario 2.3. This also does not give a separate value for high speed rail emissions, and the average level of rail emissions is lower than calculated in the CE Delft study. This scenario therefore results in the greatest increase in rail market share. However, again the difference in market share with scenario 2.3 is also quite small (a maximum of 1.4 points).

6.25 This analysis shows that the most important factor determining the impact of an environmental tax on rail/air market share will be the price of CO_2 and whether its value for air transport is increased to reflect the greater effect of emissions at high altitude. The projected change in rail market share in each scenario is summarised in Table 6.8 below.

TABLE 6.8 CHANGE IN RAIL MARKET SHARE IN EACH SCENARIO, RELATIVE TO BASE CASE

	Change in rail market share									
	Scenario 2.1		Scenario 2.2		Scenario 2.3		Scenario 2.4		Scenario 2.5	
	2011	2016	2011	2016	2011	2016	2011	2016	2011	2016
London - Manchester	0.5%	0.4%	2.2%	2.0%	6.9%	6.5%	6.6%	6.1%	7.0%	6.6%
London - Edinburgh	0.4%	0.3%	2.1%	1.7%	7.7%	6.3%	7.2%	5.8%	7.8%	6.4%
Frankfurt - Cologne	0.0%	0.0%	0.2%	0.1%	0.7%	0.7%	0.8%	0.7%	0.8%	0.8%
Milan - Rome	0.5%	0.4%	2.3%	1.8%	10.5%	9.3%	11.0%	9.8%	11.9%	10.7%
Paris - Marseille	0.6%	0.4%	2.8%	2.2%	11.5%	10.5%	12.0%	11.0%	12.8%	11.9%
Madrid - Seville	0.2%	0.2%	1.2%	0.9%	4.9%	4.3%	5.1%	4.6%	5.4%	4.9%
Madrid - Barcelona	0.4%	0.3%	2.0%	1.7%	9.7%	8.8%	10.1%	9.3%	10.9%	10.1%
London - Paris	0.3%	0.3%	1.7%	1.3%	7.0%	6.3%	7.3%	6.7%	7.8%	7.2%

6.26 In addition to the change in market share, a tax applied to both air and rail emissions would reduce the total size of the air/rail market. This would cause a further reduction in emissions, and in some scenarios on certain routes, this reduction could actually exceed that caused by the change in market share. However, the reduction in size of the total travel market also means that the economic impact of the tax would be greater. The impact of the tax on total market size is shown in Table 6.9 below.

TABLE 6.9 IMPACT ON TOTAL AIR/RAIL MARKET SIZE IN EACH SCENARIO

	Scenario 2.1		Scenario 2.2		Scenario 2.3		Scenario 2.4		Scenario 2.5	
	2011	2016	2011	2016	2011	2016	2011	2016	2011	2016
London - Manchester	-0.4%	-0.3%	-1.7%	-1.7%	-2.9%	-2.9%	-2.8%	-2.7%	-2.5%	-2.4%
London - Edinburgh	-0.7%	-0.6%	-3.2%	-3.0%	-7.2%	-6.6%	-7.1%	-6.4%	-6.9%	-6.2%
Frankfurt - Cologne	-0.5%	-0.5%	-2.2%	-2.2%	-3.3%	-3.2%	-3.0%	-2.9%	-2.5%	-2.3%
Milan - Rome	-0.6%	-0.6%	-2.9%	-2.9%	-5.4%	-5.3%	-5.2%	-5.1%	-4.8%	-4.7%
Paris - Marseille	-0.7%	-0.6%	-3.2%	-3.0%	-6.9%	-6.3%	-6.8%	-6.1%	-6.6%	-5.9%
Madrid - Seville	-0.4%	-0.4%	-1.9%	-1.9%	-2.1%	-2.1%	-1.7%	-1.7%	-1.2%	-1.1%
Madrid - Barcelona	-0.7%	-0.6%	-3.3%	-3.1%	-8.0%	-7.5%	-8.0%	-7.6%	-8.0%	-7.5%
London - Paris	-0.3%	-0.3%	-1.6%	-1.5%	-3.2%	-3.1%	-3.6%	-3.4%	-3.2%	-3.1%

Other pollutants

6.27 We also evaluated whether noise charges and charges for other emissions should be levied. However, we found that these would have minimal impact on market share. Noise charges would primarily impact long haul flights, which tend to use larger and noisier aircraft, and are more likely to takeoff and land at night or in the early morning. Short haul intra-European flights increasingly use small/medium sized new aircraft such as the new generation 737 and Airbus A320 series, and operate during the day. The values of emissions of NO_x (nitrogen oxides) and PM_{10} (particularates) are low compared to CO_2 and this would not have a substantial effect; neither mode is significantly better or worse than the other in terms of these emissions.

Scenario 3: Limits on airport slots for short routes

6.28 The increase in air traffic in Europe has generated a shortage of capacity in several key airports. At present, it is left to the market to determine what services should operate using the available slots, subject to some constraints such as bilateral air services agreements. Long haul services tend to be more profitable and therefore there is a tendency for airlines to concentrate the offer in those flights, rather than low capacity short haul services, although the times of operation of long haul services are relatively constrained, which limits this trend. Where there is secondary trading in slots on the 'grey' market, at airports such as London Heathrow, this has tended to further reduce the share of slots used for short haul flights. This trend could be accelerated through policy measures – either to formalise secondary trading and enable this to take place at all airports, or to preclude or limit allocation of slots for very short routes for which rail transport is an alternative.

Assumptions

6.29 For many of the routes we study, there are unlikely to be any significantly more serious constraints on slot availability during the period covered by the model than there are at present. This is due to planned capacity expansions and the relatively faster growth rates that are being experienced at secondary airports and on services that bypass hubs. However, where there are such constraints, slot availability may be restricted for short haul services.

6.30 Limits on airport slots for short routes would result in the reduction in air service frequency at certain airports, and increases in airport access time/costs, as some passengers are required to transfer to other, less convenient, airports. Table 6.10 sets out our assumptions for this scenario.

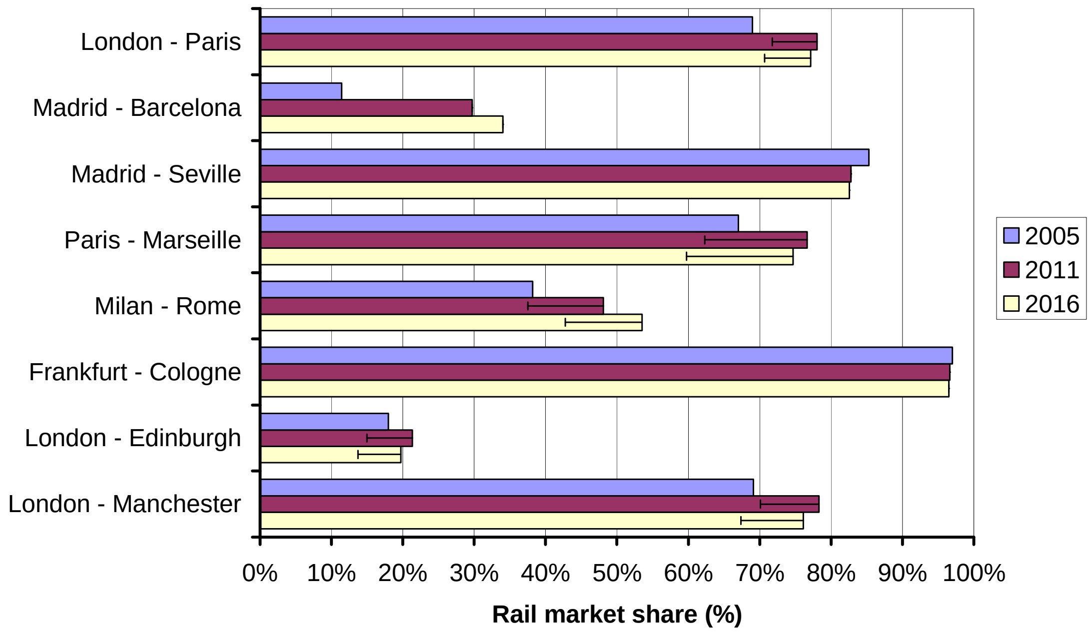
TABLE 6.10 IMPACTS OF SHORT HAUL CONSTRAINTS

Route	Description of Constraint	Air Access Cost relative to Base Case (€)	Air Access Time relative to Base Case (minutes)
		2016	2016
London-Paris	Short haul de facto market limitation at London Heathrow and slot cap at Orly; no significant constraints at CDG due to 4th runway. Rail is not an alternative for passengers interchanging onto other flights on this route, and therefore the main airlines (BA and Air France) are likely to maintain it at least in some form. In this scenario we assume a reduction in frequencies at LHR, forcing some passengers to use other London area airports.	+5	+10
Madrid-Barcelona	Expansion of Madrid and Barcelona airports means that there will be no constraint	No impact	No impact
Madrid-Seville	Expansion of Madrid airport and spare capacity at Seville means that there will be no constraint		
Rome-Milan	There is limited access to Milan Linate. However, there are no long haul services at this airport, so there is limited potential to substitute flights. We assume a reduction in frequency at Linate, causing a proportion of passengers to be diverted to Malpensa or Bergamo.	+5	+10
Paris-Marseille	Due to the slot cap at Orly, We assume that Orly-Marseille frequencies will reduce, causing a proportion of passengers to be diverted to CDG; assuming CDG Express is not built, this results in much higher airport access times	+5	+20
Frankfurt-Cologne	There will be no constraints, due to the opening of a fifth runway at Frankfurt.	No impact	No impact
London-Edinburgh	Heathrow will be fully slot constrained unless a new runway is constructed, not expected during next 10 years. We assume a reduction in Heathrow frequencies of 25%. Some passengers would have to use the other London airports instead.	+5	+10
London-Manchester	Heathrow will be fully slot constrained unless a new runway is constructed, not expected during next 10 years.We assume a reduction in Heathrow frequencies of 25%. Some passengers would have to use the other London airports instead.	+5	+10

Results

6.31 Figure 6.4 shows our projection for rail market share in this scenario. The figure shows rail market share in 2011 and 2016; for reference, it also shows the base case projections.

FIGURE 6.4 RAIL MARKET SHARE PROJECTIONS, SCENARIO 3



6.32 In this scenario, rail market share would increase on routes where airport slot constraints apply, relative to the current situation as well as base case projections. The increase in rail market share would be most significant on the Paris-Marseille route, because we assume that air passengers will be switching to CDG, which is associated with a particularly high access time and cost.

6.33 We have assumed no further changes in fares and service frequency in this scenario. This implicitly assumes that slot constraints have little impact airlines' operating costs, and that operators could divert services to another airport at no cost. Furthermore, we assume that air journey times are the same regardless of the origin/ destination airport used on each route. In practice, airlines may react to slot constraints differently. For example, increased frequency at airports without constraints may create traffic congestion, in which case the amount of taxiing time and waiting time for landing may be longer, hence increasing the scheduled air journey time in addition to increased access time and cost. This could potentially result in even greater increases in rail's market shares.

Scenario 4: New airport capacity at higher charges

6.34 There is a growing number of European airports with severe limitations in terms of capacity, some of which are included in the routes under consideration in this report. Capacity expansion requires substantial investment and planning and is liable to delay due to environmental and other problems. In this scenario, we assume that capacity constraints (where these exist) are alleviated, but that airport charges increase to fund the necessary investment. As for the previous scenario, for many airports there is no change in airport charges or capacity in this scenario, as they are not expected to reach capacity during the period covered by our model.

6.35 It should be noted that in two of the constrained airports covered by this study (Linate and Orly), the constraint is artificial and arises from a government policy of limiting the number of slots available. In these airports, we assume that lifting the constraint would require some work on noise mitigation and terminal modernisation and expansion, but no major new infrastructure (such as new runways). There would be some increase in charges but rather less than at an airport such as Heathrow, where capacity expansion would require construction of a new runway. In these cases, average fares might actually fall as a result of the investment, as low cost airlines would be able to enter these airports and the consequent reduction in fares would offset the higher charges. This effect could be particularly significant at Orly.

Assumptions

6.36 Expansion of airport capacity would have four main consequences:

- The costs of airport expansion and noise mitigation would be passed directly onto the passengers in the form of a passenger charge;
- Expanded capacity would allow for entry of low cost carriers, thus putting downward pressure on air fares.
- Access times would improve as a result of extra capacity at airports that are deemed more convenient to passengers.
- Access costs would improve as a result of extra capacity at airports that are deemed more convenient to passengers.

6.37 We assume that the new airport capacity would be fully available by 2016, with half of it being available by 2011; costs associated with the expansion would be recovered through progressively increased airport charges. Table 6.4 shows the assumptions that we have made for changes in airport charges, air fares and access times. The two Spanish domestic routes are not shown because we do not expect any capacity constraints on these routes during this period.

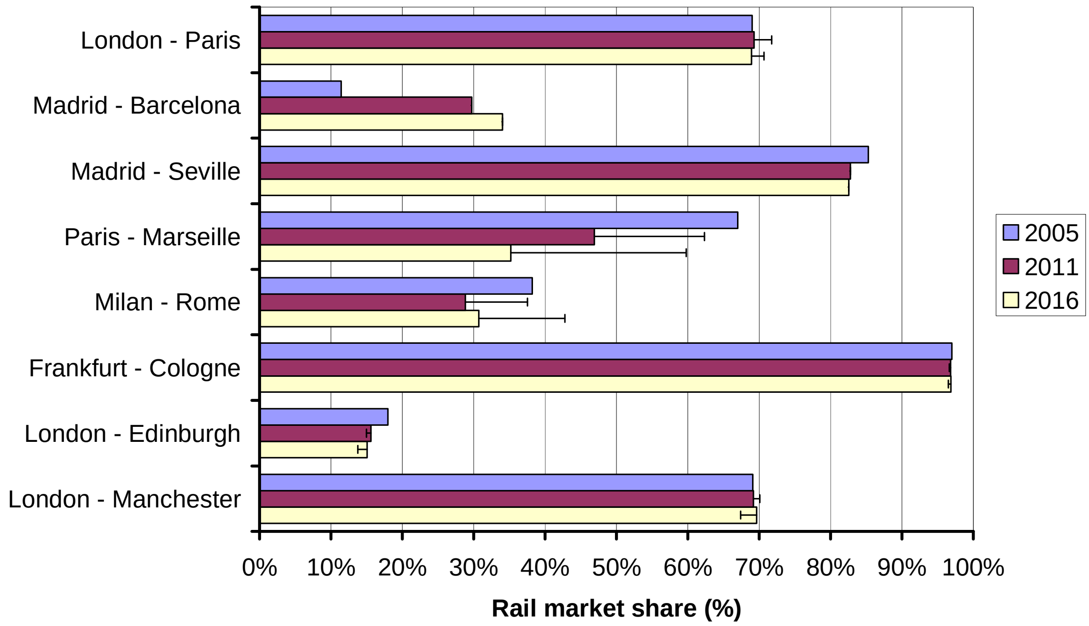
TABLE 6.11 IMPACTS OF EXPANDED AIRPORT CAPACITY

Route	Description of constraint	Change to passenger charge in 2016 (€)	Changes from base case			
			Access Time (hour)	Access Cost (€)	Air fare 2011 (€)	Air fare 2016 (€)
London-Paris	Short haul de facto market limitation at London Heathrow and slot cap at Orly; no significant constraints at CDG, due to 4th runway. We assume new runway and terminal at LHR, lifting of cap at Orly and full costs of CDG expansion passed on to as passenger fees.	10	-0:05	-5	+2	+5
Rome-Milan	Limited access to Linate airport. We assume Linate constraint will be lifted, leading to increased entry by low cost airlines	2	-0:05	-5	-4	-7
Paris-Marseille	We assume that slot cap at Orly will be lifted, leading to significant entry by low cost airlines	2	-0:05	-5	-10	-19
Frankfurt-Cologne	Fifth runway planned at Frankfurt will required funding through an increase of airport charges	6	0	0	+1	+3
London-Edinburgh	Heathrow is fully slot constrained unless new runway constructed.	6	0	0	+1	+3
London-Manchester	We assume a new runway and terminal at LHR, and subsequent increases in airport fees.	6	0	0	+1	+3

Results

6.38 Figure 6.5 shows our projection for rail market share in this scenario. The figure shows rail market share in 2011 and 2016; for reference, it also shows the base case projections.

FIGURE 6.5 RAIL MARKET SHARE PROJECTIONS, SCENARIO 4



6.39 Where limited airport capacity is a growth constraint, capacity expansion makes air a more attractive option on the selected routes by 2016, except for Frankfurt- Cologne. The planned fifth runway at Frankfurt generates little additional benefits to travellers between Frankfurt and Cologne, as Frankfurt remains the only choice of airport option and rail is already a very popular option on the route. On the other hand, passengers would need to pay higher air fares in order to fund the planned upgrades.

6.40 Increasing airport capacity, even at the expense of higher charges, is likely to increase air market share if it enables passengers to switch to airports that are quicker and cheaper to get to. This is particularly the case on routes from Milan, Paris and London, where the 'best' airports (Linate, Orly and Heathrow) are currently capacity constrained. This scenario has the largest effects on the Paris-Marseille and Rome-Milan routes. This is mainly due to the relatively low increase in passenger fees assumed to be associated with the upgrades at Linate and Orly airports, and because the increases to capacity would allow low cost airlines to expand services at these airports, resulting in significantly lower average fare levels.

Scenario 5: Higher rail speeds

6.41 Most of the routes that we studied are either already high speed throughout, or are high speed for most of the journey. This allows maximum operating speeds of up to 300km/h and, in principle, average speeds of around 250km/h (allowing time for acceleration and deceleration). However, in many cases, the average operating speed is much less than could in principle be achieved on new high speed infrastructure. It might in principle be possible to achieve higher rail speeds on some of these routes. Taking into account the better location of the railway stations in the city centres any significant reduction in the rail journey times could make the rail service a formidable contender for the air services.

Assumptions

6.42 The routes under evaluation have different margins of improvement and therefore the future scenarios vary. For routes such as Paris–Marseille, only marginal improvements are possible, and in consequence the market would not be affected significantly by this change. But there are other routes in Europe, such as Rome–Milan and Madrid–Barcelona, where there is significant room for improvement. The two UK domestic routes, London-Edinburgh and London-Manchester, are unlikely to be served by new high speed infrastructure within the period shown; in this scenario, we test the impact of construction of entirely new high speed line for these routes.

6.43 In this scenario, we test an average operating speed of 250km/h on each route, equivalent to that achieved by the fastest current Paris-Marseille trains. The operating speeds we have used are lower where it is unrealistic to assume that a higher speed could ever be achieved – for example, we assume an average speed of 225km/h for the London-Paris route, as it would never be possible to achieve very high speeds whilst transiting the Channel Tunnel.

6.44 Table 6.12 summarises the average journey times associated to the speed increases.

TABLE 6.12 RAIL JOURNEY TIMES

Route	Current journey time	Base case journey time 2016	Scenario journey time 2011	Scenario journey time 2016
London-Paris	2:40	2:20	2:20	2:12
Madrid-Barcelona	4:50	2:45	2:45	2:25
Madrid-Seville	2:30	2:30	2:30	2:05
Rome-Milan	4:30	3:15	3:15	2:32
Paris-Marseille	3:10	3:10	3:10	3:00
Frankfurt-Cologne	1:10	1:10	1:10	0:50
London-Edinburgh	4:30	4:30	4:30	2:32
London-Manchester	2:20	2:10	2:10	1:10

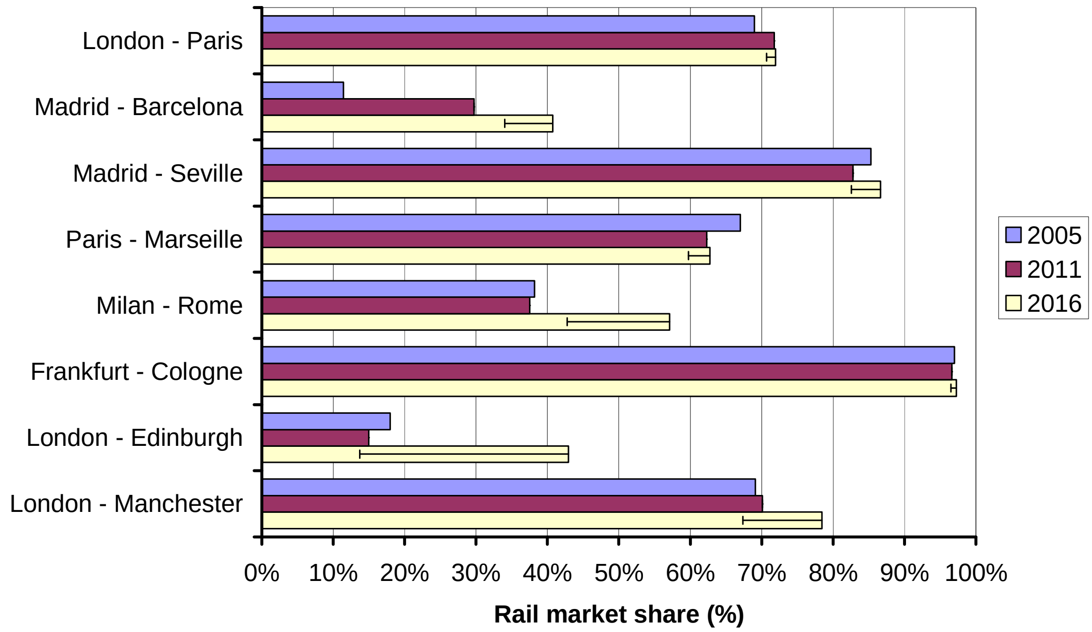
6.45 Since increasing rail speeds requires investments and upgrade over time, we have assumed that journey times would not significantly come down until the year 2016. Although rail speeds on the London-Edinburgh and London-Manchester routes are unlikely to improve significantly over the evaluation period, we have shown what would happen if the average operating speed of 250km/h could be achieved on these routes by 2016.

6.46 In order to separately identify the affect of improved speeds, we do not allow for any increase in rail fares in order to fund the investment.

Results

6.47 Figure 6.6 shows our projection for rail market share in this scenario. The figure shows rail market share in 2011 and 2016; for reference, it also shows the base case projections.

FIGURE 6.6 RAIL MARKET SHARE PROJECTIONS, SCENARIO 5



6.48 Rail market shares would increase as a result of shortened journey times. The potential for rail market share increase, however, is minimal on the London-Paris, Paris-Marseille, and Frankfurt-Cologne services. As discussed, there is little room for rail speed improvement on these routes due to the already high speed at present, as well as infrastructure constraints such as the speed limit in the Channel Tunnel.

6.49 We project significant reduction in rail journey time between Madrid and Barcelona, but the potential increase in rail market share is not as great as that on other routes. This has to do with the characteristics of journeys between the two cities, and the locations of the airports. Madrid and Barcelona airports are well-suited for travel between the two city centres, which (as the cities are quite densely populated) a high proportion of passengers wish to do. Despite the massive decrease in rail journey time, travelling by train is still much slower than travelling by air.

6.50 Rail market shares on the London- Edinburgh and London- Manchester routes could increase significantly if an average speed of 250km/hour could be achieved. Although it is highly unlikely that such a speed could be achieved by 2016, the results are consistent with the case studies findings-- the rail operator on the London-Edinburgh route believes that the current rail timetable is the most limiting factor on demand growth.

Scenario 6: Reduction in rail operating costs

6.51 In this scenario, we assume that rail operators achieve reductions in operating costs along the same lines as those that have been achieved by low cost airlines. The reductions in operating costs that we assume are:

- 50% of direct costs incurred by the operators, equivalent to that achieved by low cost airlines relative to classic airlines.
- 20% of infrastructure costs. This is lower than we assume might be possible for the direct costs incurred by the operators, as, consistent with experience in other transport sectors, the opportunities for infrastructure cost savings are likely to be lower.

6.52 Direct costs refer to

- Energy and fuel costs;
- Use of station charges;
- Rolling stock charges;
- Staff;
- General administration and overheads; and
- Sales and marketing costs

We assume that direct cost savings on a per passenger basis can be achieved by continued improvement in rail labour productivity[9], and reduction in sales-associated costs such as ticketing and marketing.

6.53 Infrastructure costs are incurred by the infrastructure manager rather than the operator, and in most cases they are at least partly subsidised. We assume that the benefits of reduced infrastructure costs would be shared between the governments, through lower subsidies, and rail operators, through lower infrastructure charges.

6.54 The reduction in the direct and infrastructure costs is assumed to lead directly to lower fares. The implications of this for rail fares are shown in the table below.

[9] According to CER's *Mid term Review of 2001 White Paper*, rail labour productivity, measured in traffic units by staff member, rose by 40% between 1995 and 2005.

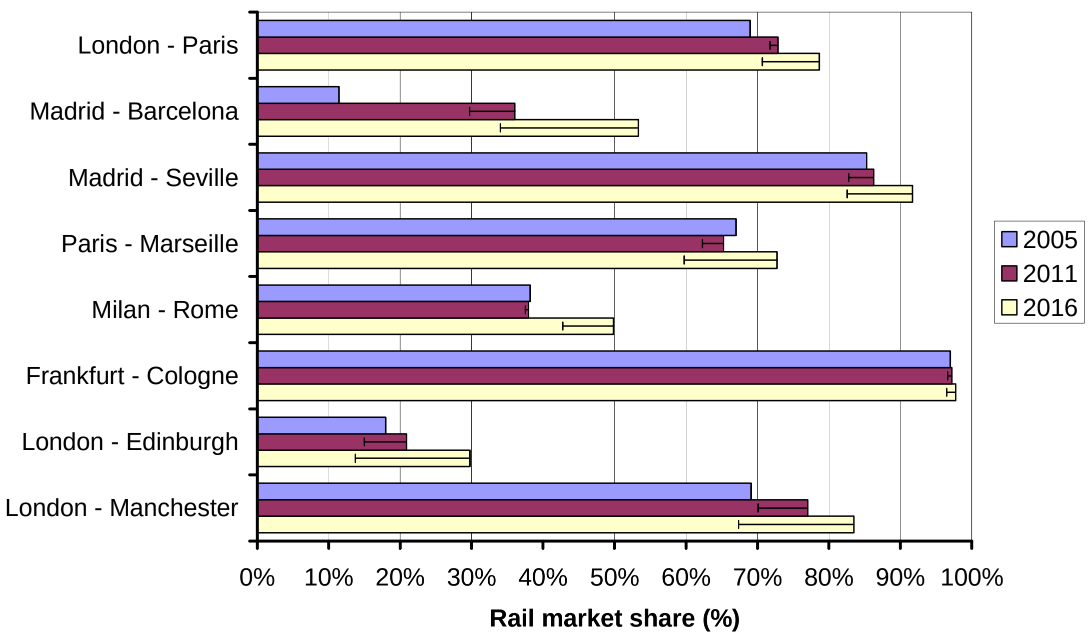
TABLE 6.13 IMPACT OF LOWER RAIL OPERATING COSTS ON FARES

Route	Rail fares (2006)	Scenario rail fares (2011)	Scenario rail fares (2016)	Rail fare reduction as a result of cost savings (2016)
London-Paris	90	82	73	-19%
Madrid-Barcelona	55	44	33	-40%
Madrid-Seville	58	46	34	-40%
Paris-Marseille	63	53	44	-31%
Rome-Milan	46	42	39	-17%
Frankfurt-Cologne	42	36	30	-30%
London-Edinburgh	66	52	39	-41%
London-Manchester	49	39	30	-40%

Results

6.55 Figure 6.7 shows our projection for rail market share in this scenario. The figure shows rail market share in 2011 and 2016; for reference, it also shows the base case projections.

FIGURE 6.7 RAIL MARKET SHARE PROJECTIONS, SCENARIO 6



Scenario 7: Constrained public spending on rail

6.56 In this scenario, we assume that future rail fares would have to increase to cover more of the costs of operation and maintenance of infrastructure, and would therefore increase by a maximum equivalent to the proportion by which these are currently subsidised.

Assumptions

6.57 We define infrastructure costs as the ongoing costs incurred in operating and maintaining rail infrastructure, and do not include the fixed and capital costs of building the infrastructure, which would in any case rarely be covered by the operator. We have modelled this scenario in order to provide an indicative estimate of the impact of significantly reduced subsidies.

6.58 In practice, it would not be realistic to assume that governments would remove rail subsidies entirely, because the subsequent increase in fares would cause a significant proportion of passengers to switch to other modes, and therefore revenue would not increase by the amount necessary to cover the costs. Furthermore, competitive pressures would make it impossible for rail fares to increase by a large amount. We have thus limited fare increases as a result of reduced subsidies to be 20%.

6.59 The assumed fares impacts of this scenario are shown in Table 6.14 below.

TABLE 6.14 IMPACT OF LOWER RAIL SUBSIDIES ON FARES

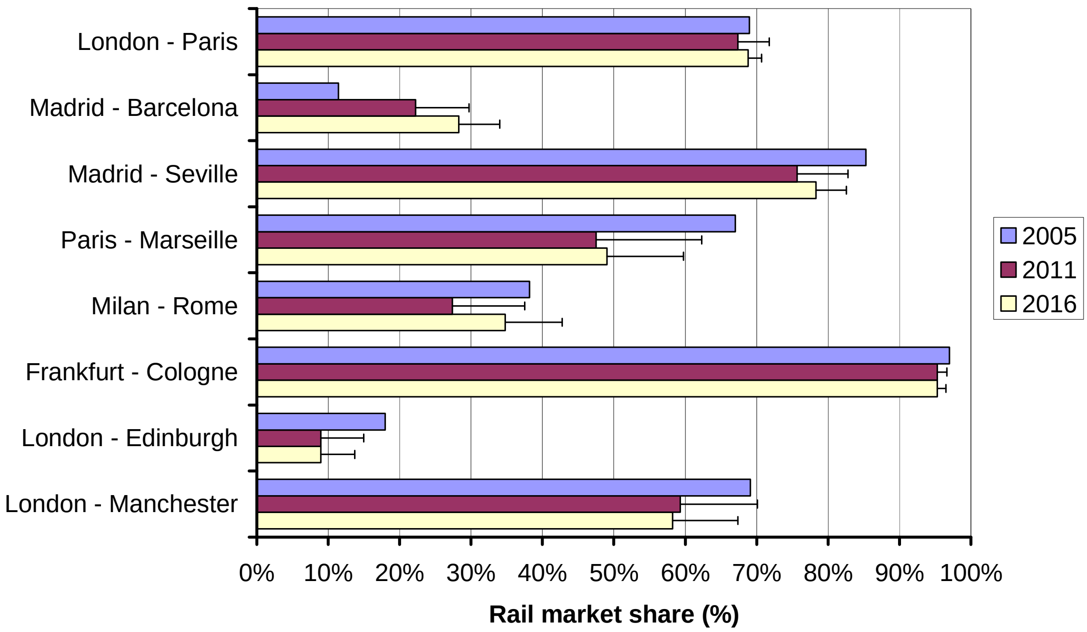
Route	Rail fares (2006)	Scenario rail fares (2011)	Scenario rail fares (2016)
London-Paris[10]	90	89	87
Madrid-Barcelona	55	62	62
Madrid-Seville	58	65	65
Paris-Marseille	63	73	72
Rome- Milan	46	56	56
Frankfurt-Cologne	42	51	51
London-Edinburgh	66	79	79
London-Manchester	49	62	65

Results

6.60 Figure 6.8 shows our projection for rail market share in this scenario. The figure shows rail market share in 2011 and 2016; for reference, it also shows the base case projections.

[10] Most of the infrastructure charges for the Eurostar service would not change in this scenario, so the trend in fares for this route is quite similar to the base case

FIGURE 6.8 RAIL MARKET SHARE PROJECTIONS, SCENARIO 7



6.61 Rail market shares would decline relative to the base case and the current situation in this scenario. The decline is especially pronounced on routes where governments are currently subsidising a high proportion of rail infrastructure costs, such as Paris-Marseille, Milan-Rome and London-Manchester.

7. PHASE 2: SECURITY ISSUES FOR RAIL-AIR TRAVEL

Introduction

7.1 In this phase of the project, we investigated:

- The **security issues** arising from high speed rail to air connections for passengers and baggage; and
- The development of **travel with e-tickets and through ticketing products** for integrated air-rail services and any resulting impacts on security.

7.2 A key part of the investigation has been consultation with stakeholders involved with current rail-air services. We have consulted with and benefited from the knowledge and experience of representatives of:

- Fraport, Lufthansa and Deutsche Bahn;
- Heathrow and Gatwick Express, and BAA;
- Paris Charles De Gaulle Airport and DGAC (the French Civil Aviation Authority).

7.3 We were unable to secure interviews with SNCF or Thalys regarding the aviation security and other issues arising from the Air France air-rail service through Paris Charles de Gaulle airport although useful information was provided by DGAC. To assist with our understanding of the air-rail offer available in Paris our project manager undertook a rail air journey from London Heathrow to Paris CDG, travelling to Lyon by the Air France/ Thalys air rail service and his experience has been reflected in the report. We have also benefited from comments made during visits to Ryanair, easyjet and Iberia as a part of the wider consultation undertaken for Phase 1 and have collected additional data from various public sources.

7.4 The rest of this section is structured as follows:

- Firstly, we discuss recent events which affect air and rail security;
- We then provide an overview of security issues and requirements applying for air and rail services;
- We describe the air/rail arrangements at the airports reviewed;
- We set out security arrangements and risks for through baggage handling; and
- Finally, we discuss security issues arising in e-ticketing.

7.5 Appendix C contains a glossary of security terms which may be helpful.

Background

7.6 Aviation security has been high profile for many years with events such as the Lockerbie Disaster, 9/11 in the United States and many other acts of sabotage and hijacking targeted at aeroplanes. This has resulted in a well developed international framework of aviation security. However, until recently rail has not been considered to face the same level of threat. The recent terrorist attacks on commuter rail services in Madrid and London have challenged this assumption.

7.7 With the exception of Eurostar services, rail systems tend to be largely or wholly **open access**, with ticket checks on train, in contrast to the **closed access airside security** imposed in the aviation industry. In the rail industry, barriers are used to prevent fare evasion rather than to ensure passenger security. Baggage is screened prior to boarding high speed rail services in Spain, but the degree of security is not comparable to either air services or the Eurostar service. In the United Kingdom, there have been recent experiments with mobile passenger and baggage screening systems to be used at random on the heavy rail and underground systems, but the aim is to provide an active deterrent to terrorists, rather than a guarantee of protection. However, these systems are in their infancy and the nature of the open access rail system in Members States means that they will only ever address a small part of the rail network. We do not envisage a situation where rail services move to a closed access system as the costs and inconvenience of doing so would be prohibitive.

Security issues arising in the rail-air interface

Overview of air/rail security

7.8 As described above, there is a clear distinction between the security framework governing aviation and that applied to the rail sector. The present aviation security framework is a result of 40 years of development and coordination by many nations, to counter a wide range of potential threats. There is no such framework in existence for rail services within the European Union. Most operate open access systems with minimal passenger and baggage security measures.

Aviation Security

7.9 The principles of International Aviation Security have been developed through the International Civil Aviation Organisation (ICAO), established at the Chicago Convention in 1944. ICAO, through their Standards and Recommended Practices, produce a “Security Manual for Safeguarding Civil Aviation Against Unlawful Interference”, which is constantly updated to reflect changing circumstances, and each of the 188 Contracting States implements the recommendations as appropriate. Within Europe, the European Civil Aviation Conference (ECAC) has a Security Working Group which produces recommendations for the guidance of Member States.

7.10 Regulation (EC) No 2320/2002 (as amended) of the European Parliament and of the Council which was issued on 16 December 2002 provides the legally binding requirements for Member State aviation security. As an EU Regulation, it is directly applicable in Member States.

7.11 Countries adopt ICAO and ECAC recommendations through their own legislative instruments, subject to the legal requirements of Community Law (EC 2320/2002). However, although few major states apply security standards less than recommended by ICAO, they can require higher standards if felt appropriate, as is the case with all Member States of the European Union through the legal requirements of EC 2320/2002. In addition, the United States requires its airlines to apply different processes, including comprehensive profiling prior to the passenger and baggage being checked-in. This coordinated aviation security framework has enabled a unified approach to the implementation of appropriate security measures within the civil aviation industry which ensures all passengers and baggage items boarding aircraft are screened and accounted for.

7.12 Prior to 9/11, the security focus was preventing passengers carrying guns onto an aircraft and prevention of an explosive device being carried in hold luggage. Following on from 9/11 and Richard Reid (the "Shoe bomber"), a number of enhancements have been introduced, including[11]:

- More sophisticated **explosive detection** equipment.
- Increased **manual searching** of hold baggage.
- More **hand searching** of passengers and cabin baggage.
- **Secondary searching** just prior to aircraft boarding.
- Expanded **list of prohibited** items.
- **Additional screening** of retail goods prior to entry to the Restricted Zone.
- Increased **guarding of aircraft**.
- **Increased patrols** within the airport restricted Zone.
- **Tighter controls** in relation to transportation of cargo.
- Aircraft **cockpit doors locked** during flight.
- **Installation of CCTV cameras** in aircraft cabins.
- Increasing number of "**Sky Marshals**" on aircraft.
- Increased application of "**Passenger Profiling**" techniques.

7.13 Further development of detection equipment and other measures continues. A number of trials are underway including "whole body" screening and explosive vapour detection.

Details of Aviation Security Protocols

Aviation Security - Screening of Hold luggage for Carriage by Air

7.14 The regulations governing security screening of hold luggage are laid down by the Member State from which the aeroplane departs. The minimum requirements are determined by Community legislation through Regulation EC 2320/2002. As described above, due to the natural cross-border activity of aviation, considerable effort has been undertaken to harmonise the requirements to ensure standardisation throughout most of the world. On occasions, specific threats make it necessary to have supplemental procedures which overlay those of the host Member State; for example, El Al for Israel and Unites States' air carriers. However, these processes do not replace the basic procedures which the host Member State applies.

7.15 The security screening process applied in the majority of the countries of the world adopts most of the key principles outlined in Regulation (EC) 2320/2002 which has been adopted by Member States. The following sections describe the generic security screening process which would apply to hold luggage being through-checked from rail

[11] This list is based on a number of security projects undertaken by members of the study team since 9/11.

to air. However, Regulation 2320 enables flexibility in the way in which certain processes can be achieved and detailed arrangements will depend on local circumstances and physical characteristics.

- The most important principle is that all people and items boarding a departing aircraft shall be security screened to ensure that no prohibited items are being carried.
- The security screening process can be achieved in a number of ways but the following as described in Regulation 2320 are implicit in all procedures:
  - Hold baggage shall be properly marked externally to permit identification with relevant passengers;
  - The passenger to whom such baggage belongs shall be checked in for the flight on which it is to be carried;
  - Prior to loading, hold baggage shall be held in an area (of the airport) to which only authorised persons have access;
  - All items of baggage taken into the custody of an air carrier for carriage in the hold of an aircraft shall be identified as either accompanied or unaccompanied. The process of identification shall be achieved either by manual or automated means;
  - Measures shall be established to ensure that if a passenger checked in for a flight, who has placed baggage in the custody of the air carrier, is not onboard the aircraft, such hold baggage shall be removed from the aircraft and shall not be carried on that flight;
  - A hold baggage manifest or an alternative means of providing evidence which confirms the identification and screening of unaccompanied hold baggage shall be drawn up;

7.16 Details of the hold luggage security screening process approved under Regulation 2320 are described as follows:

- hand search; or
- conventional x-ray equipment with at least 10 % of screened baggage also being subjected to either:
  - hand search; or
  - EDS or EDDS or PEDS; or
  - conventional x-ray equipment with each bag being viewed from two different angles by the same operator at the same screening point; or
  - conventional x-ray equipment with TIP installed and employed; or
  - EDS or EDDS; or
  - PEDS; or
  - Trace Detection Equipment on open pieces of baggage.

7.17 The security screening equipment used for hold luggage is required to meet defined criteria which is illustrated in Regulation 2320, as follows:

- **Equipment**: X-ray security equipment shall be applicable to any X-ray-based screening equipment that provides an image for an operator to interpret. This includes conventional X-rays as well as EDS/EDDS used in indicative mode.

- **Items**: Similarly, requirements and guidelines for X-ray security equipment shall be applicable to every item being screened, whatever its type or size. Any item going on board an aircraft, if it has to be screened, has to be screened to the standards contained in the Annex attached to Regulation 2320.
- **Performance requirements**:
  - Security: The X-ray equipment shall provide for the necessary detection, measured in terms of resolution, penetration and discrimination, to ensure that prohibited articles are not carried on board aircraft.
  - Tests: Performance shall be assessed using appropriate test procedures.
  - Operational requirements: The X-ray equipment shall display a complete image of any item fitting into the tunnel. There shall be no corner cut-off.
  - Distortion of the item displayed shall be kept to a minimum.
  - The belt of the machine shall be marked to indicate where bags are to be placed on the belt to obtain optimum images.
  - Contrast sketching: the X-ray equipment shall have the ability to display groups of grey levels (scan a smaller range).
  - The image of any part of the item being screened shall be displayed on the screen for at least 5 seconds. In addition, the operator shall have the ability to stop the belt and, if necessary, reverse the belt when further examination is required.
  - Screen size: the monitor's screen shall be sufficient in size for the operator's comfort (typically 14 inches and above).
  - Screen characteristics: the screen shall be flicker-free and have at least 800 lines (typically 1024 × 1024 pixels, i.e. high-resolution monitors).
  - Where dual monitors are used, one shall be monochrome only.
  - The X-ray equipment shall indicate visually materials it cannot penetrate.
  - The X-ray equipment shall provide organic and inorganic stripping.
  - The systems shall provide automatic threat recognition to facilitate the operator's search.
- **Staff training**: One of the critical elements of screening of hold luggage relates to levels of staff training undertaking this activity. Some of the key training components, described in regulation 2320 are as follows:
  - screening technology and techniques
  - screening check point operations
  - search techniques of cabin and hold baggage
  - security systems and access control
  - pre-boarding screening
  - baggage and cargo security
  - aircraft security and searches
  - weapons and restricted items
  - overview of terrorism
  - other areas and measures related to security that are considered appropriate to enhance security awareness.

The scope of training may be increased subject to aviation security needs and technology development. The initial training period for screening staff shall not be shorter than the International Civil Aviation Organisation (ICAO) recommendation.

Rail security

7.18 Until recently, most rail security within Europe focused on preventing criminal rather than terrorist threats. We are not aware that any attempt has been made to date to coordinate a framework of measures aligned to the prevention of terrorism on rail services within the European Union.

7.19 There is only one European passenger rail service where security resembles that at an airport. Since the opening of the Channel Tunnel between Calais (France) and Folkestone (United Kingdom), rail passengers on Eurostar have been subjected to security screening. The process for passengers boarding Eurostar at the terminals is very much on the lines of aviation security for both passengers and their hold luggage. Passengers using high speed rail services in Spain are also subject to security screening but this is less extensive than for either Eurostar or air services.

7.20 The recent terrorist atrocities targeted at commuter rail services in Madrid and London has resulted in rail security coming to the fore. Trials at rail stations are being undertaken of a range of detection techniques, although to date, the large volumes of passengers using major rail stations presents significant challenges to current detection systems.

7.21 Although there appears to be no suggestion that rail stations serving airports are under any greater threat than other high profile locations, we have reviewed a recent report by the International Air Rail Organisation regarding Security on airport railways. This contains a framework of recommendations for the prevention of terrorist attacks on stations and trains but it does not suggest security screening of passengers and their luggage to the same standards as presently adopted for aviation security.

Rail/Air interface

7.22 From the research we have undertaken, it is clear that it is possible to provide through rail/air baggage handling on the basis of a service similar to that currently operated by Lufthansa at Stuttgart, Cologne/Bonn and Frankfurt Airport and (before its withdrawal) the service operated by BAA for the Heathrow Express between London Paddington and Heathrow. From a pure security viewpoint, there are no greater security requirements associated with conveyance of luggage (accompanied or un-accompanied) on trains. However, this could alter in the light of a change in the threat assessment and some form of security screening may then be introduced to mitigate these concerns.

7.23 The only real security issue is that of ensuring any luggage checked-in at a rail station is fully screened to the appropriate aviation standards (Regulation 2320/2002) prior to being loaded onto an aircraft, that the passenger is on the same flight and that the air-rail check-in process **does not compromise aviation security protocol**. To minimise the aviation security risk, the most appropriate location to screen luggage is at the airport prior to going into the main airside baggage handling system. This principle is adopted at Frankfurt airport and was also applied at Heathrow prior to cessation of the Paddington check-in operation. For airports with in-line security screening integral to the baggage sortation system, this represents both a secure and cost effective solution.

7.24 **It would theoretically be possible to undertake passenger/baggage check-in at a rail station and at this point screen the baggage to aviation security standards.** However, this process would require the luggage to be regarded as coming under the appropriate aviation security regime, including maintaining it within a totally secure environment, from the rail station security screening process to the airport secure area. This process would inevitably result in additional costs and would also raise concerns regarding the overall integrity of the security supply chain. However, this option has been evaluated below.

7.25 For luggage arriving by aircraft and conveyed to a rail station destination, again, we are not aware of any Member State requirements associated with the security of luggage on the train. Given that the airline/handling company has a duty of care and responsibility whilst looking after a passenger’s luggage, the luggage will have been kept in a safe environment from the arriving flight, on the train and to the point where the passenger reclaims it at the rail station. Under this scenario, we believe the key issue will be to ensure appropriate customs clearance for luggage arriving from outside the EU. At Stuttgart and Cologne/Bonn, the Customs clearance process is carried out adjacent to the baggage reclaim carousel at the rail station.

Experience with air-rail services to date

7.26 Based on stakeholder consultation, publicly available information and first hand experience of using the services, this section describes the rail-air services currently in place at Paris Charles de Gaulle and Frankfurt airports and the services that operated at London Heathrow and Madrid airports before their withdrawal. It also reflects key issues raised during stakeholder consultation.

Paris Charles de Gaulle

7.27 SNCF, Thalys and various airlines provide an integrated air/rail service through Paris Charles De Gaulle. Airlines issue rail tickets and trains carry flight numbers, but there is no through baggage handling offered. We were unable to speak directly with SNCF or Thalys, but we had a helpful interview with DGAC, who informed us that a key reason for this was the prohibitive cost of the additional infrastructure, particularly if recovered on a per passenger basis. In 2005, 1.8 million passenger journeys used high speed train services to travel to CDG, representing approximately 3.3% of total airport passenger traffic, but 88% of these passengers used two separate tickets rather than a joint air/rail ticket. 4% used joint Thalys airline tickets and 8% a common TGV-airline ticket.

1.1 The service is primarily used by Air France but has now been extended to some other airlines, such as Qatar airlines. Air France tickets sold through their usual distribution points, including their website, can include a Thalys or TGV sector, and in theory, the TGV-Air ticket can be purchased just like any other Air France ticket. However, in practice, there are two significant issues with this:

- It can be difficult to get the website to show air/rail options; and
- Passengers must obtain a paper ticket.

7.28 As the nominal journey time of an air-rail journey through Paris to Lyon is longer than for an air-air journey, the option only shows up on the Computer Reservation System (CRS) with some persuasion. For example, to get an air-rail option for a London-CDG-Lyon journey, we found that the reservation site required the passenger to enter the code for Lyon Part Dieu (XYD) - which few people know; entering Lyon, or LYS, as a destination would only show air-air options.

7.29 Passengers transferring from rail to air can obtain their TGV and airline boarding pass at the train station but this option is not available for those transferring from air to rail. The TGV-Air ticket issued by Air France is essentially a rail voucher that has to be exchanged for another train ticket issued by the railway operator SNCF at check-in, as:

- There is no train seat and coach numbers issued on the boarding card (this currently does not appear possible with the current reservation systems of Air France and Thalys);
- The train ticket represents a contract between the passenger and Thalys
- The exchange is necessary to ensure financial accountability for both Air France and Thalys.

7.30 There is no more ticket security for the air-rail ticket than for any other rail ticket although there is no more apparent security risk either. There is no access security control before boarding the TGV or Thalys train services and therefore there is no way to ensure that the person who checks-in actually boards.

7.31 The lack of through baggage handling does appear to be a deterrent to use of this service rather than air-air services. The issue is exacerbated because of the relatively long walking distances at CDG and as some types of TGV train used on services to/from CDG do not really have adequate luggage space for this type of service.

Frankfurt

7.32 Frankfurt airport offer an air-rail service to Frankfurt Cologne/Bonn and Stuttgart. A full hold baggage and passenger check-in service is offered from these stations. Approximately 170,000 air passengers per year use this service. Trains are allocated an IATA flight number and information is transferred between the Lufthansa reservation system and Deutsche Bahn booking system.

7.33 The original rationale for the introduction of the service was to relieve runway slot capacity constraints at Frankfurt airport by replacing domestic air services with rail services feeding the international hub services from Frankfurt. However, this has not really happened and only two daily services have been withdrawn as a result of the rail service. Fraport believes the air-rail service has improved its reach to the wider catchment area and therefore helps their competitive position compared to adjacent airports.

7.34 Although the air passenger is provided with a reserved seat in the air-rail coach on the train, there is no specific airline branding other than an on-board steward. There is no reconciliation to ensure that baggage checked and passengers use the same train service, although that is the intention of the reservation system.

7.35 The main steps in the process of a passenger and baggage arriving at Cologne railway station to departing in the plane from Frankfurt airport are as follows:

- Passengers with hold baggage arrive at Cologne rail station. The passenger checks in themselves and their bag, receives a boarding card for both rail and air legs of the journey and a baggage receipt from the Lufthansa operated facility;
- The hold luggage is manifested and placed in secure / locked containers which are stored in a protected area prior to being loaded into a dedicated luggage compartment of the train;
- Passengers board the train. The train is allocated a flight number and the intention is for passengers to travel on the same train as their hold bags. However, there are no checks to ensure that passengers travel on the same train as their bags, nor is it specifically required;
- After arriving at the airport rail station, passengers proceed through the terminal building to the aircraft boarding gate and are subject to the same security checks as all other departing passengers;
- Hold luggage is off-loaded from the train at Frankfurt airport rail station by the dedicated baggage handling staff of Fraport. The locked containers are then conveyed to a special baggage room. In that room the containers are opened the luggage is security screened to German Government aviation standards and the baggage tag is interfaced into the airport baggage system database and the luggage is then fed into the airport's main baggage handling system.

7.36 For passengers arriving at Frankfurt airport and continuing by AIRail, the process is as follows:

- The passenger arrives by aircraft to Frankfurt airport with a boarding card for the journey from the airport to Cologne rail station. The passenger proceeds from the main terminal direct to the Frankfurt airport rail station and boards the train
- Baggage is offloaded and placed in the airport's main baggage handling system where it is automatically routed (via barcodes) to the special baggage room. It is then manifested and loaded into secure containers and then taken by dedicated staff to the dedicated rail compartment.
- At the Cologne Rail station the passenger proceeds to the Lufthansa baggage reclaim carousel. The hold baggage is delivered from the train to the carousel by dedicated staff. The passenger reclaims their luggage and proceeds through a customs channel. A lost and found facility is also located at the airport.

7.37 AIRail shows up on the CRS as an ordinary flight and can be booked as such. Every train is allocated a flight number, although this sometimes causes confusion with travel agents and passengers, who expect to travel by plane. Under some circumstances, due to the longer rail journey time, the option may not appear on the first screen of the CRS and therefore is not promoted by travel agents. Options involving air-rail travel do not appear at all on the Lufthansa website, nor those of the major intermediaries (such as Expedia). Lufthansa is not able to sell AIRail tickets on their website because their yield management system does not recognise the sector as being by train, and prices it as an air journey.

7.38 Lufthansa operate passenger and baggage check-in counters at rail stations to issue Lufthansa and other alliance/code-share passenger boarding cards for both the train and the flight. Passengers are not required to use the train whose 'flight number' appears on their tickets, although in this case they are not guaranteed a seat. Passengers transferring from air to rail would have been issued a boarding card for the rail journey at the time of check-in at the departing airport.

London Heathrow

7.39 An integrated rail-air service from London Paddington rail station to London Heathrow airport railway station is operated by the Heathrow Express. Until 2002, a hold baggage check-in facility was provided at London Paddington, although there was **no** arrangements for baggage reclaim at Paddington for arriving passengers. Heathrow Express carried 5.3 million passengers in 2004/05. When the hold baggage check-in facility was available around 23% of passengers used it.

7.40 The main steps in the process of a passenger and baggage arriving at Paddington to departing from London Heathrow are described below:

- Passengers with baggage arrived at London Paddington.
- Passengers checked themselves and their baggage at the check-in desks, they were issued with their boarding card and baggage tag.
- The hold baggage was transferred by tunnel from the check-in desk to a secure area on the rail platform.
- The hold baggage was then put into a container, which was sealed with a secure radio device to show that it had not been opened (or when it was).
- These containers were then loaded onto a separate baggage carriage.
- On arrival at Heathrow, these containers were un-loaded (in a secure area) into vans and then transferred to the airports baggage sortation process .
- The hold baggage and passengers were then subject to the same security screening process as bags and passengers arriving at the airport independently for a departing flight.

7.41 The main reasons for withdrawal of the service were:

i. **Airlines** found that check in at Paddington **did not provide them with a unique sales offer to passengers**. Passenger found the service useful, and used it. However, surveys found that it was not a key factor in determining whether a passenger flew with a particular airline (price and service frequency were the key factors).

ii. Following 9/11 there was significant pressure for airlines to cut costs. The non-essential service of off-airport check-in was an easy target to make cost savings.

iii. British Airways changed its strategy to promote **e-check in associated with a bag drop off at the airport terminal building.** This decision was also driven by cost efficiency.

7.42 An additional complication arose from security requirements introduced by the United States' Federal Aviation Administration after 9/11. It required that on Unites States airlines only full time employees of the airlines could check passengers and bags in. Agency staff, that had previously provided some of the services at Paddington, were no longer permitted under these rules.

7.43 Although the Heathrow Express has withdrawn its hold baggage service it does take security very seriously and uses a number of methods to promote and monitor security on the services:

- Extensive use of CCTV on the train and on platforms;
- Passenger profile training to target high risk individuals
- Security sweeps at the end of each journey to ensure that nothing is left on the train between legs of the service (Paddington-Heathrow; Heathrow-Paddington)
- Amendment to infrastructure to take lids of litter bins, and to taper the roofs of ticket machines (to avoid items being place their).

7.44 There are now no integrated rail-air ticket for passengers taking the Heathrow Express, and the rail journey is not available on airline reservation sites. A number of airlines do offer passengers the option of buying tickets on board for on the Heathrow, Gatwick or Stansted Express rail services. The Heathrow Express does possess an IATA 9G code however this has not been used and airlines appear reluctant to use it.

7.45 Although there are potential benefits to HEX from through ticketing there are also downsides, in that it has led to a large number of refunds on the service as people – particularly business passengers tend to change their mode of travel at short notice. There is a general understanding that airlines have found limited benefit in offering an integrated rail-air product.

Madrid

7.46 A check-in facility for Madrid airport was opened in 2002 at Nuevos Ministerios rail station in central Madrid. This is currently served by suburban trains and it is planned to open a high speed rail station here in the future. Nuevos Ministerios was linked by express metro, not rail, to the airport, but the arrangements were similar. The service was used by Iberia and some other Spanish airlines only but has now been withdrawn. Iberia explained to us that there were no serious security issues with it: the problem was that it was used by very few passengers. No exact figures were available but Iberia said the number was "much less than 5%" of their passengers. The reasons it was unattractive included:

- Check-in times: Nuevos Ministerios to Madrid airport is only 15 minutes by metro, but the advance check-in period required at Nuevos Ministerios was much greater than at the airport
- Convenience: The service was only useful for passengers joining the metro at Nuevos Ministerios, not at any other metro station.

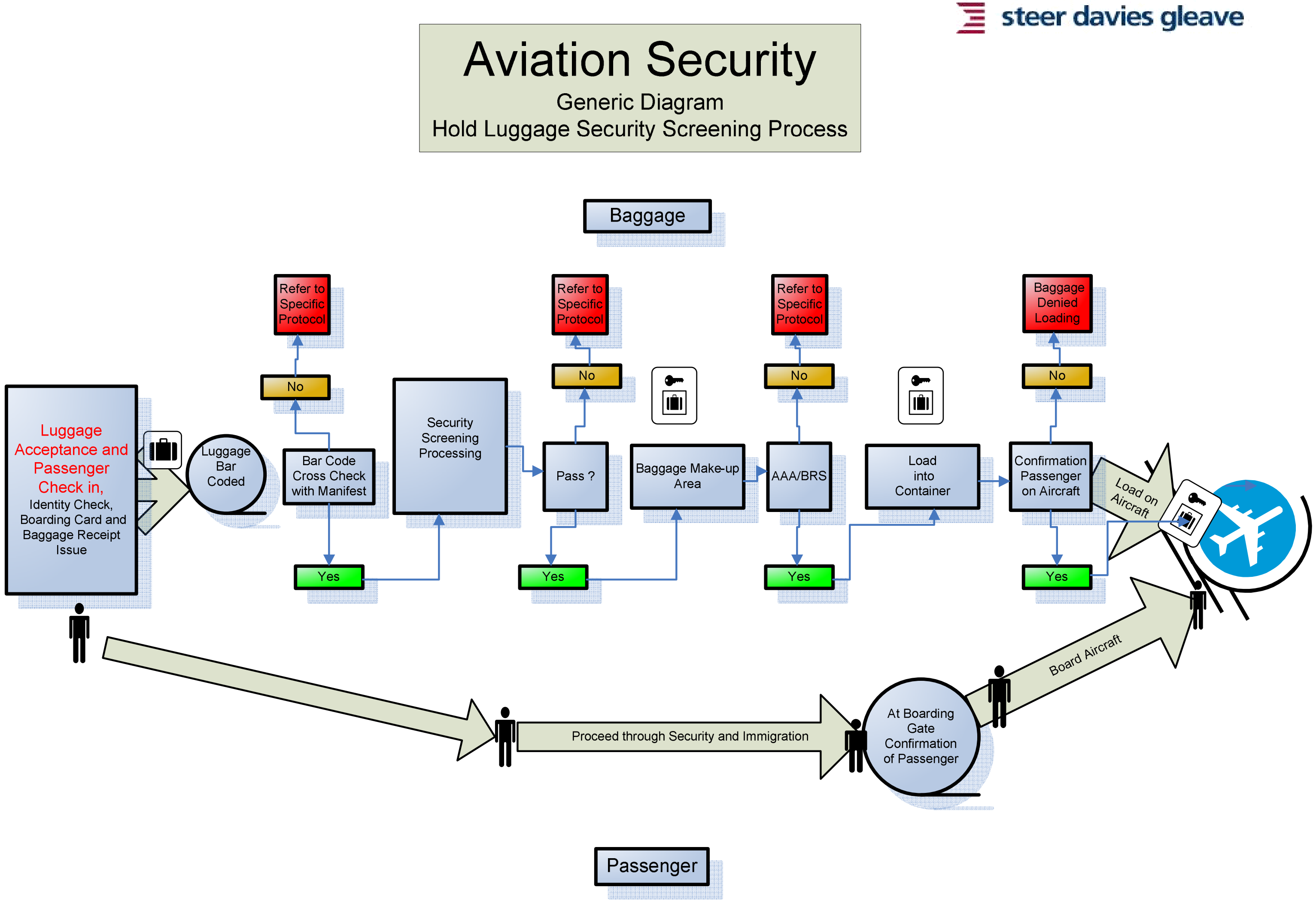
7.47 The service was withdrawn when the new Iberia terminal at Madrid airport opened in early 2006, because the new terminal is not yet connected to the metro; however, due to cost and lack of demand, there are no plans to reinstate it when the metro extension to the new terminal opens.

Baggage check-in and passenger security

Overview of normal aviation security arrangements

7.48 The generic security screening process for hold luggage, to be carried by air, is illustrated in Figure 7.1 and described below. As is explained later in the chapter, there could be a number of options relating to the way in which this process would be integrated into a rail/air operation. The key security risks are also identified below.

FIGURE 7.1 HOLD LUGGAGE SCREENING PROCESS



7.49 The main steps are as follows:

- **Step 1:** Luggage and passenger checked-in, boarding card and baggage receipt issued. For passengers who have previously checked-in (internet, phone, SMS, etc.) there is still a requirement for the luggage to be identified (normally by bar-code label). This process may also include an element of passenger profiling-dependent on specific protocols.
- **Step 2:** The unique baggage identifier is linked to the specific passenger in the airline computer reservations system.
- **Step 3:** Hold luggage will then be security screened to defined standards, either while the passenger is checking-in (i.e. within their presence) or by use of a method integrated within the baggage handling system. For small passenger volumes it may be appropriate to conduct a manual search of hold luggage but most screening operations will use some form of x-ray technology. The level of sophistication of the x-ray equipment dictates the number of bags which may have to be subjected to a manual search. Many larger airports have made significant investment in security systems which minimise manual screening; these systems are often referred to as Level 1 to Level 5.
- **Step 4:** After successful security screening, the luggage must be kept in an area which has restricted access and people (and their possessions) authorised to be within this area will also have been security-screened to the same standards as is applicable to passengers and their luggage.
- **Step 5:** Using the unique luggage label/passenger identifier, the item of hold luggage will not be permitted to fly on the departing aircraft unless confirmation is received that the passenger has boarded the aircraft.

Rail-Air passenger and baggage process options

7.50 The following section details the process flows associated with the air/rail checked baggage options. It covers both airports which have an integral main line rail station (such as CDG) and those which do not have such a link (such as Madrid). For airports not having a integrated rail station, it is assumed that connection to the city main line station from the airport could be a number of alternatives, such as, metro, local rail, light rail/tram or bus. Baggage security screening could be either at the airport or the rail station. It is assumed that under all the scenarios, the passenger would be in possession of a combined rail/air ticket covering all legs of the journey.

7.51 This results in six options (four for departing and two for arriving passengers):

- **Option 1:** Rail to air, integrated rail station, baggage security screening at airport
- **Option 2:** Rail to air, remote rail station, baggage security screening at airport
- **Option 3:** Rail to air, integrated rail station, baggage security screening at station
- **Option 4**: Rail to air, remote rail station, baggage security screening at station
- **Option 5**: Air to rail, integrated rail station
- **Option 6**: Air to rail, remote rail station

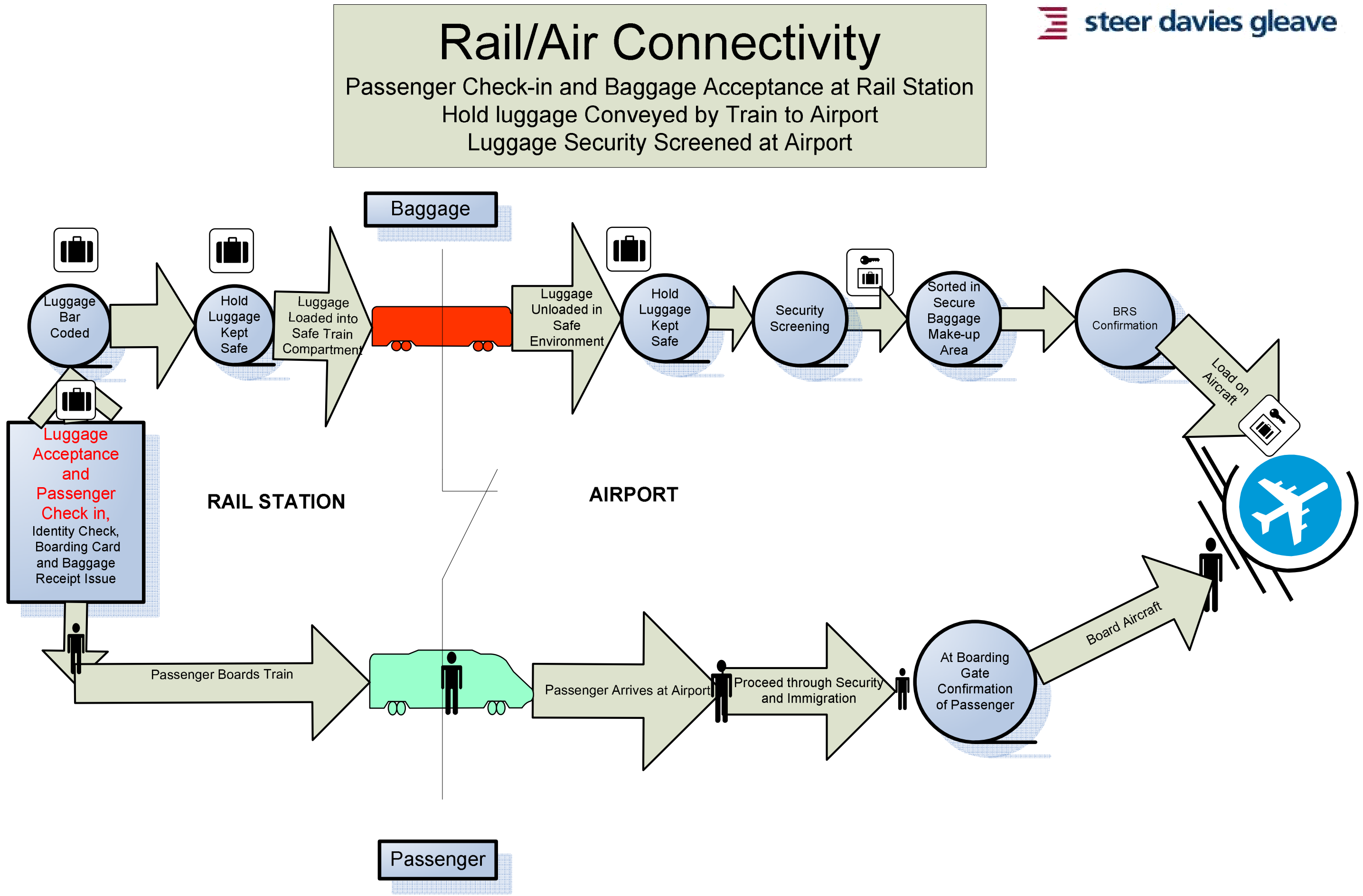
Rail air security process: Option 1

7.52 Broadly speaking, this is the arrangement that is currently used at Frankfurt airport and which was previously used at Heathrow and Gatwick airports. This process works as follows:

- The passenger and hold luggage are checked-in at the rail station, the passenger's **identity is confirmed** and then they are issued with a **boarding card**, their **luggage is tagged with a bar code** and the appropriate receipt is issued (in the future boarding cards may be issued via e-ticketing).
- The passenger then boards the appropriate train and proceeds to the airport as a conventional departing passenger.
- After the luggage is accepted by the airline/handler at the rail station, but **not** security screened, it is still necessary, under a duty of care, to keep it under surveillance for the avoidance of theft, etc. It us then manifested and loaded into an appropriate and "safe" compartment of the train. It would have to remain in a "safe" environment during this whole supply chain activity with appropriate records kept.
- On arrival at the airport, the luggage is un-loaded from the train, manifest checked and then conveyed in a safe manner to the baggage handling facility, where it is security screened and recorded into the appropriate airline Baggage Reconciliation System (BRS), thus becoming a regular item of hold luggage subjected to all the normal aviation departing baggage protocols.
- The final process would be to ensure the departing passenger boards the aircraft before the hold luggage is cleared to fly on the aircraft.

7.53 This process is illustrated at Figure 7.2.

FIGURE 7.2 OPTION 1 RAIL AIR SECURITY

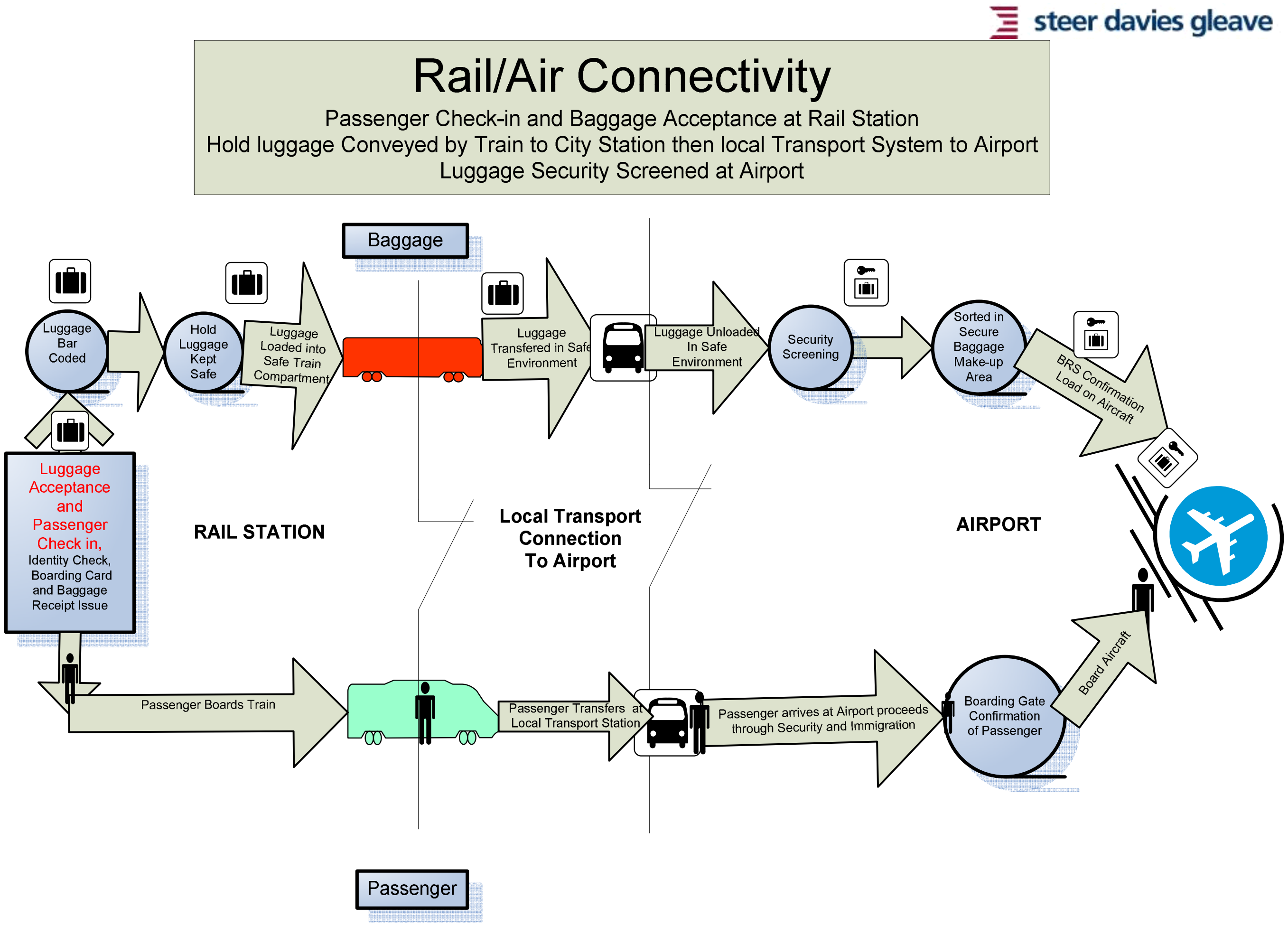


Rail air security process: Option 2

7.54 This option uses the same process as Option 1 but the passenger would board a regular train from the appropriate remote train station to the city centre station, then transfer to a local transport link to the airport as a conventional departing passenger. After the luggage is accepted by the airline/handler at the rail station, but not security screened, it would still be necessary, under a duty of care, to keep the luggage under surveillance for the avoidance of theft, etc. The luggage would then be manifested and loaded into an appropriate and "safe" compartment of the train to the city centre station. The luggage would then be transferred to the local transport link to the airport. It would have to remain in a "safe" environment during this whole supply chain activity with appropriate records kept.

7.55 This process is illustrated in Figure 7.3 below.

FIGURE 7.3 OPTION 2 RAIL AIR SECURITY

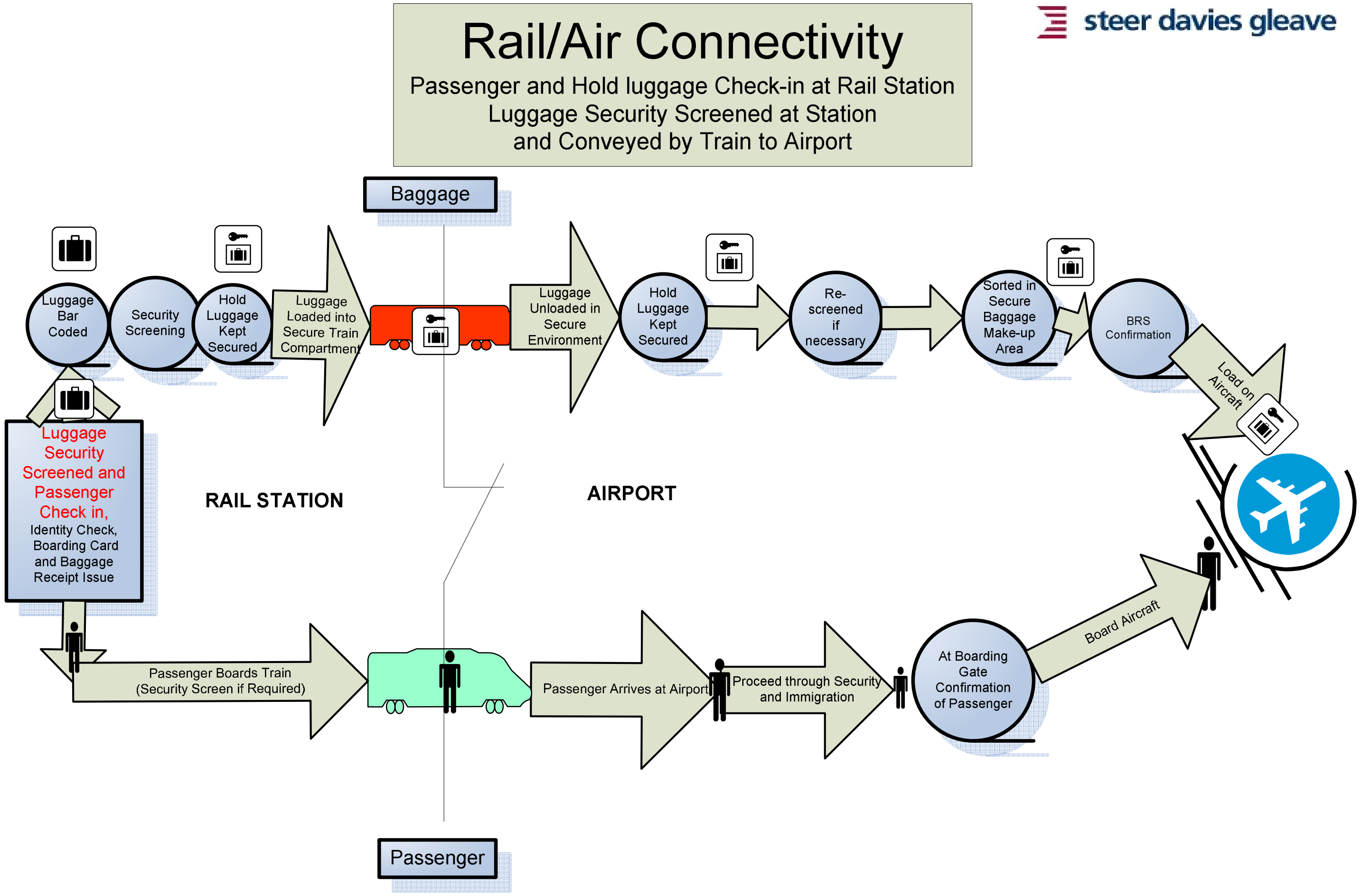


Rail air security process: Option 3

7.56 This option uses the same process as Option 1 except that, after the luggage is accepted by the airline/handler at the rail station, it would be security screened to **full aviation standards**. This activity would be carried out in a secure environment with all the necessary safeguards to prevent unauthorised access. This would need to take place at *all* stations at which there was remote check-in.

7.57 The luggage would then be manifested and loaded into an appropriate and “secure” compartment of the train. It would have to remain in a “secure” environment during this whole supply chain activity with appropriate records kept. It would not need security screening at the airport although it would still be necessary to check that the correct passenger boarded the aircraft. This process is illustrated in Figure 7.4 below.

FIGURE 7.4 OPTION 3 RAIL AIR SECURITY



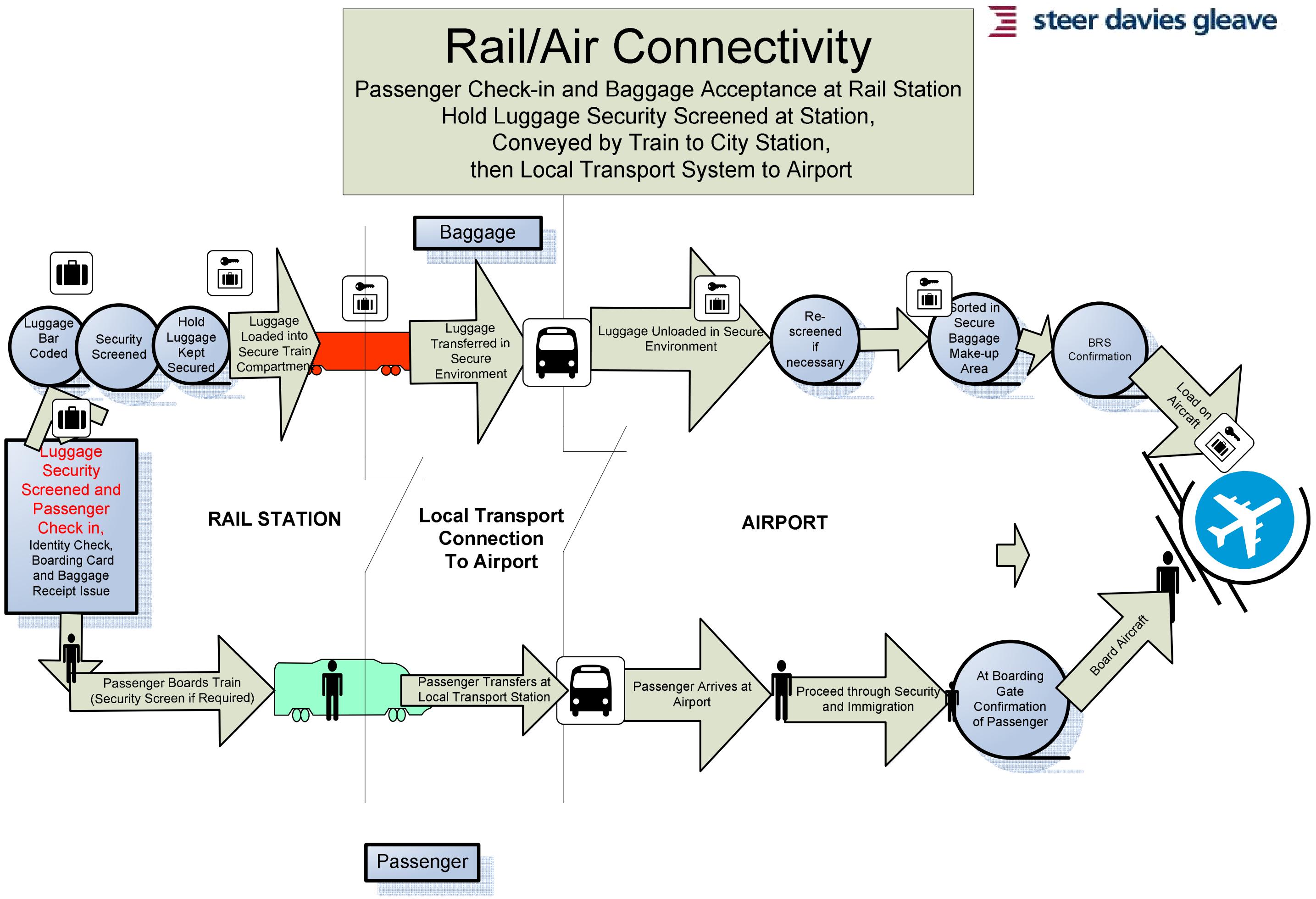
Rail air security process: Option 4

7.58 This option uses the same process as option 2 except that, as in option 3, after the luggage is **accepted by the airline/handler at the rail station**, it would be security screened to full aviation standards. This activity would be carried out in a secure environment with all the necessary safeguards to prevent unauthorised access.

7.59 The passenger would board the appropriate train and proceed to the airport as a conventional departing passenger. The luggage would then be manifested and loaded into an appropriate and "secure" compartment of the train. It would have to remain in a "secure" environment during this whole supply chain activity with appropriate records kept.

7.60 On arrival at the city centre station, the luggage would then be transferred to the local transport link to the airport. It would have to remain in a "secure" environment during this whole supply chain activity with appropriate records kept. This process is illustrated in Figure 7.5 below.

FIGURE 7.5 OPTION 4 RAIL AIR SECURITY



Rail air security process: Option 5

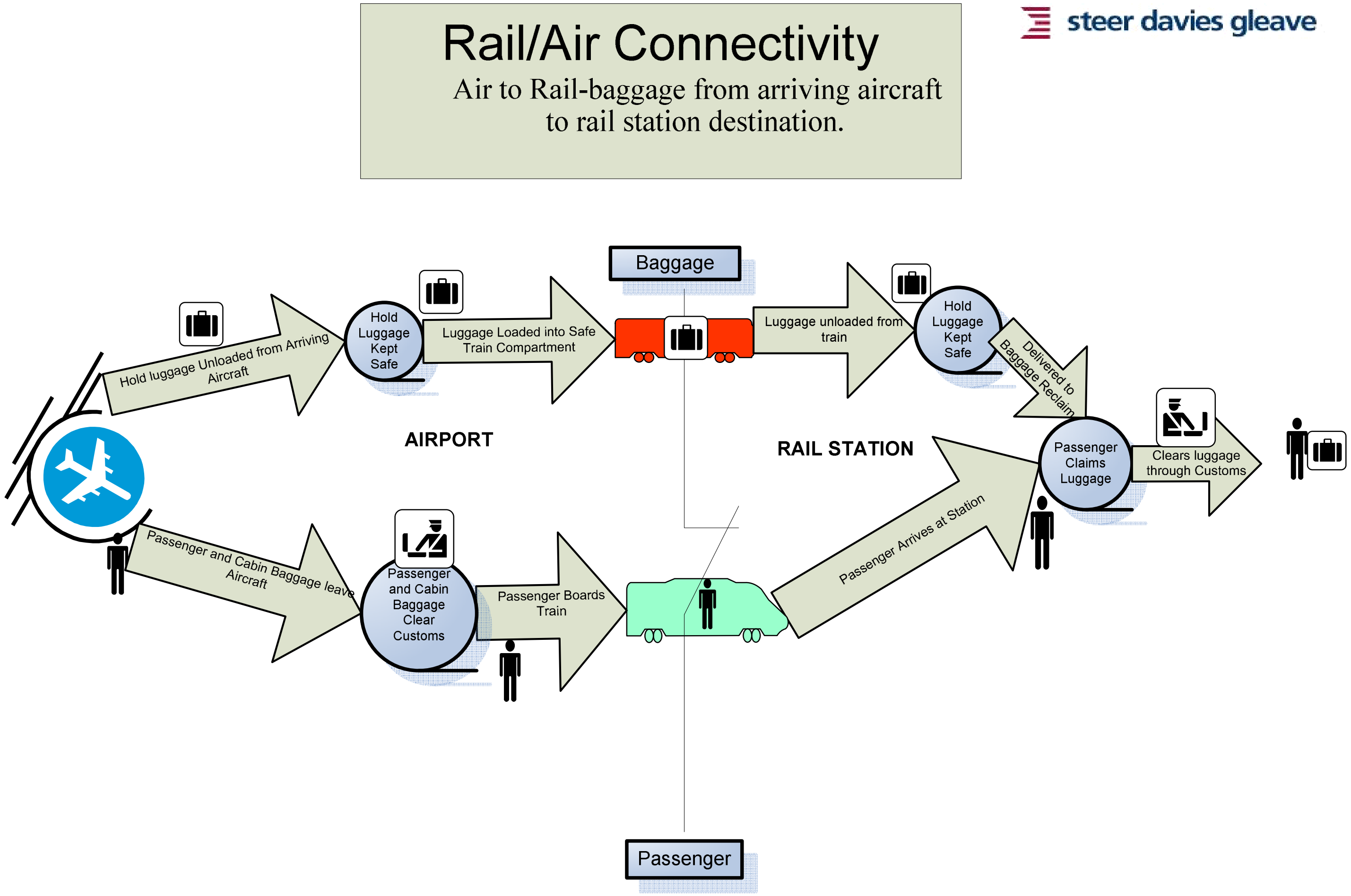
7.61 Under this option, the passenger arrives by aircraft, proceeds through the appropriate **customs and Immigration checks**, boarding the train at the airport rail station and proceeds to his rail destination.

7.62 The passenger's hold luggage would be intercepted during the aircraft un-loading process and taken by a **discrete route to the rail station** where it would be conveyed by train to the passenger's rail destination. As in all cases, the luggage would have to remain in a "safe" environment during this whole supply chain activity with appropriate records kept.

7.63 Given that the airline/handling company has a duty of care and responsibility whilst looking after a passenger's luggage, the luggage will have been kept in a safe environment from the arriving flight, on the train and to the point where the passenger reclaims it at the rail station. Under this scenario, we believe the key issue will be to ensure appropriate **customs clearance for luggage** arriving from outside the EU. At Stuttgart and Cologne/Bonn, the customs clearance process is carried out adjacent to the **baggage reclaim carousel** at the appropriate rail station.

7.64 Although this option represents high levels of customer service, this can be negated if the passenger manages a rapid exit from the airport, catches an earlier train than booked and arrives at their destination to find their luggage is on a later train. This process is illustrated in Figure 7.6 below.

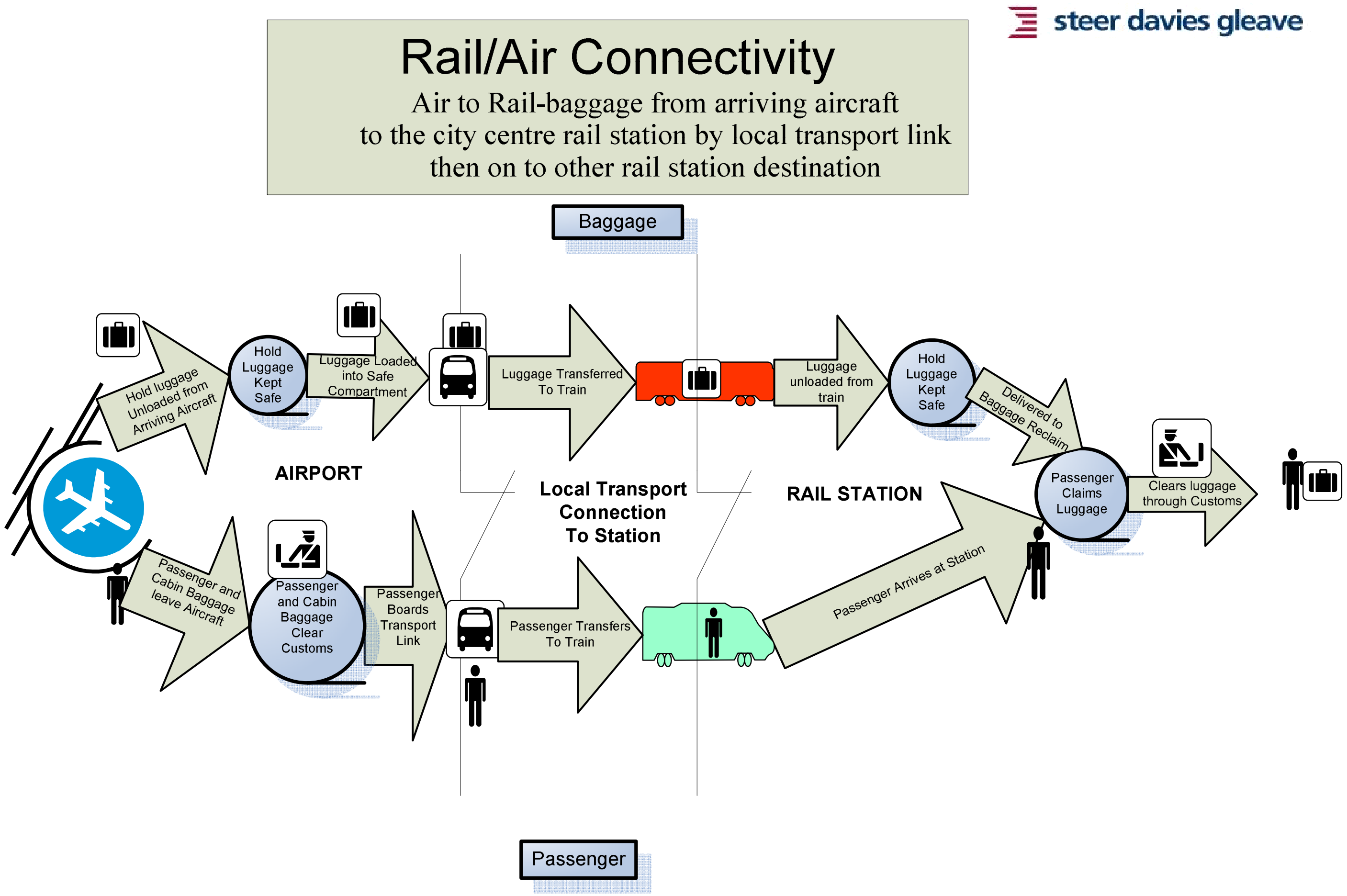
FIGURE 7.6 OPTION 5 RAIL AIR SECURITY



Rail air security process: Option 6

7.65 This option uses the same process as Option 5 but the passenger’s hold luggage would be intercepted during the aircraft un-loading process and taken by a **discrete route to the local transport link**, on to the city centre rail station and transferred to a train to the passenger’s rail destination. As in all cases, the luggage would have to remain in a “safe” environment during this whole supply chain activity with appropriate records kept. This process is illustrated in Figure 7.7 below.

FIGURE 7.7 OPTION 6 RAIL AIR SECURITY



Air-rail security risks and the mitigation

7.66 In the following table we highlight the key security risks arising from an air-rail operation as defined under each of the six options described above and possible methods of mitigation.

TABLE 7.1 OPTIONS: AIR-RAIL SECURITY RISKS

Option	Aviation Security Risks	Mitigation
Option 1: Rail to Air-baggage checked-in at rail station, conveyed to the airport rail station and then security screened at the airport prior to being loaded onto the aeroplane. **Option 2:** Rail to Air-baggage checked-in at rail station, conveyed to a city centre rail station then by local transport link to the airport and then security screened at the airport prior to being loaded onto the aeroplane.	From an Aviation Security perspective, security screening associated with these 2 options is most similar to that at present operated for checked luggage at airport terminals. Providing normal security screening is carried out at the airport, **this option represents the lowest risk.**	The physical characteristics of the airport would determine the ease by which luggage from the rail connection could be interfaced with the existing hold luggage screening arrangements. At Frankfurt a dedicated baggage screening operation has been constructed adjacent to the rail station, with bags then proceeding into the automated baggage handling system. However, we were advised that a direct link to the airport central baggage screening area was going to be constructed which would considerably reduce the operational costs. At Heathrow, when this facility was in operation, baggage was conveyed from the rail station and injected into the normal transfer baggage acceptance points. Under this scenario, there were no direct security costs incurred.
Option 3: Rail to Air-baggage checked-in at the rail station, security screened to aviation standards at that point then delivered to the airport for loading onto the aeroplane. **Option 4**: Rail to Air-baggage checked-in at the rail station, security screened to aviation standards at that point, conveyed to the city centre rail station then by local transport link to the airport for loading onto the aeroplane.	Both these options represent a **greater security risk compared to options 1 and 2.** Obviously, the longer the period of time after screening and the increased number of handling activities, increase the opportunity for interference with the item of luggage.	The **costs associated with these options will be considerable and not directly volume related**. In essence, it will be necessary to set-up a luggage security screening operation at the rail station; maintain a sterile environment for this area and any other locations where persons may have access to the screened luggage; maintain a complete audit trail for every item screened and have a very secure/robust arrangement for conveying the luggage (sealed containers, dedicated train compartments, CCTV cameras, etc.) from station to airport. These arrangements would also have to be agreed and approved on an individual basis by the appropriate regulatory body and be subjected to regular inspections.
Option 5: Air to Rail-baggage from arriving aircraft to rail station. **Option 6**: Air to Rail-baggage from arriving aircraft to the city centre rail station by local transport link then to other rail station.	As these items of luggage will have already been screened and flown on an aircraft, it is difficult to envisage they would represent any more threat than luggage which is conveyed normally on transport and rail links.	None at present appropriate.

Overview of costs of mitigation

7.67 Options 3 and 4 would incur substantial security mitigation costs. Under Options 1, 2, 5 and 6 there are no “aviation security” regulations relevant to the landside element of the luggage process, and therefore few additional security related costs would be incurred, although clearly there is a “duty of care” to ensure items of hold luggage within the responsibility of the airline/handling agent is maintained in a safe environment to prevent criminal activities associated with theft, smuggling, etc.

7.68 However, the costs associated with provision of the check-in and baggage handling infrastructure at the rail station may be considerable. These costs could also involve adaptation to trains necessary to convey the hold luggage (for example, the Heathrow Express had to comply with stringent fire regulations). We were advised that the costs in establishing the Heathrow Express check-in and baggage acceptance operation (non-aviation security) at Paddington Station was in the order of €40 million. Although Fraport, Lufthansa and Deutsche Bahn were unwilling to provide us with the costs of implementation of the baggage and check-in system at Frankfurt, we understand the costs, due to the higher specification of the system used, would have been higher than those incurred at Paddington, and indicatively we would expect these to have been in the range of €60-100 million.

Conclusions Associated with Rail Station Luggage Acceptance/Delivery

7.69 We believe that providing adequate security measures as outlined above are in place, the integrity of the present aviation security regime would not be compromised by the introduction of rail station luggage operations. However, unless there is a requirement to introduce security screening associated with rail travel, it is difficult to quantify any specific benefits of screening hold luggage to aviation security standards at a rail station rather than at the airport.

7.70 One of the key aviation security precepts is to undertake the security screening process at the last possible moment prior to boarding/loading the aircraft. This clearly minimises the potential risk of interference after the screening process. Therefore, from an aviation security, economic and practical point of view the most appropriate location to screen luggage following a rail station check-in would be at the airport of departure.

7.71 Delivering luggage from an arriving aircraft to a rail station would appear to have no aviation security implications, although the costs could be considerable, and it would also be necessary to ensure compliance with customs requirements.

Security issues arising in other modal interchanges

7.72 To inform this analysis, we have investigated whether there are similar security issues arising with other intermodal interchanges. However, we have not found any similar security checking processes involving inter-modal transfers of passengers and baggage, including road to rail and road to maritime. We therefore do not believe that the aviation-high speed rail interface can learn from these passenger based services.

7.73 For cargo services, there are some security and customs processes in place for road to maritime and road to aviation services. However, most maritime security is focused on detection of smuggled cargo or illegal immigrants.

7.74 The majority of air cargo by its nature does involve an element of intermodal connectivity and is regulated under the same aviation security legislation as described in EC 2320/2002. The security screening process can take place on or off the airport, dependent on the consignor's status. Once the consignment has been security screened, the sterility of the shipment must be maintained until such time as it is placed onboard the aircraft and it has departed. The security technology used for air cargo screening is not dissimilar to that used for hold luggage although equipment is now available capable of x-raying whole containers. However, the security provenance of each item within the container would have been verified beforehand.

Key policy issues arising

7.75 Air and rail security frameworks and regulation are separate. The rail system, with the main exception of the Eurostar service is characterised as an open access system. This is in contrast to the aviation "closed" access security system.

7.76 We have described a number of options where air-rail hold baggage can be integrated into the aviation security led process. However, the two systems remain for security purposes separate, as the aviation security for passenger and baggage takes place at the airport.

7.77 In France, due to costs and Air France's choice, there is no hold baggage check–in product on its air-rail services. This contrasts to the situation in Frankfurt with Lufthansa that offers a full hold baggage check-in service. In addition, the experience at Madrid and London Paddington and Victoria where hold baggage check-in services were withdrawn is important. The service was considered a benefit to passengers but it is not a clear decision parameter for passengers in terms of which air carrier to buy their ticket from. Therefore, in many ways the hold baggage check in can be considered a **luxury, but discretionary service**. In addition, the costs of implementing and operating the service are substantial: unless usage increases substantially, we estimate that the capital costs alone of the Lufthansa service are likely to be in the range of €10-30 for each passenger that uses it. In the current environment, where air travel is increasingly commoditised and chosen by most passengers on the basis of price more than anything else, we believe it is unlikely that many European airlines would chose to pay for such a system.

7.78 It is also difficult to determine a commercial case for installing this infrastructure on the basis of freeing up space at airports. More and more passengers are adopting self-service or e-check-in, so the pressures on airport check-in concourses are becoming eased as full check-in counters are replaced with much more efficient fast baggage drops.

7.79 **In summary, we found that there are no insurmountable security issues – the problem appears to be one of cost. Unless a host airline/airport received funding support for introduction of a rail station baggage check-in service, it is unlikely that this type of air-rail baggage service would be introduced in many other places in the European Union**.

Air-rail e-Ticketing and joint ticketing offers

Recent trends

7.80 The use of integrated ticketing between airlines has been a key feature of airline code share agreements and airline alliances. The airline computer reservation systems readily allow passengers to be issued multi-legged tickets served by different airlines under the IATA ticket clearing system. However, until now the integration between air and other modal tickets has been limited.

7.81 The increase in ticketless travel, or e-ticket arrangements, at least in theory, makes an integrated rail-air product potentially more accessible. At the same time some airlines are promoting e-ticketing and rapid bag drop-off which promotes cost efficient check-in methods at the airport and discourage the more costly remote check-in. All these features impact the air-rail e-ticketing and joint ticketing offers available to passengers.

Security issues arising with ticketing

7.82 The increase in e-ticketing represents a challenge to aviation security, but it does not have a specific impact on the air-rail security interface. It is of greatest importance for aviation security that the baggage and passenger check-in process is not compromised by e-ticket check-in.

7.83 We understand there is on-going debate as to which medium is appropriate to record ticketing information. For example, an e-ticket for a traveller who prints a ticket on his/ her home printer with a unique barcode allied with passport checks would seem to be wholly appropriate and would not compromise security. However, we understand that some air e-tickets in Members States are being reconciled through text messages and unique numbers provided by a mobile phone. In principle this raises more questions for the aviation security interface due to the mobility of a phone and would always need to be backed up with secondary checks such as passport and credit card checks.

General issues regarding integrated ticketing

7.84 There are few instances where a full rail-air through ticketing regime has been implemented. Examples of joint marketing are much more common, whereby airlines actively market rail connections. These are sometimes supported by commission arrangements, sharing of marketing costs, discounted rates to the selling airline or discounted rates to the passenger.

7.85 A basic problem is that the traditional airline interline system was based on accounting for the revenue on the basis of travel, whereas the rail system was generally based purely on sale. Interline revenue shares for air were calculated on the basis of real transactions, though often aggregated by a sampling system. For rail, much revenue allocation was done on the basis of what amounts to a mathematical model that had might have been supported by a market survey; therefore, the train company still got the payment due, whether or not a ticket inspector has actually checked the passengers' travel documents. Although both air and rail systems have evolved, they remain incompatible. If the carrying airline does not collect the relevant flight coupons (whether physically in terms of a paper transaction, or as a computerised record) then the carrying airline would be unable to invoice the selling airline. Where a train operator is providing the carriage, the infrastructure necessary to collect the coupon has somehow to be introduced into the journey. This has the obvious problem that ticket inspectors on trains are not trained to identify air tickets and are not supported by suitable technology to facilitate verification. The increasing use of e-tickets adds to the technological challenge.

7.86 As a result, through rail-air check-in arrangements require some system at the boarding station for lifting airline coupons and substituting documents for train travel. This requires the airline to provide some sort of presence at all the railway stations concerned. This is a workable proposition on a limited route structure with a high volume of rail-air passengers. However it does commit the airlines to providing resources and this is generally not considered to be cost effective.

7.87 Consequently a genuine check-in service, permitting checking of bags for onward carriage and assignment of boarding passes and seat numbers, requires dedicated desks for airline passengers.

7.88 There are a number of other issues that deter the development of through ticketing arrangements:

- An increasing proportion of travel is price driven. Airlines sell their cheapest fares as simple point to point options, usually as a means of selling capacity on off peak services. This also applies for rail-rail journeys where the operator is different: for example, to obtain the lowest fare for a Paris-Barcelona journey, which requires a change of trains, a passenger must buy separate tickets, from different outlets, for the SNCF and RENFE sectors.
- Over 50% of journeys, consequently, are sold as point to point, whether on low cost airlines or on the classic airlines. This has the effect of marginalizing the demand for inter-modal products.
- Airlines want to avoid complexity and the additional costs created by peripheral products. This is epitomized by the development of low cost carriers, who exclude interline facilities amongst other frills. Classic airlines are being forced to apply similar simplifications to their services, so far as they can.
- The number of railway stations in Europe – even if only main line stations are counted – is so large that there would not be enough codes available under the IATA 3 letter code arrangement. Though this on the face of it seems a trivial matter, the implications of going to a new system based on 4 letter codes would be extremely expensive for the industry and would involve re-writing a vast number of computer systems covering sales and operational functions.
- The user costs of CRS systems such as Amadeus are in part based on the number of segments in the journey. Consequently multi coupon ticketing is relatively expensive to distribute (typically US$ 5 per coupon) which means that it is not cost effective for low fare or very short connecting journeys.
- Marketing arrangements are considered by airlines to be an attractive alternative as they are cheaper to operate and have less complexity. They are not necessarily as flexible as a genuine interline system, but are satisfactory for targeted markets.
- Airlines are now developing e check-in arrangements. For the airline, this has the benefit of reducing costs. For the passenger it reduces the number of interfaces

with the airline (and hence queues). Consequently where e check-in is possible, a through check-in product only becomes attractive if the passenger has more luggage than can be carried comfortably on and off the train and through the airport - in practice this amount is significantly larger than the hand luggage limits permitted onboard the aircraft.

Key policy issues arising

7.89 According to our analyses, the differences in air and rail reservation systems are the main obstacle to marketing complementary air-rail services. Air and rail services in France, Germany and the United Kingdom are currently operating as two separate products. Joint ticketing would support the consumer appeal of the complementary services, but this is expensive and operationally complex.

7.90 The fact that it is not currently possible to get an e-ticket for air-rail journeys in France appears to have more to do with separate and unlinked CRS for the rail and air operators than security. There are three apparent solutions to this problem:

- The Air France website could have a function equivalent to that used by SNCF on its website for passengers to print their own tickets. This could not pose any security risk beyond that applying for any other domestic rail journey for which a self-printed ticket is issued. However, the setup costs of this could be considerable and it might not be practical due to different rules on changing tickets.
- Have a separate coach, or at least a separate group of seats on the train, reserved for rail/air passengers (at present they are allocated whatever seats are available). Then this coach or group of seats could be treated as an aircraft for the purposes of the CRS and the boarding pass could be issued by Air France staff.. However this has obvious cost implications.
- Air France could be linked to the SNCF booking system so that its staff could see what space was available on trains and allocate a seat at check-in; the boarding pass issued would then have to be accepted by SNCF. Again this would be expensive – depending on the systems used it might even require a separate terminal at the ticket issue/check-in point – and SNCF would probably be unenthusiastic about granting anyone else access to its booking system.

7.91 Improvement in the reservation and ticketing process of air-rail travel requires commitment of air and rail operators, as well as costly IT solutions. At present, there is only one airline intermediary website (Opodo) that is able to offer through rail-air tickets. Evidence from the case study routes suggests that demand for wholly integrated air-rail journeys is low, which makes it difficult to justify the investments in the interoperability of current systems.

Conclusions

7.92 We have not found any security issues that would prevent the greater introduction of rail-air services, as the security frameworks and protocols between air and rail services continue to be separate. Introducing greater use of e-ticketing does not change these conclusions. Any options for introducing more rail-air services would need to ensure there **was no compromise** of the strict aviation security protocols in place in the European Union.

7.93 Air-rail services have been relatively unsuccessful in transferring or substituting rail for air services. The passenger numbers using the services are significant but often transferring from other surface access modes.

7.94 The difficulties with communicating and consolidating information between the respective air and rail computer reservation systems cause confusion with potential customers. The marketing is often unclear and the presentation of the product confused. In principle, all these issues can be resolved but will cost significant investment in people and infrastructure. This will need to be commercially justified.

7.95 The introduction of any **new** high speed rail-air integrated services with baggage check-in will require significant investment in physical infrastructure (secure carriages, baggage sortation systems), as well as internet based reservation systems. Without such investment, the new operations are unlikely to be successful. However, low usage of the air-rail services when these are available means that it is difficult to recover the capital costs of the service.

7.96 The case where the high speed rail station is located away from the airport, and the passenger is required to make an additional surface transport journey leg adds complexity to the journey. The infrastructure and logistics costs of integrating this service would be considerable. It would add extra security processes, however we do not think these are a barrier to their introduction. However, we expect the additional infrastructure and operating costs will prevent its widespread introduction.

7.97 Experience in Germany has shown that the air-rail service has been unsuccessful in persuading passengers originating from outside Germany to use it. Some international passengers, such as those from the United States, who are accustomed to domestic air travel (and do not use unreliable rail services), will have perceptions of rail travel that are difficult to change. There is some evidence that passengers using the service tend to be repeat users, but that the market penetration has been limited. It has been easier to persuade German originating passengers to use the service.

APPENDIX A

AIRLINE OPERATING COST MODEL

AIRLINE OPERATING COST MODEL

Background

A1.1 We have constructed an airline operating cost model. Analysis of airline operating costs is simpler than analysis of railway operating costs, for two main reasons:

- airline costs are largely generic, whereas rail costs differ significantly between operators; and
- airline operating and financial data is often publicly available, whereas rail data generally is not.

A1.2 The costs of operating a service on two routes of equivalent length in two different EU states are very similar. The same two types of aircraft (the Boeing 737 and the Airbus 319/320) are used for the vast majority of significant intra-EU routes; fuel consumption and costs are a function of distance but otherwise do not vary by route. Even staff costs tend to be similar, because the most expensive staff (flight crew) can easily transfer between states and airlines, partly as by international convention all air traffic communications take place in the same language. As a result of this mobility, salaries tend to equalise. The only item that can vary significantly is airport and en-route air navigation charges, which are published by airports and air navigation service providers, and collated by IATA.

A1.3 In addition, much more of the data that we need to construct an airline operating cost model is public. Most airlines are listed companies, and therefore they are required to publish detailed financial reports, although the requirements for information disclosure do depend on where the shares are listed (requirements are particularly onerous, and therefore data is more widely available, for airlines partly listed in the USA). Many states also publish detailed airline traffic data and, in some states, airlines are required to publish detailed financial information. In contrast, route-specific traffic data for rail operators is almost never publicly available, and financial data can be very difficult to obtain.

Approach

A1.4 We have constructed a cost model for airlines using the following data:

- For airport charges and en-route charges, we use actual charges published in the IATA Airport Charges Manual.
- For fuel, we use average unit costs of fuel from airline accounts and manufacturers fuel consumption curves, showing fuel consumption by distance.
- For other cost items, we have used unit cost data obtained from UK CAA published airline financial data. This is used as the source as it is significantly more detailed than the financial data available through airlines’ annual reports. As explained below, we use data for various classic airlines, plus data for easyJet to model the low cost airline.

A1.5 We have allocated a cost driver to each of these factors. Most costs are either a function of number of passengers, aircraft hours, flight hours, or are route specific.

The operating cost categories used by the UK CAA and the cost driver than we have allocated are shown in the table below.

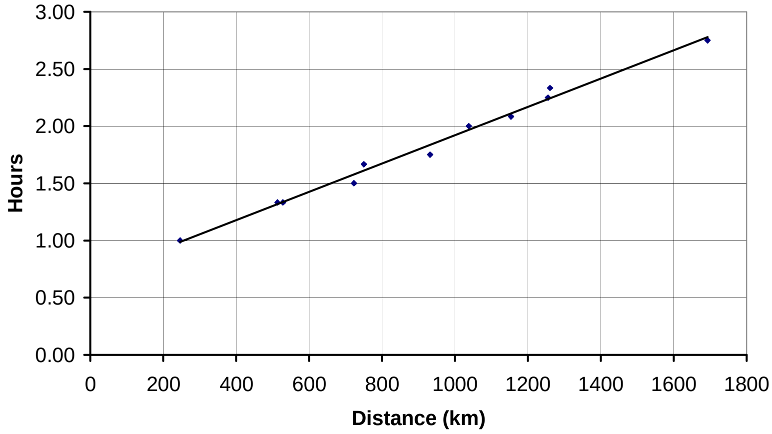
APPENDIX: TABLE B1.1 AIRLINE COST DRIVERS

Cost item	Cost driver	Notes
Aircraft costs	Aircraft operating hours	Includes turnaround time
Flight crew / cabin crew costs	Aircraft operating hours	Includes turnaround time
Handling charges	Passengers	This is airport specific but is not published, we have used averages per airlines
Sales and reservations	Passenger hours	
Advertising and promotion	Passenger hours	
Other costs	Varies	Varies between detailed cost categories
Commission	Revenue	
En route ANS charges	Route, aircraft type	Actual charges used
Landing charges	Route, aircraft type	Actual charges used
Passenger service charges	Route specific	Actual charges used
Aircraft fuel and oil	Formula based on distance	Actual fuel consumption / costs used

A1.6 For airport and en route charges, we have used the level of charges published by IATA. We assume that the low cost airline is able to negotiate some discount on published airport charges except at fully slot constrained airports where it is not in a position to negotiate such discounts. In some cases these discounts reflect the negotiating power of the airline, but in other respects these reflect different levels of service provision: for example, low cost airlines often negotiate lower charges in return for using remote stands or less well equipped terminal space. These differences are discussed in more detail below.

A1.7 A further key input is the flight time on each route, which is partly a function of route length, but is not directly proportional. By extracting timetable data for a number of routes, we have adopted a simple function relating route length (in kilometres) to average flight time, which we have calibrated based on a sample of routes. This relationship is shown in the figure below.

APPENDIX: FIGURE B1.1 RELATIONSHIP BETWEEN DISTANCE AND JOURNEY TIME



A1.8 The model enables us to project the operating costs incurred by each airline on each route, taking into account the route length and load factor, and route-specific factors such as airport and en-route charges.

Airlines used for the model

A1.9 As explained above, we used actual published prices for airport and en-route charges, and manufacturers fuel consumption curves for fuel. For other cost items, we estimated unit costs using airline financial data reported by the UK CAA. Therefore, we had to select appropriate airlines to use as a base.

A1.10 A key issue in analysing airlines operating cost data, from whatever source, is that the cost structures of airlines operating long haul services differ significantly from the cost structures of airlines operating short haul services. Long haul services incur lower costs **per passenger kilometre**, because many airline costs are associated with takeoff and landing rather than level flight. In addition, aircraft size tends to be larger for long haul flights, and aircraft utilisation is higher, which also lead to lower costs per kilometre. Unfortunately, most major European airlines (other than the low cost airlines) operate a significant number of long haul services and do not publish separate cost data for short and long haul services. Therefore, analysis of their operating costs is of limited use for a study such as this, which requires modelling of short haul services only.

A1.11 For full service airlines, we have used the following airlines as our base:

- BMI British Midland
- British Airways Citiexpress
- City Flyer Express
- GB Airways

A1.12 Except for BMI, these airlines are franchise carriers which provide short haul services on behalf of British Airways. Use of franchise carriers enables us to look at the costs of an airline providing a service similar to that provided by the full service network carriers, but without the effect of long haul services on the cost base. BMI British Midland is a largely short haul UK-based full service carrier, which is partly owned by Lufthansa and operates some codeshare services on Lufthansa's behalf. BMI has now switched its short haul services to a partly low cost business model, and has added more long haul services, but the data that we are using refers to financial year 2003/4, before these changes.

A1.13 For low cost airlines, we have used easyJet as our base. easyJet serves three of the routes being analysed for this study (London-Edinburgh, Paris-Geneva and London-Paris) and has previously served one other (Paris-Marseille), whilst the other large low cost airline (Ryanair) does not yet serve any (although it will commence Milan-Rome services on 28 March 2006).

A1.14 Ryanair has had a significant effect on medium distance European travel but generally does not serve very short routes (except on routes where surface travel is very weak due to there being a sea crossing involved). The most important difference is that Ryanair uses secondary and tertiary airports that are often significant distances from city centres. This enables it to make further cost savings:

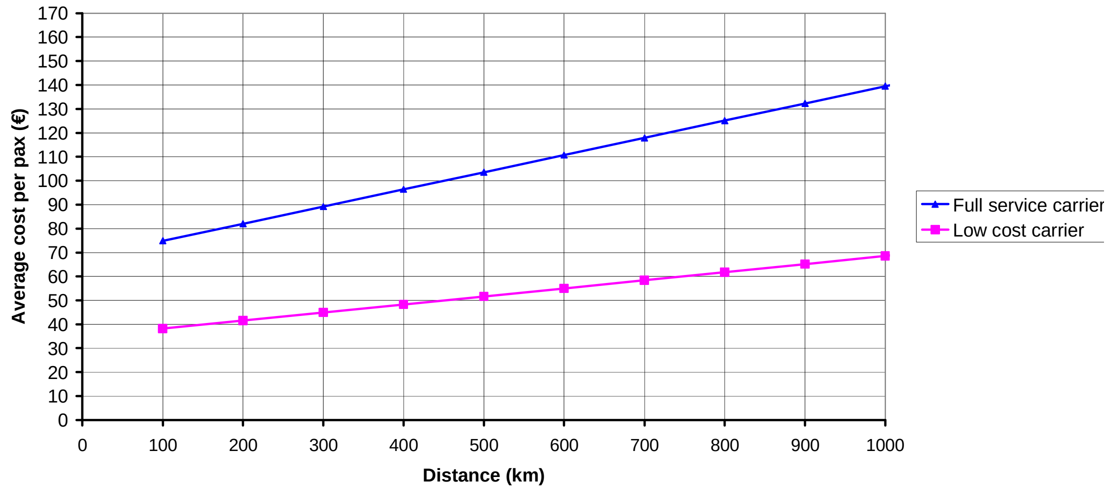
- Charges levied at these airports are very low, because there is usually substantial spare capacity and so Ryanair is in a strong position to negotiate attractive deals including substantial rebates on airport charges. In contrast, many of the airports used by easyJet are capacity constrained, and therefore it is more difficult for it to negotiate discounts.
- Use of minor secondary airports enables Ryanair to turn around its aircraft more quickly and means that Ryanair does not need to add as much time to its schedules for delay recovery. This enables it to improve its aircraft utilisation and achieve lower aircraft and staff costs per passenger.

7.98 As a result of this, Ryanair has lower costs per passenger than easyJet, and we will analyse this in our assessment of future trends in airline operating costs. However, the use of distant secondary airports is not attractive for a short journey where the rail journey time is 3-4 hours, as air travel may be slower than surface travel on such routes if the access time is taken into account. Taking this into account, Ryanair's business model is less relevant than easyJet's for this study.

Results

A1.15 The output of the model is shown in APPENDIX: FIGURE B1.2 below. This shows airline operating costs including airport charges but excluding any taxes. In this example we have used airport charges and en-route charges applicable as if the airports were Edinburgh and London (Heathrow for the full service airline and Luton for the low cost airline). The analysis shows that the operating costs of the low cost airline are approximately 50% less than the operating costs of the full service airline, and that this relationship does not vary significantly with route length.

APPENDIX: FIGURE B1.2 RELATIONSHIP BETWEEN DISTANCE AND COST



A1.16 As the example shown here is of the Edinburgh-London route, it assumes an average load factor of 85% for the low cost airline (as actually achieved by easyJet) and 67% for the full service airline (the average achieved by British Airways on UK domestic flights). When we apply this model on each route to compare the costs of rail operators and airlines, we use load factors appropriate for the airlines operating on that route.

Validation

A1.17 For the purposes of this study, the key objective for the model is to ensure that it predicts air fares reasonably accurately. Therefore, in order to validate the model, we have estimated the average yields that it predicts operators would need to have achieved in order to have covered their costs (as modelled), and compared this to actual yields reported by the airlines for intra-European routes. In order to undertake the validation, we also used appropriate operating data (average route length, aircraft type and load factor). We have used:

- For ‘full service’ carriers, actual data reported by the Association of European Airlines (AEA) for 2004 for average yields, route length and load factor for domestic and other European routes.
- For easyJet, actual data for average yields, route length and load factors for 2004/5

A1.18 We model costs rather than yields. In order to project yields, we assume that the low cost airline makes a margin of 5% and that the classic airline makes a margin of 2%. In practice, some European classic airlines make a negative margin, and some classic airlines make greater losses on short-haul intra-European routes, which are maintained partly in order to feed their long haul networks. For this reason, the cost based model slightly overestimates yields for short distance intra-European routes. Validation also depends on assumptions about average airport charges, as these vary significantly between European airports.

A1.19 The model validates well. Using plausible assumptions about airport charges, the model overestimates the yields that classic airlines would need to achieve on average length European routes by 4%. The difference is greater for domestic routes (14%). We believe that the reason that we overestimate yields on domestic routes is that these are more likely to be loss making; our model assumes an equal margin on all routes. For easyJet, the model validates to within 3%, in part reflecting the fact that we had more detailed and up-to-date input data for easyJet.

A1.20 Therefore, we are confident that in aggregate the model validates both for AEA (classic) carriers and for the main low cost carrier.

APPENDIX B

RAIL OPERATING COST MODELS

B1. RAIL OPERATING COST MODELS

Background

B1.1 Unlike airline operating costs, rail operating costs are specific to the country in which the operator operates, the geography of the route, as well as the type of infrastructure and rolling stock for the services. We have therefore undertaken separate analysis of rail operating costs on each of the case study routes.

B1.2 In this section, we present the results of our rail operating cost analysis on a route-by-route basis. For each route, the analysis focuses on

- Ownership and cost-sharing structure
- Cost components
- Trends, cost drivers, and operators' perceptions of cost drivers

Approach

B1.3 We have constructed a cost model for each route based on the data that is available. The approach is generally "bottom-up", in that we estimate total operating costs for a service by adding up the cost components of a rail service operation, but is validated by comparison to "top-down" estimates of rail operating costs from operators' published accounts. In some cases only a simpler top-down approach was possible, due to limited availability of data. We were able to undertake more detailed analysis of rail operating costs for the routes in Spain, Germany and the UK because more detailed cost information was available for these operators.

B1.4 For modelling purposes, we divide rail operating costs into the following components:

- Infrastructure costs (track access) including maintenance, renewals and – if the line was recently built or upgraded – contributions to the cost of building or financing
- Energy costs (electricity, or diesel if the line is not electrified)
- Stations costs
- Rolling stock costs:
  - leasing charges or depreciation
  - maintenance and servicing
- Passenger service costs (such as catering)
- Staff costs
  - operating staff
  - administrative and management staff
- General administration and overheads
- Passenger compensation
- Other costs

B1.5 The information we have used has come mainly from the operators' published financial statements and reports, and charge schedules in the public domain. In some cases, we have applied estimated costs according to our professional experience of working with rail operators. Where possible, we also talked to the operators to gain a better understanding on what drives costs and to refine our estimates; however, very few rail operators were willing to discuss operating costs with us.

B1.6 The largest single cost item for most rail operators is infrastructure. However, infrastructure charges rarely reflect the full costs of the infrastructure, because the infrastructure manager only recovers a proportion of its costs from access charges. The operators' expenses therefore do not reflect the full costs of operating the a rail service. Subsidies and grants to infrastructure companies are usually given in lump sums, so it is difficult to identify the amount of infrastructure subsidy that is applied to each route. To the extent possible, we have made assumptions in our cost estimates according to our knowledge of the route's infrastructure quality and configuration.

Madrid-Seville and Madrid-Barcelona

B1.7 In order to understand the operating costs in Spain, we examine the long-distance services, Madrid-Seville, currently operated by the Alta Velocidad RENFE business unit.

B1.8 The Madrid-Barcelona high speed line is expected to be complete in 2008. At present, Madrid-Barcelona services operate on the high speed line between Madrid and Lleida but then continue via the conventional network to Barcelona. For this route, we have estimated operating costs for the services after the completion of the new high speed line. These are based on the current costs for the Madrid-Seville service, except for infrastructure charges, for which we use the actual charges planned for the new line.

B1.9 Before 2005, rail infrastructure and operations in Spain were undertaken by the same company, RENFE, which reported directly to the Ministry of Public Works. RENFE's Alta Velocidad business unit operated the passenger high speed rail services and a separate business unit was responsible for maintaining the infrastructure. In January 2005, the railway system in Spain was restructured, and the infrastructure and operational branches of RENFE were split into two separate companies, ADIF (infrastructure) and RENFE Operadora (operations).

B1.10 Alta Velocidad is a business unit of RENFE Operadora, and operates the following routes:

- Madrid-Seville (with some services continuing via the conventional network to Málaga and Cadiz)
- Madrid-Zaragoza-Huesca/Lleida
- Madrid-Toledo

B1.11 Financial information is available for the Alta Velocidad business unit although it is not route-specific. Nonetheless, this provides us with more detail than is available for many other European railways, which do not publish financial data at the business unit level. We had to make some assumptions about what proportions of Alta Velocidad's costs are incurred by the Madrid-Seville route; however, during 2004 (the most recent year for which cost data was available), the Madrid-Toledo line was not operated and the only a limited service was provided on the Madrid-Lleida route. Therefore, the large majority of the business unit's costs would have been incurred in providing the Madrid-Seville service.

B1.12 We believe that a significant proportion of the infrastructure costs are indirectly subsidised through subsidies and grants that ADIF receives, because the published unit rates for infrastructure charges appear to be low. We have assumed that the infrastructure charges only cover a proportion of the full costs of operating and maintaining infrastructure. We have estimated the 'true' infrastructure costs by comparing infrastructure costs per train kilometre implied by the ADIF charges with the costs incurred by the infrastructure maintenance business unit of RENFE for the high speed line in the last year of the integrated company.

B1.13 In addition, it should be noted that the infrastructure charges do not cover the capital costs incurred in construction of the high speed lines. A significant proportion of these costs were paid for by the European Regional Development Fund.

B1.14 The cost components and drivers for the Madrid-Seville route are as follows; we use the same structure for the Madrid-Barcelona route.

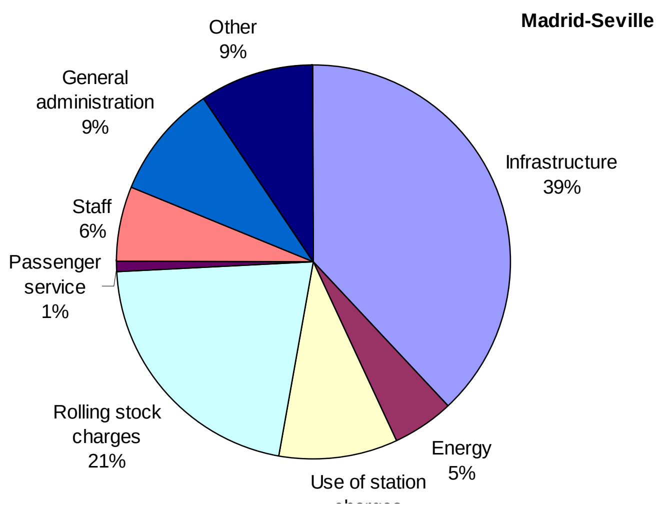
APPENDIX: TABLE B1.1 RAIL OPERATING COST COMPONENTS, SPAIN

Cost Category	Cost item	Cost driver	Note
Infrastructure	Access charge	Fixed	Fixed amount for service levels between 10 and 15 million train km/ year
	Capacity charge	Train km	Unit charge varies by the route, speed, and time periods (peak, normal, off-peak)
	Circulation charge	Train km	Unit charge varies by the route, speed, and rolling stock
	Traffic charge	Seat km	Only applies to peak services at >260kph
Energy	Electricity (traction)	Train km	
	Transfer of traction energy	Train km	
	Materials and energy (other)	Train hour	
Stations costs	Passenger use charge	Passenger journeys	Unit charge varies by type of station, speed of train
	Parking charge	Frequency, punctuality	Only applies to trains that stop at station for more than 15 minutes
	Axle change charge	Train km	Only applies when Axle Change equipment is used
	Sidings charge	Train km	Unit charge varies by type of line and time spent
	Use of public domain charge	Train km	Applies when there is a need to use the Public Domain, unit charge varies by land type
Rolling stock charges	Leasing charges or depreciation	Stock	10- to 30- year amortisation periods

Cost Category	Cost item	Cost driver	Note
	Maintenance and servicing	Train km	
Passenger service costs (e.g., catering)		Passenger km	Not explicit in the cost statements
Staff costs	Wages and overheads	Train hour	
General administration	External services	Train hour	
Passenger compensation		Passenger km	Not explicit in the cost statements
Other costs	External services	Train hour	
	Transfer of internal services	Train hour	
	Interest payment		

B1.15 According to our analysis, the unit cost of providing one km of train service between Madrid and Seville is broken down as follows:

APPENDIX: FIGURE B1.1 BREAKDOWN OF RAIL OPERATING COSTS, MADRID-SEVILLE



Validation

B1.16 As the current financial structure for the Spanish rail sector only came into existence after January 2005, we cannot, at this point, validate our estimation against actual costs. Using reasonable assumptions on RENFE's total operating costs that are attributed to Alta Velocidad in 2003/2004, we derived an average cost per train km for Alta Velocidad. The results of bottom-up and top-down approaches agree once we have assumed that infrastructure charges do not reflect the true costs of infrastructure provision.

London-Edinburgh and London-Manchester

B1.17 Inputs for the London-Edinburgh and London-Manchester models are based on published access charges, operator accounts, and general analysis of direct operating costs for long-distance rail operators in the UK.

B1.18 Rail infrastructure and operations in the UK are provided by separate companies. The infrastructure company, Network Rail, is responsible for operating and maintaining the infrastructure. Rail operators operate route-specific franchises under contract with the UK Department for Transport (DfT), using leased rolling stock.

B1.19 Operating costs incurred by train operating companies in the UK do not represent the full cost of service provision. This is because Network Rail covers its costs through direct grants from the government as well as through track access charges from train operators. The UK government is obliged under a deed of grant entered into with Network Rail to make payments to the company to cover its revenue requirements. This grant thus indirectly subsidizes train operators for the use of the rail infrastructure. Whereas franchise amounts are specific to the route, the grant is a lump sum made to Network Rail to cover its revenue requirements for the whole country.

B1.20 There has recently been a re-organization of Network Rail's income streams. Since 2004/2005, the proportion of Network Rail's costs that are covered through direct grants from the DfT has increased. A smaller share of their revenues now comes from fixed access charges paid by train operators. This has resulted in further suppressed operating costs for train companies.

B1.21 It is also important to note that UK rail operators' operating costs can include a premium payment to the government. GNER, one of the operators on the London-Edinburgh route, pays the government a premium for the franchise (as opposed to receiving a subsidy). We exclude premiums and subsidies to train operators from our analysis of operating costs.

B1.22 The cost components of a rail operator in the UK are roughly similar to those in Spain, and are as follows.

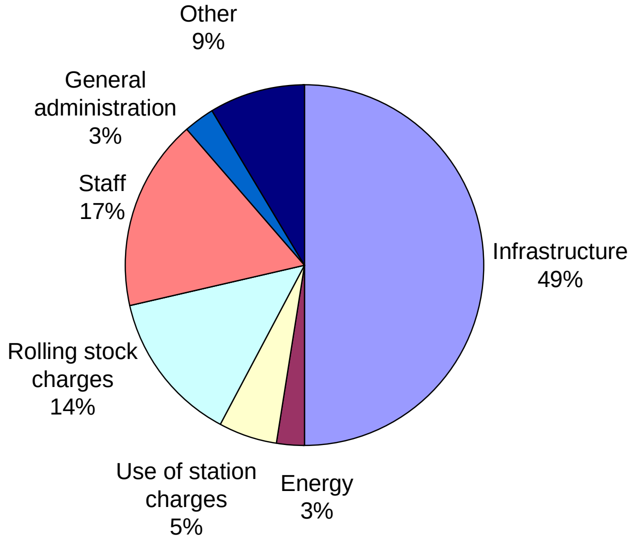
APPENDIX: TABLE B1.1 RAIL OPERATING COST COMPONENTS, UK

Cost Category	Cost item	Cost driver	Note
Infrastructure	Fixed access charge	Fixed	Fixed amount for each train operator
	Capacity charge	Fixed	Fixed amount for each train operator
	Track usage	Train km	Variable track access charge
	Supplemental charges	Fixed	Aggregate amount for each train operator
Energy	Electricity (traction)	Train km	Unit charge varies by line, type

Cost Category	Cost item	Cost driver	Note
			of rolling stock
Stations costs	Use of stations/ depots	Train hour	
	Station operating	Train hour	
Rolling stock charges	Capital leases	Trains in fleet	
	Non-capital leases	Trains in fleet	
	Maintenance and servicing	Train km	
Passenger service costs (e.g., catering)		Passenger km	Not explicit in the cost statements
Staff costs	Operating staff wages	Train hour	
	Management and administrative staff wages	Train hour	
General administration		Train hour	
Passenger compensation		Passenger km, punctuality	Not explicit in the cost statements
Other costs	Performance cost	Punctuality	
	Franchise premium	Train km	
	Industry and professional services	Train hour	
	Marketing and advertising	Train hour	

B1.23 To estimate the true operating costs of the London-Edinburgh services, we have assumed that access charges paid by train operators to Network Rail only cover 27% of revenue required to provide the infrastructure. This is based on the split in Network Rail's revenues amongst train operators, direct government grants, and borrowing. According to our analysis, the unit cost of providing one km of train service between London and Edinburgh is broken down as follows.

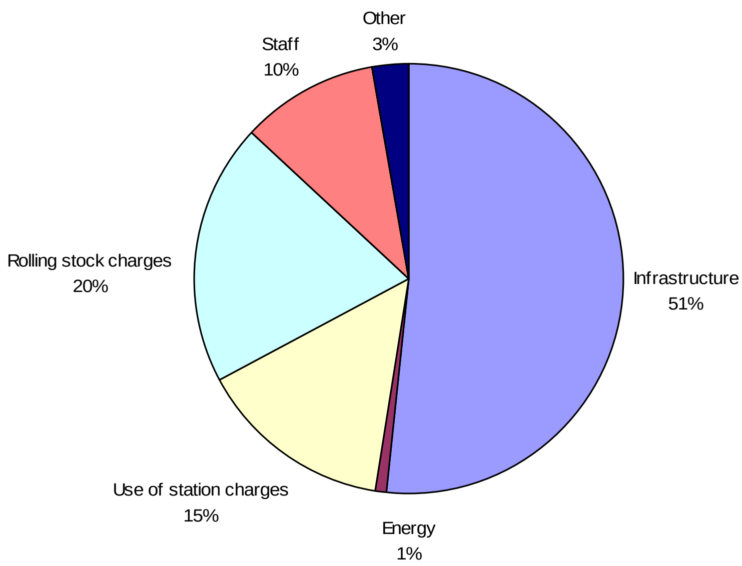
APPENDIX: FIGURE B1.1 BREAKDOWN OF RAIL OPERATING COSTS, LONDON-EDINBURGH



B1.24 We replicate the London- Edinburgh rail operating cost model to estimate the rail operating costs on the London- Manchester route.

B1.25 The differences in infrastructure quality, train types, and scope of operation results in a unit cost (€ per train km) that is 35% higher on the London -Manchester services. This is mainly due to the high costs of the rolling stock used on the route. The unit cost of providing one km of train service between London and Manchester is broken down as shown in the figure below.

APPENDIX: FIGURE B1.1 BREAKDOWN OF RAIL OPERATING COSTS, LONDON-MANCHESTER



Validation

B1.26 Changes in the UK access charge regime since the Access Charge Review of 2003 are not reflected in the latest financial statements of rail operators. As such, we cannot validate our unit cost estimation against actual figures. Using our model, however, we estimated what the unit cost would be under the 2003/2004 access charge regime, and it is within 1% of the published unit cost.

London-Paris (Eurostar)

B1.27 Eurostar is operated as a joint service by the French and Belgian national railways SNCF and SNCB, and Eurostar UK Ltd (EUKL), which is partly owned by London & Continental Railways (LCR). LCR is a private company but receives government funding and debt guarantees; it is also responsible for the construction of the Channel Tunnel Rail Link.

B1.28 Eurostar's operating costs are opaque, particularly in comparison to airlines, although more information is available than for some other rail operators. There is no single operating company and there are no consolidated accounts available. This significantly limits the detail and certainty that can be obtained from any analysis of its operating costs. There is no cost information of any kind available for the French part of Eurostar, except for track access costs which we have obtained from RFF. SNCF refused to provide any information or assistance for this study and this has limited the scope of our analysis. Reasonably detailed public financial information is available for EUKL, but unfortunately Eurostar were not willing to discuss operating costs with us, and therefore we have relied on our own interpretation of this data.

B1.29 The main sources that we have used for this analysis are:

- information included in UK government reports, most useful of which is the 2005 UK National Audit Office report on the Channel Tunnel Rail Link which includes reasonably detailed financial information for EUKL;
- data for track access costs from RFF; and
- information published by Eurostar in press releases.

B1.30 None of these sources provide any breakdown of Eurostar's costs beyond the different types of track access charges that it incurs, and other costs. Therefore, the only cost categories that we have been able to use in our analysis of Eurostar operating costs are the direct costs it incurs plus the different types of infrastructure costs.

B1.31 APPENDIX: TABLE B1.1 below summarises the operating costs incurred by EUKL in 2004. 70% of Eurostar UK costs are track access charges, paid either to the Channel Tunnel concessionaire Eurotunnel, or for use of the Channel Tunnel Rail Link (high speed line) in the UK. We have also estimated the proportion of operating costs incurred by London-Paris trains by allocating these in the following way:

- UK track access charges in proportion to the number of trains operated;
- Eurotunnel charges in proportion to the number of passengers (in practice these are partly fixed and partly variable with the number of passengers)[12]; and
- Other direct costs 80% in proportion to the number of trains and 20% in proportion to the number of passengers. The rationale for this assumption is that most operating costs will be related to the number of trains but some costs are likely to be passenger-specific (for example, advertising).

APPENDIX: TABLE B1.1 EUROSTAR UK COSTS, 2004

Cost item	Total costs (€ millions)	London-Paris costs (€ millions)
Direct costs	161	101
Eurotunnel charges	135	98
Channel Tunnel Rail Link charges	218	131
Network Rail charges	17	10
Total	**366**	**234**

Source: National Audit Office, 2005; assumes £1=€1.45

B1.32 We have estimated costs incurred by SNCF in operating their share of the London-Paris service and this is summarised in the table below. We assume that the direct costs (except track access) incurred by SNCF in operating the route are equivalent to 80% of the equivalent costs incurred by Eurostar UK. The basis for this assumption is that the number of train sets operated by SNCF is similar and the time spent by each

[12] See www.eurotunnel.com under press pack

train on the French side of the tunnel is similar to that spent on the UK side. The allocation is slightly lower to reflect the fact that SNCF has been able to find alternative uses for some of its Eurostar trains on its domestic network and therefore it may not allocate all of the costs to the international service; also, as more tickets are sold in the UK, ticket sales and marketing costs incurred by SNCF are likely to be lower.

B1.33 The other cost items are estimated as follows:

- We use actual RFF price data to determine costs for access to the French rail network, including stations charges;
- We assume that the Channel Tunnel charges paid by SNCF for its London-Paris trains are equivalent to those paid by Eurostar UK[13].

[13] This is because the UK and French railways are jointly liable for paying Channel Tunnel charges. For more information see European Commission rulings on state aid to EWS International and National Audit Office reports on sale of Railfreight Distribution.

APPENDIX: TABLE B1.2 ESTIMATED SNCF EUROSTAR COSTS, LONDON-PARIS ROUTE, 2004

Cost item	Total costs (€ millions)
Direct costs	81
Eurotunnel charges	98
RFF charges	41
Total	**220**

Source: SDG analysis

B1.34 Our estimate of total costs for the London-Paris route is shown in APPENDIX: TABLE B1.3 below. We estimate that the total costs per passenger for Eurostar in operating the London-Paris route are around €106, of which direct costs, Channel Tunnel tolls and track access costs account for similar proportions. This is equivalent to a cost per passenger kilometre of €0.21 and per seat kilometre of approximately €0.13 (given that Eurostar achieves a load factor of around 60% on this route). For comparison we also show revenue for the London-Paris route, calculated using an assumption that revenue per passenger for London-Paris passengers is equal to that for all Eurostar passengers. This analysis indicates that Eurostar makes a loss of approximately €102 million per year on this route in aggregate.

APPENDIX: TABLE B1.3 EUROSTAR COSTS AND REVENUES, LONDON-PARIS ROUTE, 2004

Cost item	€ millions (total)	€ per passenger
Revenue	**458**	**86.5**
Direct costs	181	34.3
Eurotunnel charges	196	37.1
Track access	182	34.4
Total costs	**559**	**105.7**
Profit (loss)	(102)	(19.2)

Source: SDG analysis, based on data from UK National Audit Office, RFF, Eurostar.com and Eurotunnel.com

B1.35 These costs are not entirely marginal, but nor do they cover the full capital costs of the lines used. Both the UK and French governments subsidised the construction of the high speed lines between their capital cities and the Channel Tunnel. Although the Channel Tunnel itself was not subsidised, the concessionaire is unable to pay the full interest on its debts, and therefore by implication the charges it levies are not sufficient to recover its capital costs.

Validation

B1.36 Our Eurostar operating cost analysis includes the London-Paris route only, which is probably the more profitable of the two Eurostar routes, as the load factors achieved on the London-Brussels route are considerably lower. As many of Eurostar's costs are fixed, it is misleading to evaluate costs for one of the routes in isolation, and we therefore provide an estimate of the total costs and revenue incurred by Eurostar. This is summarised in APPENDIX: TABLE B1.1 below.

APPENDIX: TABLE B1.1 ESTIMATED EUROSTAR TOTAL COSTS AND REVENUES, 2004

Cost item	Eurostar UK (€ millions)	SNCF/SNCB (€ millions)	Total (€ millions)	€ per passenger
Revenue	**266**	**362**	**629**	**86.5**
Direct costs	161	190	351	48.3
Eurotunnel charges	135	135	270	37.1
Track access	235	68	303	41.7
Total costs	**531**	**393**	**924**	**127.1**
Profit (loss)	(264)	(31)	(295)	(40.6)

Source: SDG analysis, based on data from UK National Audit Office, RFF, Rail Fan Europe, Eurostar.com and Eurotunnel.com

B1.37 Our analysis indicates that Eurostar in total made a loss of nearly €300 million in 2004, but that the losses are overwhelmingly incurred by Eurostar UK rather than the continental Eurostar partners SNCF and SNCB. SNCB has stated publicly that it incurs significant losses from its involvement in Eurostar, and we would expect the London-Paris route to be more profitable than the London-Brussels route because of the better load factors obtained. It is therefore likely, although not certain, that SNCF makes some profit on its involvement in Eurostar, despite the substantial losses incurred by the other parties. This is difficult to verify in the absence of any information from SNCF. Furthermore, the London-Brussels route is not within the scope of this study and so we have not investigated Eurostar costs for the London-Brussels route in any detail. The analysis on the London- Paris route must therefore be considered indicative.

Paris-Marseille

B1.38 We did not have access to any cost information from SNCF, and as a result, the cost analysis that we could undertake for this route was very limited. The sources that we have used are as follows:

- For infrastructure, we have used actual track access charges published by RFF
- For other costs, we have used information provided by RFF which has been used in appraisal of high speed rail projects in France

B1.39 SNCF, the operator of high speed train services in France, pays RFF for use of infrastructure. The fee depends on the quality of the infrastructure and the period of time, but not on the size of trains. The infrastructure fee schedule for each train service on the Paris- Marseille route in 2007 is shown in APPENDIX: TABLE B1.2.

APPENDIX: TABLE B1.2 TGV MARNE LA VALLÉE-CHESSY MARSEILLE, 2007

	Peak (6h-9h and 17h-20h)	Off Peak
Fee for slot reservation	7953,19 €	6177,16€
Fee for station stop reservation x number of passengers	109,80 €	30,00 €
Fee for circulation	1181,40 €	1181,40 €
Additional royalty for electricity	210,68 €	210,68 €
Total	**12 317,50 €**	**9 970,64 €**

Source: RFF

B1.40 It should be noted that the infrastructure fees only cover 62% of the total infrastructure costs incurred by RFF, with the rest being covered by government subsidies. We have no information on whether this subsidy is specific to individual routes and therefore we assume that an equal proportion of infrastructure costs are covered by subsidies on all routes.

B1.41 In addition to infrastructure and energy charges, RFF estimates that the TGV operating cost per passenger km is 0.50€.

B1.42 Taking into account the route length, train configuration and load factors on the Paris-Marseille services, we estimate the rail operating costs to be as follows.

APPENDIX: TABLE B1.3 PARIS- MARSEILLE RAIL OPERATING COST ESTIMTES

	Costs per train service (€)	€ per passenger km
Infrastructure	11,144	14.9
Other Operating Costs	13,125	17.5
Indirect Subsidy	6,783	9.0
Total	**31,052**	**41.0**

Source: SDG analysis

Frankfurt-Cologne

B1.43 We have made two estimates of operating costs for the Frankfurt-Cologne route:

- A 'top-down' estimate based on the annual report and accounts of DB Fernverkehr; and
- A 'bottom-up' estimate of the costs that a new entrant would face if it provided services on the route.

Top-down estimate

B1.44 The top-down operating costs estimates for the Frankfurt-Cologne route are based on data from the annual report and accounts of DB Fernverkehr, the operator of long distance trains in Germany (both high speed and conventional). The advantage of this approach is that we can confirm that it is accurate at an aggregate level for DB Fernverkehr, but it does not take into account route-specific factors such as the higher track access charges and rolling stock costs applying for the high speed line.

B1.45 Total operating costs for DB Fernverkehr are shown in APPENDIX: TABLE B1.1. These cost levels equate to an operating cost per seat kilometre of approximately €0.05, and per passenger kilometre of approximately 0.12.€Unfortunately, DB Fernverkehr does not provide separate figures for track access or energy costs, but these are included within ‘Cost of services’ and ‘Materials, merchandise and supplies’ respectively.

APPENDIX: TABLE B1.1 DB FERNVERKEHR COSTS, 2004

Cost item	Total costs (€ millions)	Per train km (€)
Rolling stock maintenance	274	1.98
Staff	599	4.34
Rents and leases	127	0.92
IT services	37	0.27
Contribution to overheads	143	1.04
Costs of services	1,216	8.81
Materials, merchandise and supplies	291	2.11
Rolling stock depreciation	307	2.22
Total costs	**2,994**	**21.68**

Source: SDG analysis

Bottom-up estimate

B1.46 We also made a bottom-up estimate of the costs that a standalone new entrant operator would face if it operated on the route. The advantage of this approach is that takes into account route-specific factors such as track access charges and rolling stock costs. Potentially, it also enables us to work at a more disaggregate level and use more appropriate cost categories than those given in the annual accounts for DB Fernverkehr. However, there is inevitably a greater risk of inaccuracy with this approach.

B1.47 We have estimated costs for a new entrant operator providing an hourly service 15 hours per day between Frankfurt and Cologne main stations with one intermediate stop at Frankfurt airport. The table explains the assumptions we have used for each item.

APPENDIX: TABLE B1.1 FRANKFURT-COLOGNE NEW ENTRANT COSTS: METHODOLOGY

Cost item	Source	Notes
Track access	DB Netz	Specific to the Frankfurt-Cologne line
Stations cost	DB Station&Service	Specific to the Frankfurt-Cologne line
Rolling stock capital costs	Actual costs paid by DB for ICE3 unit	ICE3 unit chosen as this is the only train authorised to operate on this line. 4 units required to operate service, hence 5 units required in total for maintenance cover.
Drivers	Assumption based on other railways	Assumed a driver cost of €60,000 per year and that drivers productive time is equivalent to 50% of working week (35 hours)
Other on-train staff	Assumption based on other railways	Assumed 4 staff per train, a staff cost of €40,000 per year and that productive time is equivalent to 60% of working week (35 hours)
Energy	Assumption based on DB	Set equivalent to 80% of DB Fernverkehr materials/merchandise costs per train KM
Rolling stock maintenance	Assumption based on equivalent trains in Spain	Using per-train rates from a maintenance contract for equivalent types of train that have been sold to Spanish railways
Ticket sales	Other transport operators	€2.50 per ticket (assuming €1/ticket for internet sales and €4/ticket for others)
Administration and overheads	Assumption	10% of all other costs

B1.48 Our estimate of total costs for the standalone operator are shown in APPENDIX: TABLE B1.2 below.

APPENDIX: TABLE B1.2 FRANKFURT-COLOGNE NEW ENTRANT COSTS: METHODOLOGY

Cost item	Total (€ millions)	Per train kilometre (€)
Track access	25.67	13.02
Stations cost	6.84	3.47
Rolling stock capital costs	9.68	4.91
Drivers	1.82	0.92
Other on-train staff	1.01	0.51
Energy	3.32	1.69
Rolling stock maintenance	6.80	3.45
Ticket sales	6.00	3.04
Administration and overheads	6.11	3.10
Total	**67.25**	**34.12**

Source: SDG analysis

B1.49 The DB figures for track access costs that we have used do not include all capital or construction costs, as DB has received significant grants towards the cost of construction of the high speed line. In addition, loans were provided by the European Investment Bank (EIB) at rates lower than the commercial rates which would be paid by airports for new infrastructure projects. We estimate that, if the full construction costs of the line were recovered from trains using it, this would account for the full current access charge – leaving nothing for either capital costs or maintenance costs.

B1.50 We did not have information from DB about the proportion of track access costs that are covered through access charges and the proportion that is subsidised, and therefore we have used information from the 2005 report for the ECMT. It should be noted that this is not route-specific.

Validation

B1.51 Our estimates using the bottom-up approach results in an estimate for operating costs per seat kilometre that is approximately 50% higher than the top-down approach. This result is consistent with the higher track access charges levied for the high speed line, higher costs for high speed rolling stock, and the fact that we have taken into account the full capital costs of the rolling stock.

Rome-Milan

B1.52 We had no access to specific cost information for the high speed trains business unit of Trenitalia (Treno Alta Velocità). This has substantially limited the analysis that we were able to do of operating costs on this route.

B1.53 Therefore, we have estimated operating costs for this route as follows:

- For infrastructure charges, we have used the actual charges levied for Rome-Milan trains; and
- For costs other than infrastructure, we have used an average of the direct costs incurred by the operators on all of the other routes we have studied.

APPENDIX C

GLOSSARY

C1. GLOSSARY

“AAA”: The Authorisation and Accountability for carriage by Air of an item of hold luggage

"Accompanied hold baggage": Baggage accepted for carriage in the hold of an aircraft, on which the passenger who checked it in is on-board.

"Airside": The movement area of an airport, adjacent terrain and buildings, or portions thereof.

"Aircraft Security Search": A thorough inspection of the interior and the exterior of the aircraft for the purpose of discovering prohibited articles.

"Background check": A check of a person's identity and previous experience, including any criminal history, as part of the assessment of an individual's suitability for unescorted access to security restricted areas.

“Baggage Manifest”: The record (electronic or manual) of all items of hold luggage for a specific flight

“Bar Code”: Unique identification label interfacing passenger and luggage information to an airline/handler computer reservation system.

“BRS”: The Baggage Reconciliation System employed by airlines/handlers to confirm the status of a bag prior to loading onto an aircraft.

"Cabin baggage": Baggage intended for carriage in the cabin of an aircraft.

“CRS”: The Computer Reservation System containing all relevant information on passenger and baggage.

"Continuous Random Checks": Checks conducted during the entire period of activity, whilst those checks are to be conducted on a random basis.

"EDS" - Explosive Detection System. A system or combination of different technologies which has the ability to detect, and so to indicate by means of an alarm, explosive material contained in baggage, irrespective of the material from which the bag is made.

"EDDS" - Explosive Device Detection System. A system or combination of different technologies which has the ability to detect, and so to indicate by means of an alarm, an explosive device by detecting one or more components of such a device contained in baggage, irrespective of the material from which the bag is made.

"Hold Baggage": Baggage intended for carriage in the hold of an aircraft.

"Landside": The area of an airport which is not airside and includes all public areas.

“Level 1 - 5”: The common term for a sequential security screening process involving automated explosive detection technology

"Prohibited article": An object which can be used to commit an act of unlawful interference and that has not been properly declared and subjected to the applicable laws and regulations. An indicative list of such prohibited articles is found in the Attachment.

“Protocols”: The term used to identify specific and agreed actions to deal with a process failure. These are generally unique to an organisation or operation.

"PEDS": Primary Explosive Detection System. A system or combination of different technologies which has the ability to detect, and so to indicate by means of an alarm, explosive material contained in baggage, irrespective of the material from which the bag is made.

Regulated Agent": An agent, freight forwarder or other entity who conducts business with an operator and provides security controls that are accepted or required by the appropriate authority in respect of cargo, courier and express parcels or mail.

"Security Restricted Area": Airside areas of an airport into which access is controlled to ensure security of civil aviation. Such areas will normally include, inter alia, all passenger departure areas between screening points and aircraft, ramp, baggage make-up areas, cargo sheds, mail centres and airside cleaning and catering premises.

"Security Controls": Means by which the introduction of prohibited articles can be prevented.

"Screening": The application of technical or other means which are intended to identify and/or detect prohibited articles.

"Unaccompanied hold baggage": Baggage accepted for carriage in the hold of an aircraft, on which the passenger who checked it in is not onboard.

"Terminal": The main building or group of buildings where the processing of commercial passengers and freight and the boarding of aircraft occurs.

"TIP": Threat Image Projection, a software programme, which can be installed on certain x-ray machines. The programme projects virtual images of threat articles (e.g. a gun, knife, improvised explosive device) within the x-ray image of a real bag under examination, and provides immediate feedback to the x-ray machine operator on the operator's ability to detect such images.

"Trace Detection Equipment": Technology system or combination of different technologies which has the ability to detect very small amounts (1/billion of a gram), and so to indicate by means of an alarm, explosive materials contained in baggage, or other articles subjected for analysis.

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