JOINT TRANSPORT RESEARCH CENTRE

Round Table, 2-3 October 2008, Paris

Discussion Paper No. 2009-7
October 2009

Competitive Interaction between Airports, Airlines and High-Speed Rail

SUMMARY AND CONCLUSIONS

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ABSTRACT

This paper summarizes, structures, and provides some context for discussions of the Round Table mentioned in the title. The first part of the paper focuses on sources of market power for airports and on policy responses. When an airport is congested and competition with other airports is limited, regulation may be justified, and the dual till approach likely works best. In other cases, however, policy should establish conditions for competition to emerge as much as possible, instead of attempting to design a general regulatory framework. The second part of the paper discusses elements of climate change policy in aviation. Including aviation in emission trading schemes is a sensible idea, but should not be expected to produce major cuts in CO2 emissions from aviation; containing its growth possibly is a more realistic, yet ambitious and not necessarily socially optimal, objective. High-speed rail is justified in some situations, but is not a general alternative for air travel and certainly not a second-best way to reduce greenhouse gas emissions from aviation.

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1. INTRODUCTION

Air travel has become a commodity over the last two or three decades. Travel volumes were boosted by a combination of income growth and lower real fares, and there is strong competition on many origin-destination pairs. Lower fares are the consequence of more intense competition, which in turn was made possible by deregulation, first in the US and later in Europe. While there is broad consensus that this evolution has increased the net benefits generated by air travel, concerns remain about the economic efficiency of the air transport industry. One such concern is that there may be excessive market power in some market segments. For example, the emergence of hub-and-spoke networks after deregulation has reduced costs, but it has also allowed dominant carriers to charge hub premiums and it may have helped them to deter entry. Another example relates to the up-stream services provided by airports. Airline competition does not imply airport competition, and airports may enjoy location- or congestion-driven market power. Institutional arrangements including regulation affect the way such market power plays out. Other market failures in aviation include Pareto-relevant externalities[2], such as marginal congestion costs, and environmental impacts, such as noise and CO_2 emissions. On the other hand, regulatory interventions to try to correct for market failure also impose costs and imperfect information might lead to separate distortions.

This paper discusses the efficient functioning of the air transport industry and some issues arising. Like most economic activity, air transport is characterised by multiple market failures. Here, we focus on the potential market power of airports (Sections 2 and 3), on climate change (Section 4), and on the competitive effect and the social desirability of high-speed rail (Section 5). In each case, we ask if the market failures are sufficiently serious to warrant implementation of costly and imperfect policy.

Section 2 starts with a basic observation on airports: the context in which they operate is very varied and market power is more likely in some cases than in others. When airport capacity in the region where an airport is located is scarce, that airport is served by a set of competing airlines and is not very strongly reliant on hub traffic;, the airport most likely enjoys substantial market power. But when airport capacity is abundant, local demand is not of particularly great interest to airlines; airlines are strong, there is a large share of hub traffic and market power is likely to be very limited.

[2] A Pareto-relevant externality is an external effect whose removal, by one or other intervention, would lead to a potential Pareto-improvement, i.e. an increase in overall economic welfare.

After the diagnosis in Section 2, Section 3 asks about the remedies. Is regulation required, and what type of regulation is available to avoid abuse of market power? In answering these questions, the aim is to strike a balance between market failure and regulatory failure. Competition, while not perfect, arguably works quite well in many situations. Furthermore, devising a regulation that alleviates one or several shortcomings of the market while maintaining appropriate incentives regarding prices, quality of service and system capacity, is no small feat. Given this trade-off, the preferable approach is to create an institutional environment stimulating competition and turn to regulation where necessary on a case-by-case basis, rather than attempting to come up with a general-purpose regulatory framework. In case regulation is required to contain location- or congestion-generated market power, care needs to be taken that good investment incentives are retained and excessive use of available capacity is avoided. Among the archetypical forms of regulation, the dual till approach seems best suited for major congested airports. These issues are the subject of a sizeable literature, and our treatment just touches upon some elements.

Aviation accounts for a small [e.g. some 3.2% in Europe in 2004 (Anger *et al*., 2008)] share of CO2 emissions. This share is expected to grow fast, and aviation emissions cause greater radiative forcing than those from many other sources. For these reasons, the sector is widely expected to contribute to efforts to reduce greenhouse gas emissions. From a cost-minimization perspective, shares and growth patterns are not relevant as such. Instead, the question is how aviation abatement costs compare to those of other sectors. Section 4 discusses the potential impacts of greenhouse gas abatement policies on aviation. Aviation's abatement efforts should be guided by its abatement costs compared to the costs of other sectors, and including aviation in emission trading systems is one step in that direction. If aviation is confronted with prevailing carbon prices[3], it would most likely engage in a limited amount of abatement and would need to acquire permits in excess of its historical emission levels, at least when demand grows as expected. The reasons for the limited abatement potential are that demand for air travel is not very elastic in the aggregate, and that technological fixes are scarce – and most likely will remain so in the foreseeable future. Where capacity constraints are strictly binding, putting a price on carbon would affect volumes to an even smaller extent, instead triggering a transfer of scarcity rents to owners of carbon rights.

Given the limited scope for cheap greenhouse gas abatement in aviation, Section 5 asks if it makes sense to increase the availability of high-speed rail alternatives. High-speed rail can substitute for air transport on mid-range distances and produces fewer emissions per trip, especially when electricity is produced in non-carbon-intensive ways. However, life-cycle emissions, relevant in an *ex ante* analysis, for rail arguably are high, given the high emissions from track infrastructure construction (see e.g. Chester and Horvath, 2008) and

[3] Prices prevailing at the time of the Round Table – current prices are lower because of reduced overall economic activity.

maintenance. However, a broader comparison of costs and benefits shows that (a) high-speed rail links are socially desirable in a certain set of circumstances and should not be viewed as a general alternative to air transport, and (b) environmental benefits play a fairly minor role in the overall evaluation of high-speed rail projects.

2. AIRPORT COMPETITION: REGULATION-RELEVANT AIRPORT CHARACTERISTICS

This section provides an overview of potential sources of market power for airports. The degree of competition faced by an airport varies strongly with market conditions. While this is an obvious statement, it is worth making explicit what market conditions one has in mind when analysing airport market power. We discuss the role of capacity constraints, relations with airlines and hub functions. Airports may also derive market power from their location. Overlap between airports' catchment areas limits this market power, and in "multi-airport regions" competition among airports can be intense. We touch upon these issues where relevant. This section also mainly focuses on airports' aeronautical activities. Non-aeronautical activities are an important source of revenue and the demand for such services is complementary to the demand for aeronautical services. Furthermore, for at least some non-aeronautical services, airports enjoy market power. These issues are addressed in Sub-section 2.1. Questions regarding how regulation, when required, should take account of interactions between aeronautical and non-aeronautical activities are the subject of intense debate among academics and practitioners, and are briefly discussed in Section 3.

2.1. Airport capacity constraints

Airports' physical capacity to handle flights is determined mainly by runway and terminal capacity. Investments in physical capacity are lumpy (e.g. it makes no sense to build half a runway) and projects often take a very long time to implement, so that capacity levels cannot be matched perfectly with changing demand levels[4]. Lumpiness implies that airports can have excess capacity or, when demand grows, can become congested for extended periods of time[5]. Airport congestion means that access to the airport is a rival good: an additional take-off or landing implies increased time and operating costs for other flights, or – when technical capacity is reached – requires another flight to be omitted. In other words, the opportunity cost of an additional flight is positive. Scarce capacity needs to

[4] Technological improvements may decrease the lumpiness of airport capacity.

[5] The polar cases where capacity is always abundant or there is always excessive congestion are unattractive from an economic point of view.

be allocated somehow. Economics prescribes that charging the opportunity cost of a flight is an efficient allocation mechanism, but determining this cost is not straightforward[6] and few airports use congestion-dependent access charges.[7] Some US airports and many EU airports use slot constraints to manage capacity utilisation.

An airport that is not overly constrained by regulation or by bilateral agreements with airlines can set access charges in line with its objectives (e.g. maximising profit, revenue or output), of course subject to constraints imposed by demand for the airport's services and competition from other airports or transport modes. Scarcity of capacity, i.e. congestion, is a source of pricing power for the airport *vis-a-vis* airlines, because the airport has some degree of monopoly power over a scarce input to airline traffic. Pricing power means that an access charge can be set that is (inversely) related to an airline's elasticity of demand for access to the airport. Such pricing power can exist in multi-airport regions, if the joint capacity of the region's airports is low compared to the demand for air travel, and airports compete in Bertrand or Cournot fashion (Van Dender, 2005).

Does pricing power for airports lead to welfare losses that require a policy intervention? As noted above, when a facility of limited capacity becomes congested, it is efficient in the short run to charge a price for access equal to the marginal social cost. The main component of such an access charge is the cost of delays imposed on other airplanes seeking access to the airport during the congested period. It was also noted that the existence of congestion confers pricing power on airports, so it could in principle set a price equal to marginal social cost. However, it is generally not the case that profit-maximising airports charge welfare-maximising charges. If the airport is a profit-maximising monopolist, it will leverage the market power from scarce capacity to charge higher prices than the welfare-maximising ones (and thus withhold capacity). In oligopoly markets, this leverage is smaller but not absent. If the airport pursues other objectives than profit maximisation, other prices result and their relation to efficient charges changes accordingly. Output maximisation, for example, likely results in less than efficient charges.

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6 Apart from difficulties in defining cost functions, there is the question of to what extent airlines with large market shares at an airport internalise part of the congestion cost at that airport. Brueckner and Van Dender (2008) show how incentives to internalise depend on market structure. The existence of a small competitive fringe is sufficient to destroy internalisation incentives. Daniel and Harback (2008) provide evidence of limited or no internalisation at major US airports, suggesting that Pigouvian charges are desirable in many cases.

7 The paucity of congestion charges at airports may be related to regulation (allowing weight-based charges only), to a lack of welfare- or profit-maximizing behaviour at airports (perhaps as a consequence of interest-groups' lobbying efforts), or to agreements between airlines and airports. Furthermore, slot allocation mechanisms, such as those in operation throughout Europe and at some US airports, can substitute for congestion charges to some extent, in principle. Whether prevailing slot allocation mechanisms can mimic congestion charges is a point for debate, but without a well-functioning secondary slot market they most likely do not.

Airports offer non-aeronautical services, which are complementary to aeronautical services, and for which the airport enjoys some market power. Consequently, profit-maximizing airports may reduce access charges in order to boost total profits. This effect pulls in the opposite direction of the pricing-power effect for access charges, moving the access charge in the direction of the efficient ones (without necessarily equating both). The interaction between aeronautical and non-aeronautical charges also depends on how one or both components are regulated (see Section 3).

The deviation between unregulated and efficient charges depends on various circumstances, and its direction and size cannot be determined in general terms. Oum and Fu (2008) point out that airport competition is a critical factor in determining the difference: an airport facing stiff competition from nearby airports will be inclined to set low aeronautical charges, whereas absence of such competition likely implies higher than socially optimal charges. In balance, whether any difference between profit- and welfare-maximizing prices justifies a regulatory intervention is not clear. If costless and perfect regulation were available, the recommendation would obviously be to introduce it. However, regulation is imperfect and costly. If, as may well be the case, allowing airports to introduce congestion charges as they please yields more efficient capacity use than is obtained when there are no congestion charges, then the welfare loss from having non-optimal charges may be small or non-existent compared to the costs of regulating those charges.

In the long run, airport capacity is variable. Of course, this does not mean that capacity should be expanded to eliminate congestion. Instead, it should be expanded to the point where the marginal costs of doing so equal the marginal benefits. Given the often very high costs of adding capacity (land, environmental impact, etc.), many airports are likely to remain strongly congested. At any rate, the argument for congestion-based access charges is just as valid for the long run as it is for the short run. A different question is whether airports will provide roughly optimal levels of capacity. Since airports can benefit from congestion, it seems likely they will provide less than socially optimal capacity, at least when they maximize profits. This suggests that congestion pricing is more attractive when it is constrained by (potential) competition. When airports pursue different objectives, and when they are subject to regulatory constraints, capacity decisions are obviously affected. Section 3 discusses some interactions between regulation and capacity provision.

In multi-airport regions, airports face joint capacity constraints in addition to airport-specific constraints: they partly share the same airspace and the same land-access transport network. Both of these facilities are congestion-prone. For the case of airspace, in a Cournot market structure congestion confers pricing power upon airports (i.e. the ability to set prices higher than marginal social cost, where the latter includes marginal congestion costs)[8]. The

[8] Adapting the framework of Van Dender (2005) to the case of shared congestion-prone facilities shows there is pricing power when airports are Cournot competitors, but not when they are Bertrand competitors. However, Cournot (quantity or capacity) competition seems the more

arguments on airport-specific capacity hence in principle extend to the case of shared airspace constraints.

Summing up, the argument in this section is that congestion at airports or airspace generates pricing power for (independent) airports and renders a congestion charge desirable for efficiency's sake. While there is no guarantee that a charge that is optimal from an airport's point of view is also the socially optimal charge, the welfare resulting from airports' setting unregulated charges may very well be higher than the welfare obtained when there are no congestion charges. Depending on one's view of the costs of regulation, it hence is not clear that congestion-based airport pricing for given airport capacity should be an object of specific regulation. However, decisions on capacity levels may require closer attention.

2.2. Airport-airline relations

In order to isolate the impacts of congestion effects, we assumed in sub-section 2.1 that airports are independent of airlines, i.e. airlines act as price-takers *vis-a-vis* the airport. However, vertical relations between airlines and airports may lead to deviations from such independence. Close vertical ties between an airport and one or several airlines reduce the airport's business risk of investing in long-lived sunk assets, but imply a risk of making entry by competing airlines more difficult. When there is sufficient competition among airports, the latter risk is small and there are likely to be net benefits. But when there is less airport competition, the costs of limiting competition may well outweigh the benefits of reducing business risk.

An airport serving a strong local market and subject to capacity constraint may enjoy market power, depending on which airlines serve the airport and on the nature of its relations with these airlines. For example, an airport served by a dominant network carrier may be in a weak bargaining position with that carrier (so that market power is effectively transferred to the airline), whereas an airport served by several network carriers tends to enjoy a stronger position because of competition among the carriers[9]. Airports that mainly depend on low-cost carriers are in a particularly weak bargaining position, because such carriers are much less tied to a particular geographical market (and hence to a particular airport) than network carriers (e.g. Starkie, 2008). Furthermore, airports and airlines serving smaller cities also face more price-elastic demand, limiting their capability to translate any

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reasonable assumption for airspace competition. In the case of ground access, airports share the network with non-airport users, and this undoes market power.

9 LAX is an example of an airport serving several network carriers. Experts observe that LAX is not managed very efficiently but still does well, a situation presumably made possible by its market power. ATL is very efficiently managed, maybe partly because of the weaker market position it holds, with a single dominant carrier.

market power into higher prices[10]. Low-cost carriers do benefit from dominating an airport, however, through lower airport charges (see below).

Starkie (2008) discusses how relations between smaller airports and low-cost airlines in the UK have been revolutionised through the emergence of vertical supply contracts. These are long-term contracts (up to 20 years) that stipulate access charges for low-cost carriers and are not exclusive (in contrast to many long-term vertical contracts in the US). The contracts allow airports to generate a normal rate of return and arguably make appropriate investments in quality and capacity, a commercial requirement imposed on them by the market for corporate control of commercial airports[11]. Given the market structure in which these airlines and airports operate, the absence of increasing returns to scale, and the satisfactory commercial market outcome, Starkie (2008) argues strongly that there is no need for regulation in this segment of the aviation industry.

The good performance of airports and airlines in these markets leads to spillovers elsewhere: vertical relations between the main full-service carrier at Manchester Airport and the Airport have been revised, similar models are used in commercial and publicly-owned airports (suggesting that competition matters more than ownership at the margin[12]), and the increased presence of low-cost carriers in long-haul markets may imply that this business model will be used outside the traditional short-haul segment served by low-cost airlines.

Is the UK model transferable to the rest of Europe and the US? The geographical prerequisites for the UK system to work – a large number of small airports with overlapping service areas – are present in much of continental Europe, though not everywhere. However, no country has the same long experience with privatisation as the UK, and this may render replication of the UK model less than straightforward.

In the context of major airports and full-service carriers, Oum and Fu (2008) emphasize that, while airports have little market power *vis-a-vis* an airline when that airline dominates the airport, the airport has an incentive to co-operate with such a carrier because such co-operation allows the airport to boost non-aeronautical revenues. As airports, for example in the US, are being "commercialised", they become geared towards the exploitation of non-aeronautical activities to maximise profits. While some US airports historically have been

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10 Apart from lower willingness to pay for air travel in smaller markets, the high price elasticity facing an airport or airline derives from overlap between airports' service areas. Even if different airports or airlines in fact serve separate destinations, potential entry into overlapping destinations may be sufficient to discipline incumbents.

11 Concentration of airport ownership may emerge in this market, and could form a basis for oversight by competition authorities.

12 However, the competition among regional airports in the UK is generated by outbound passengers using low-cost carriers. It is not clear that this market segment would have developed as strongly under more widespread public ownership of airports, and in this sense ownership is not neutral with respect to competition.

heavily dependent on airlines through exclusive gate use agreements, the development of common use infrastructure has increased their independence from airlines, allowing them to pursue strategies to benefit from integration with airlines. Hence, while integration between airlines and airports in the US does not disappear with commercialisation of airports, its form tends to be more advantageous for airports, because of the reduced grip airlines have on capacity decisions.

The above suggests that not all forms of vertical integration are per definition suspect from the airport's or regulator's point of view. However, integration should not mean loss of independence for either party. For example, Fraport (Frankfurt airport) became strongly integrated with its dominant airline, Lufthansa, when it acquired partial ownership of the airport. This evolution is seen as problematic from the airport's point of view and from a broader concern about market power. For example, such ownership forces Fraport to share information on performance and on pending strategic decisions with the airline[13]. Nevertheless, full vertical separation between airlines and airports is not necessarily required to maintain sufficient competition. Airlines could own terminals at an airport (and decide on its capacity) as long as there are common use facilities as well. With vertical integration, the main concern is to avoid exclusive access for the home carrier or, more generally, avoid limitations on access by competing airlines.

While vertical integration should not be avoided in general, it may generate considerable market power in some market segments. Integration between airlines and airports generates airline-airport bundles. Consumers may have a choice between various bundles, but they are imperfect substitutes[14], and airlines and airports may enjoy considerable market power in some market segments. The degree to which airline-airport bundles are substitutes also depends on passenger characteristics. For example, while leisure passengers in the UK may have various choices, it is arguable that the choice set is smaller for business travellers. Hence, some form of policy intervention may be justified in some situations.

2.3. Hub functions

Airlines use hub-and-spoke networks to connect origins and destinations between which demand is not sufficiently dense to allow profitable direct services. This implies that hub-and-spoke networks become less competitive when the density of demand increases (e.g.

13 It is also conceivable that Lufthansa and Fraport have differing views on the desirability of capacity expansion at Fraport and on Fraport's relationship with nearby Hahn airport (used by a low-cost carrier and for freight). Fraport gave up its ownership of Hahn airport in early 2009.

14 Imperfect substitution follows from differences in service quality (airport access times, parking costs, expected delays, flight frequencies, etc.; see Ishii *et al.,* 2009) and from consumer loyalty programmes such as frequent flier programs. Product differentiation can also occur within airports, e.g. with similar but not identical services offered by low-cost and full-service carriers.

because of income growth and continuing agglomeration of economic activity) and when the costs of providing service decline (e.g. with low-cost business models being applied in less dense markets). While hub-and-spoke structures save costs, they also are a source of market power for airlines, as suggested by the evidence on the existence of hub premiums[15]. But what about the relationship between hub status and airport market power?

Market power is weaker for an airport that focuses strongly on connecting traffic[16]. Airports compete for hub functions, and this weakens the position of airports with airlines. Furthermore, airlines offer competing hub-and-spoke networks, and this indirectly weakens the benefit of a particular hub's location. In general, hub functions are not very strongly dependent on location, so they are not strongly dependent on airport location. Airlines are particularly interested in combining hub functions and serving a strong local market in a single airport, so that hub airports with small local markets are in a particularly weak position with respect to their home carrier. In Europe, this classification arguably applies to most hub airports except London Heathrow and Paris Charles De Gaulle. The potential for market power in this situation lies mainly with the home carriers, less with the airports. Since generating competition within such hubs is difficult, competition between hubs and the creation of alternative airports in the hub's catchment area is desirable to limit hub-related market power.

The major, successful hub airports tend to be located where there is strong local origin-destination demand, because of complementarities between hub and local demand from the airline's point of view (allowing, amongst other things, airlines to charge hub premiums). In addition, the trend is for the number of hub competitors to decline, as the number of independent major airlines declines. One view is this means that the market is increasingly oligopolistic and a candidate for regulation[17]. A different view is that even with fewer major airlines, there usually is a competitive fringe that disciplines major carriers and therefore reduces the need for regulatory intervention. For this to hold, access conditions in major airports need to support the existence of such a fringe[18].

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15 Hub premiums may reflect quality or cost differences instead of, or in addition to market power. Borenstein (2005) presents suggestive evidence that hub premiums are smaller in multi-airport regions in the US, so that factors other than pure product characteristics and costs may be involved.

16 The ticket tax introduced in The Netherlands in 2008 illustrates the importance of hub competition (for Schiphol Airport), as the tax is four times higher for long-haul traffic than for European traffic. Transfer passengers are fully exempted from the charge. In early 2009, political debate on the desirability of the ticket tax as such re-emerged after reports on Schiphol's loss of market share, and the tax will be abolished as of July 2009.

17 Consolidation probably will reduce the number of hubs (e.g. the DL-NW alliance may very well eliminate one or more of its current six hub airports), so that airline consolidation leads to concentration of traffic at airports, with potentially detrimental effects on competition.

18 Daniel (1995) and Daniel and Harback (2008) find no evidence of internalisation of congestion costs at major US airports and attribute this finding to the existence of a competitive fringe.

Apart from hub competition, mergers and alliances of airlines tend to weaken airports' positions, all else being equal. But if airports respond by co-operating, as may become the case for Aéroports de Paris and Schiphol, for example, then airports' countervailing power increases. Whether such horizontal integration is desirable from a broader social perspective is far from clear, however[19].

In summary, hub functions may generate market power, and this more likely accrues to airlines than to airports. In particular, airlines charge hub premiums to passengers for the airport's local market. This market power can partly be limited, e.g. through competition via secondary airports and maintaining competition between hub-and-spoke networks[20].

2.4. Summary

The degree of competition an airport faces depends strongly on the specific market environment it operates in. Some of the key market characteristics are scarcity of capacity, vertical relations with airlines and the importance of hub traffic.

Congestion at airports generates pricing power. A congestion charge is one way to attain efficient use of scarce capacity. A charge that is optimal for an airport is liable to differ from the efficient charge, but plausibly generates more welfare than where there are no congestion-related charges. Since regulation is costly, allowing airports to charge for congestion can be satisfactory. However, care needs to be taken with incentives to invest.

While full vertical separation between airlines and airports is not required to maintain sufficient competition, exclusive access for the integrating airlines should be avoided. Vertical integration may also generate considerable market power in some market segments, possibly justifying some form of policy intervention.

Hub functions may generate market power, mainly for airlines. Maintaining airport competition via secondary airports and between hub-and-spoke networks are ways to curb such market power.

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19 The recent decision in the UK to separate ownership of the three main London airports reflects the view that the benefits from competition outweigh any gains from co-operation on investment decisions and operations.

20 These remedies do not fully erode market power, because secondary airports do not offer entirely similar services to main airports, and because hub carriers limit substitution through frequent flier programmes. Whether better mechanisms to curb market power exist is not clear. Furthermore, some would argue that allowing some market power is one way to allow companies to survive where there are network economies.

Lastly, some experts doubt the extent to which the concepts outlined up to now can be applied empirically, because of a lack of suitable data (e.g. on prices at the origin-destination level, but also on the measurement of capacity) to settle the issue.

3. WHETHER AND HOW TO REGULATE

The previous section discussed several potential sources of market power in aviation and concerning airports in particular. Abuse of market power is a form of market failure, leading to a lower surplus than in a fully efficient market. If suitable policy interventions to restore efficiency are available and they are costless, they should be used. But policies are imperfect and costly, so the presence of market failures does not justify intervention in itself. Before turning to explicit policy interventions, including regulation, opportunities for competition should be played out as much as possible. Some examples of such conditions in aviation, including stimulating airport competition, avoiding exclusive arrangements between airlines and airports, and competition authorities' oversight of mergers and alliances, were mentioned in the previous section. Starkie (2008) provides evidence that creating competition is feasible in a substantial subset of aviation markets, including some large airports serving large urban markets (e.g. Manchester, Birmingham).

The governance priority should be to implement ownership structures that maximise competition, with further regulation only introduced when that solution is not satisfactory. The scope for competition among airports is broader than is often assumed by policy-makers, prompting the question of whether the application of competition law may be enough to handle problems in airport competition. Minimising *ex ante* regulation reduces the risk of discouraging the adoption of innovative business models[21].

Even when the policy priority is to maximise competition, airport regulation is still likely to be required in some situations. In deciding if and how to regulate an airport, the totality of constraints facing the airport operator need to be considered, on a case by case basis. No single type of regulation can address all shortcomings of the market in a satisfactory and universal manner. The type of regulation used for Gatwick and Heathrow exemplifies some shortcomings of commonly proposed regulatory systems. The regulation is based on average accounting costs, which are below economic (forward-looking) costs. The consequence is that capacity expansion incentives for these airports are muted, despite severe congestion problems. Furthermore, even with capacity being scarce, the airport operator is rewarded for boosting passenger volumes, leading to more crowding, lower

[21] However, *ex post* oversight requires access to data to monitor performance, and such information is lacking in some countries.

service quality and limited reliability ("sweating the assets")[22]. In light of the discussion in Section 2, regulation removes a congestion-prone facility's incentive to allocate scarce capacity well. In addition, it does not provide good incentives for capacity expansion in the long run.

One approach to avoiding regulatory failure is "light-handed regulation", used in Australia and New Zealand for major airports that are far apart and hence enjoy location-generated market power. This regulatory approach may be appropriate in cases where the airports' objectives do not lead them to abuse market power, and where there is a legacy of excess capacity. However, the approach meets with criticism (and litigation) from airlines and passengers because of high charges. Service quality and investment are "satisfactory". This outcome is in line with what the discussion in Section 2 suggests for the case of a congestion-prone facility with a considerable degree of market power (and in a sense is the opposite of the Heathrow–Gatwick case), with the proviso that theory predicts high quality and high prices, but not necessarily socially optimal levels of capacity (abstracting from lumpiness).

Oum and Fu (2008) argue for more forceful airport regulation, particularly in the case of major airports and where airports co-operate closely with airlines in order to exploit better complementarities between aeronautical and non-aeronautical services. Single till and dual till systems are both forms of price-cap regulation. Under a single till, charges to airlines for aeronautical services are determined taking (expected) non-aeronautical revenues into account[23]. Under a dual till, aeronautical activities are treated separately from non-aeronautical ones. Oum and Fu (2008) argue that single till regulation outperforms dual till regulation, as it allows the airport to optimise complementarities between both types of service, subject only to the limits included in the regulation. Dual till regulation makes exploitation of the complementarities difficult, and poses the problem of how to allocate costs in a multi-product environment. However, single till regulation may be problematic when there is congestion, since it produces charges lower than marginal social costs. This boosts traffic, whereas the charge should actually reduce it. More traffic also means more non-aeronautical revenue, implying further reductions of aeronautical charges when the price-cap is reviewed (see, e.g., Starkie and Yarrow, 2000). It appears then, that if a choice must be made between single and dual till, dual till regulation is better suited for congested airports, while the single till may be preferable where there is excess capacity (cf. Czerny, 2006, for the latter case)[24]. However, congestion charges may outperform dual till regulation, even if they are not regulated (sub-section 2.1).

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22 It was noted that the particularly low capacity-to-volume ratio at Heathrow, and the resulting poor quality of service, is sustainable only because of particularly strong local demand. Similar conditions prevail in New York, but probably nowhere else.

23 The single till approach is supported by ICAO and is widely used in Europe.

24 The choice criterion here is efficiency. Since single-till regulation implies lower aeronautical charges, it is clear that the choice of regulatory approach also implies a different distribution of scarcity rents,

Price-cap regulation is often thought to discourage investment (see the argumentation in sub-section 2.1; Starkie and Yarrow, 2008; and Oum *et al*., 2004, for some empirical evidence). While true in an abstract setting, the practical impact of price-caps depends on the estimated cost of capital. If the regulator overestimates the cost of capital, then overinvestment can result under a price-cap. Furthermore, the UK single and dual till regulations are not pure price caps and contain elements of rate-of-return regulation. This too affects investment incentives in the direction of overinvestment.

Summing up, there is a fairly broad consensus that aviation policy should first focus on establishing governance arrangements that allow competition to emerge as much as possible, given the technology and cost structures prevailing in the industry. Doing so will not omit the need for regulation in all cases, but may limit it compared to current practice. Regulation is likely to be required for major airports serving large local markets and where capacity is scarce (at the level of the airport or at the level of the airports in multi-airport regions). It is noteworthy that regulation in these cases tends to have considerable effects on the distribution of scarcity rents. Since scarcity of capacity is the main source of market power here, dual-till regulation is likely to out-perform single-till regulation. However, allowing airports to charge for congestion may be a better approach.

4. CLIMATE CHANGE POLICY AND AIRLINE COMPETITION

Sections 2 and 3 focussed on market failures caused by market structure, i.e. by the cost structures and demand patterns prevailing in aviation. Aviation also produces external costs, including noise, polluting emissions and greenhouse gas emissions. External costs are a form of market failure (including the absence of markets), justifying a policy intervention in principle (possibly including the creation of markets).

This section focuses on greenhouse gas emissions, in particular CO_2. Climate change is an important policy concern, and aviation is widely expected to contribute to the abatement of greenhouse gas emissions. The principle that aviation should be included in overall efforts in order to arrive at cost-effective abatement, is disputed by few. In addition, many think that inclusion of aviation in emissions trading systems is an appropriate way of approaching cost effectiveness. Aviation would bear the costs of its emissions on the same basis as other sectors included in trading systems, so that overall abatement costs are minimised, and carbon prices provide a clear incentive for investing in less carbon-intensive

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with airlines being better off under the single till. Distribution obviously matters in the policy debate.

technology[25]. But since climate change is a global problem and policy is regional, piecemeal and imperfect, overall cost effectiveness is hard to reach, and concerns about the impacts of economic instruments on countries', sectors' and companies' competitive positions, as well as distributional concerns, dominate policy discussions. Forsyth (2008) discusses these issues, focusing on the potential consequences of including aviation in emissions trading systems. Such inclusion is under serious consideration in the EU, Australia and New Zealand. A particular feature of the intended EU system is that it includes all flights departing or arriving outside the EU, not just intra-EU traffic. New policy views on climate change issues in the US may lead to similar initiatives.

At a price of 20€ per ton of CO_2-equivalent, and when carbon costs are fully passed through to consumers, fares can be expected to increase by 1-5% when no cheap abatement options are available (Forsyth, 2008, Table 3). If the demand for aviation increases, as generally expected, given that the aggregate elasticity of demand for air travel is rather low and given that the technological scope for emissions reductions is limited, including aviation in trading systems will probably force the sector to acquire permits in excess of its historical emissions level. Even if permits are given away for free on the basis of historical emissions, aviation hence will be a net buyer of permits[26].

Whether pass-through is complete depends on market structure (which differs between routes), on the time-frame (allowing sufficient time for firms to exit or not) and on whether airport capacity is scarce or not. We consider non-constrained situations first. In competitive markets there is no pass-through in the short run but full pass-through after profitability has been restored through exit. In monopoly markets, pass-through is incomplete and depends on the elasticity of demand and of marginal costs. Oligopoly markets are usually in between those extremes, but it is noteworthy that pass-through can be more than 100% in the long run because exit reduces the intensity of competition in the market. Overall, when capacity is abundant, this suggests that putting a price on carbon causes a short-run profitability problem for the industry, but that long-run profitability is not jeopardised.

In the polar case, where an airport capacity is strictly binding, fares are determined by the capacity constraint and in many cases will not increase with the introduction of a carbon price. Instead, scarcity rents will fall by the amount of tax revenue, and flight volumes remain unchanged. The general lesson is that capacity constraints, whatever their source,

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25 Pricing carbon, through trading or taxes, tackles the carbon externality. However, there may be other market failures that affect emissions and require their own solutions. For example, research into and take-up of technological innovations may be slower than would be expected in an efficient market. Such arguments have been made for car transport (cf. Van Dender, 2009, for some discussion) and may apply in aviation as well.

26 This situation, where airlines buy permits but do not reduce emissions, may generate a problem of political acceptability in itself (i.e. the least-cost principle is not necessarily deemed fair by policy-makers).

tend to limit the extent of pass-through of carbon costs into fares. Given that such constraints prevail at many major airports and on some international routes, on average, fares are likely to increase by less than the cost of carbon. This implies a transfer of rents from airlines to holders of permits, but the effect on air travel demand and emissions from aviation is limited. Distributing permits for free potentially reduces the impact of pricing carbon as well, because it may weaken incentives for airlines to exit certain markets (the lock-in effect).

The impact of putting a price on carbon on the sector as a whole is expected to be fairly limited: see, e.g., Forsyth (2008) and Adler *et al.* (2008) for some estimates. Anger *et al.* (2008) use a macroeconomic model to estimate the impact of including aviation in the EU ETS, and find limited effects: aviation is a net buyer of permits, requiring about 2.5% of the total supply of permits; at a permit price of 40€, demand for airline services is estimated to be 1% lower than the baseline in 2020, while emissions drop by 7.5%. The authors point out that if permits are auctioned, the revenues should not be recycled to non-ETS sectors, as this potentially undoes carbon savings.

Including aviation in the EU ETS affects airlines differentially. The EU plans to include all flights bound for or departing from the EU in the trading system. This may allow some airlines to improve their competitive position by intensifying the use of hubs close to jurisdiction of the EU ETS, thus limiting the emissions accounted for within the trading system. More generally, carriers that are mostly active within the EU may see a worsening of their competitive position compared with carriers with a large share of non-EU operations in markets where they compete directly, as the latter can cross-subsidize from markets where there is no price for carbon.

5. AIR-RAIL COMPETITION AND THE SOCIAL DESIRABILITY OF HIGH-SPEED RAIL

Some policy-makers in the US and especially in the EU are concerned about the sustainability of prevailing interurban and interregional transport patterns. Road and air transport are perceived to generate excessive emissions of conventional pollutants and greenhouse gases, and the networks are excessively congested at some times and places. Given imperfections in road and air pricing to handle external costs, the provision of rail services is seen as a second-best policy to increase the net benefits from interurban and interregional transport. For passenger transport, high-speed rail is seen as sufficiently attractive to change the modal split in these markets.

De Rus (2008) questions the general social desirability of high-speed rail, pointing out that for a generic high-speed rail connection the benefits are well below the costs, unless

rather favourable assumptions are made on demand and costs. The construction of new lines requires a high volume of demand, with enough economic value to compensate the high cost involved in providing capacity. It is not only that the number of passengers must be large, but a high willingness-to-pay for the new facility is required as well, i.e. one needs many users who obtain high benefits when switching mode or travelling more. This suggests that careful evaluations of projects are required on a case-by-case basis. The benefits from high-speed rail mainly take the form of time savings compared to other modes, and possibly of congestion relief in competing modes. Environmental benefits are minor[27]. In fact, the benefits are outweighed by the costs (in particular the high fixed costs), except in cases where there is a high density of demand and there are pressing capacity problems in air and road alternatives[28].

The French situation was mentioned as one where capacity in aviation was a crucial factor in the assessment of high-speed rail projects. Some French TGV connections brought about a substantial shift from air to rail[29], freeing up scarce capacity (valuable slots) in aviation[30]. This effect occurs irrespective of whether low-cost or other carriers might provide service between the cities linked by the high-speed rail connection. Furthermore, since high-speed rail uses separate facilities, it can also free up capacity for rail freight and for regional passenger transport. It was noted, however, that in many cases the main (expected) modal shift in response to a high-speed rail connection is from road to rail, not from air to rail.

Low-cost carriers might respond to the emergence of a high-speed rail alternative by increasing the frequency of service. A similar improvement on the rail side would be very expensive given the cost of trains, and this would reduce rail's market share and profitability. In addition, low-cost carriers can provide services between regions instead of cities (so avoiding the need to acquire expensive slots at centrally located airports). This is effectively what happened after the high-speed rail service between Paris and London opened. The potential strategic responses from low-cost carriers reinforce the view that high-speed rail may be justified where densely populated origin-destination pairs exist, but is not a general model for interurban and interregional transport.

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27 French studies find that net reductions of CO_2 emissions represent 2-3% of total benefits.

28 With very high densities of demand, costly technologies like Maglev may be justified, as is possibly the case in the main Japanese corridors.

29 Domestic air traffic in France declined by 7% between 2000 and 2007, and this is mostly (not only) attributable to the increased availability of TGV connections. Domestic CO_2 emissions declined by 23%.

30 The costs of congestion in aviation in most of Europe are difficult to measure because there is active slot management, so that measurable delays are small. This of course does not imply there is no congestion.

De Rus' (2008) analysis considers high-speed rail projects at the level of individual links. In contrast, Adler *et al.* (2008) analyse a European network of high-speed rail connections (a 300km/h TEN network and a 160km/h conventional network), where the shape of the network is determined within the analysis. They find that the TEN network produces net benefits (and higher benefits than an all-air network), at least when access charges are based on short-run marginal costs (and the train operator maximises profits in a deregulated environment). If rail is required to break even, the network is not worthwhile. Instead, if deficits resulting from short-run marginal cost pricing are financed from costly public funds, the network passes the cost-benefit test. The difference between the outcomes of both studies is attributable to network effects and to assumptions on pricing rules and budgetary constraints, and not so much to different assumptions on costs, demand and discounting.

6. CONCLUSIONS

The first part of the paper focused on the question: what are the circumstances in which airports might have market power and what should be the policy responses? The preferred policies will be shaped by the underlying economic conditions. For example, when an airport is congested and competition with other airports is limited, regulation may be justified, and the dual-till approach likely works best. In other cases, however, policy should establish conditions for competition to emerge as much as possible, instead of attempting to design a general regulatory framework. Since *ex-ante* rules and principles cannot reflect the diversity of market conditions, good, evidence-based analysis is a prerequisite for good policy-making.

The second part of the paper discussed elements of climate change policy in aviation. Including aviation in emissions trading schemes is a sensible idea, but should not be expected to produce major cuts in CO_2 emissions from aviation; containing its growth by diktat may be more easily realised, but potentially at substantial economic cost. High-speed rail is justified in a number of situations, but is not a general alternative for air travel or a second-best way to reduce greenhouse gas emissions from aviation.

REFERENCES

Adler, N., C. Nash and E. Pels (2008), High-speed rail and air transport competition: game engineering as tool for cost-benefit analysis, mimeo.

Anger, A., P. Allen, J. Rubin and J. Köhler (2008), Air transport in the European Union Emissions Trading Scheme, Department of Land Economy, University of Cambridge - http://omega.sitekit.net/Events/OmegaStudy_17_finalreport_AAPMA_2-1__240209.pdf

Borenstein, S. (2005), US domestic airline pricing, 1995-2004, Competition Policy Center Working Paper 05'048, U.C., Berkeley.

Brueckner, J.K. and K. Van Dender (2008), Atomistic congestion tolls at concentrated airports? Seeking a unified view in the internalization debate, *Journal of Urban Economics*, 64, 2, 288-295.

Chester, M. and A. Horvath (2008), Environmental life-cycle assessment of passenger transportation: a detailed methodology for energy, greenhouse gas and criteria pollutant inventories of automobiles, buses, light rail, heavy rail and air – Version 2, UC Berkeley Center for Future Urban Transport, Working Paper 2008-2.

Czerny, A.I. (2006), Price-Cap Regulation of Airports: Single-till versus Dual-till, *Journal of Regulatory Economics*, 30, 85-97.

Daniel, J. (1995), Congestion pricing and capacity of large hub airports: A bottleneck model with stochastic queues, *Econometrica*, 63, 2, 327-370.

de Rus, G. (2008), The Economic Effects of High-speed Rail Investment, JTRC Discussion Paper No. 2008-16, revised October 2008.

Forsyth, P. (2008), The Impact of Climate Change Policy on Competition in the Air Transport Industry, JTRC Discussion Paper No. 2008-18.

Harback, K. and J. Daniel (2008), (When) do hub airlines internalize their self-imposed congestion delays?, *Journal of Urban Economics*, 63, 2, 583-612.

Ishii, J. K. Van Dender and S. Jun (2009), Air travel choices in multi-airport markets, *Journal of Urban Economics*, 65, 2, 216-227.

Oum, T.H. and C. Yu (2004), Measuring Airports' Operating Efficiency: A Summary of the 2003 ATRS Global Airport Benchmarking Report, *Transportation Research E*, 40, 515-532.

Oum, T.H., X. Fu (2008), Impacts of Airports on Airline Competition: Focus on Airport Performance and Airport-Airline Vertical Relations, JTRC Discussion Paper No. 2008-17.

Starkie, D. (2008), The Airport Industry in a Competitive Environment: A United Kingdom Perspective, JTRC Discussion Paper No. 2008-15.

Starkie, D. and G. Yarrow (2000), The Single-till Approach to the Price Regulation of Airports, www.caaerg.co.uk

Van Dender, K. (2005), Duopoly prices under congested access, *Journal of Regional Science*, 45, 2, 343-362.

Van Dender, K. (2009), Energy policy in transport and transport policy, *Energy Policy*, forthcoming.