

Computer Reservation Systems (CRS). Airlines have found computer reservation systems to be extremely helpful in influencing travel agents' recommendations. By monitoring the behavior of individual agents, airlines can design commissions that will have the optimum impact on their flight recommendations. Developing and operating these systems is quite expensive, however, and only the largest carriers have been able to market them.<sup>14/</sup> At present, the seven largest carriers all own at least a share of a CRS.

*Origin of the Systems.* In the 1970s, airlines began modifying and enhancing their internal reservation systems to make the sale of airline tickets through travel agents more efficient. The CRS gave travel agents access to information about flight schedules, fares, and seat availability. It also enabled them to make reservations and issue tickets automatically.<sup>15/</sup> Although the computer reservation systems are owned and operated by particular airlines, an agent can use one to get information and make reservations on virtually any scheduled carrier.

Since the systems make both airlines and travel agents more productive, CRS owners charge both of them for the use of their systems. Travel agents rent the equipment, while airlines pay a booking fee for each flight reservation. American Airlines introduced the first computer reservation system; United, TransWorld, Eastern, and Delta each followed with systems of their own. American and United, however, dominate the CRS industry; in 1986, they accounted for 41 percent and 33 percent, respectively, of the flight segments booked through computer reservation systems.

The influence of computer reservation systems on bookings can be seen in two facts. First, a relatively large proportion of the travel agents in a city where a carrier operates a hub use that carrier's CRS. If the systems did not influence the behavior of travel agents, there would be little reason for carriers to market them most aggressively in cities where they center their operations. Moreover, at present all the

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14. For a detailed description of computer reservation systems, see Department of Transportation, *Study of Airline Computer Reservation Systems* (1988).

15. Before the development of computer reservation systems, an agent had to make a reservation via telephone and then manually write the ticket. This manual system is still used by the relatively few travel agents who do not use a CRS.

computer reservation systems are owned and operated by airlines. While the airlines have found the systems to be profitable, the one system that was not owned by an airline has ceased operating.<sup>16/</sup>

In the beginning, at least, the profitability of the computer reservation systems stemmed not from the fees paid by travel agents or other airlines, but from the systems' ability to influence directly the recommendations of travel agents.<sup>17/</sup> Since agents tend to suggest the flights that are listed first on the computer screens, CRS owners displayed their own flights most prominently.<sup>18/</sup> In its last significant regulatory act, the CAB prohibited the use of carrier identities in determining the order in which flights are listed by computer reservation systems.

But even without this "display bias," the systems apparently still generate significant benefits for their owners. A recent Department of Transportation study found that the two largest systems are quite profitable, and a significant source of these profits is the tendency of agents to book flights on the carriers that own the systems the agents use. One possible explanation for this so-called "halo effect" is that agents believe such practices reduce the chance of error. In fact, there have been periodic complaints that CRS owners have failed to load the fare and schedule changes of other carriers into their systems promptly. Another possible explanation is that the systems enable their owners to develop effective commission overrides.

*Booking Fees.* The CAB's final significant regulatory act also required that differences in carrier booking fees be justified by differences in costs. To encourage competition among CRS owners, the CAB also ordered that leases by travel agents of computer reservation systems could not exceed five years. The CAB reasoned that longer-term

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16. See Department of Transportation, *Study of Airline Computer Reservation Systems*, pp. 39-89.

17. See General Accounting Office, *Airline Competition: Impact of Computerized Reservation Systems* (May 1986).

18. When requesting schedule information, agents specify a desired departure time. But CRS owners used carrier identity--not just departure time--in determining the order in which flights were displayed. Carriers could secure a more prominent display--although not as prominent as that of the CRS owner--by paying a higher booking fee. The cost of more prominent display tended to be highest for carriers who both competed directly with the CRS owner and did not have a computer reservation system of their own.

contracts would unnecessarily limit competition by preventing agents from switching systems.

While the CAB hoped that its order would stop the hue and cry about computer reservation systems, it only changed the nature of the complaints. In response to the board's order, the CRS owners eliminated display bias, but they also increased booking fees. Carriers now maintain that these fees are too high. In essence, they are saying that CRS owners have market power: before the board's rule, the owners exercised this power by biasing their schedule displays, but now they exercise it by charging high fees. The simple fact is that carriers must sell through travel agents in order to compete, and hence their flights must be available through computer reservation systems. The CRS owners would, therefore appear to have substantial latitude in setting booking fees. The Department of Transportation study concluded that booking fees charged by CRS owners significantly exceed the cost of the service provided to the carriers.<sup>19/</sup>

## MERGERS

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Some analysts fear that the recent merger wave has set the stage for a significantly less competitive industry in years to come. It is likely, however, that the most important factor behind the industry's consolidation was a desire to achieve some of the advantages of size. If these advantages are substantial, smaller carriers will have higher costs than the larger carriers and will not be able to compete effectively. To that extent, the mergers may have helped to create more viable competitors. There can be little question, however, that several of the mergers have led to reduced competition in some markets.

### The Approval Process

The Airline Deregulation Act required airlines wishing to merge to seek approval beforehand from the Civil Aeronautics Board. The CAB, in turn, had to rule on an application within six months. The Department of Transportation assumed this responsibility after the

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19. Department of Transportation, *Study of Airline Computer Reservation Systems*, pp. 91-112.

sunset of the CAB.<sup>20/</sup> As with other industries, mergers among airlines that may tend to reduce competition are prohibited.

Since the passage of the Airline Deregulation Act, there have been at least 15 mergers or acquisitions involving two airlines that both provided scheduled domestic jet service.<sup>21/</sup> In a number of other cases the government approved mergers between such carriers that were never consummated. In only two cases--both in 1979--did the responsible government agency fail to approve a proposed merger.<sup>22/</sup> In approving Texas Air's 1986 acquisition of Eastern, however, the Department of Transportation required Texas Air to sell takeoff and landing rights at Washington and New York. A Texas Air subsidiary, New York Air, provided the only significant competition to Eastern's air shuttle in the New York to Boston and New York to Washington markets.

Although the high approval rate might seem to suggest lax enforcement, few of the mergers raised significant competitive concerns. Most were between carriers that operated in different parts of the country and therefore served few of the same routes. In two cases, the acquired firms were in financial distress that threatened their continued existence.<sup>23/</sup> While there was substantial competitive overlap in these two cases, any adverse effect on competition was probably small. It is doubtful that another carrier would have acquired the firms, or that the acquired airlines would have been able to continue operating independently.

The Department of Transportation did approve two mergers between carriers that competed on many of the same routes and were financially viable. Northwest and Republic, which merged in 1986, each operated a hub at Minneapolis-St. Paul. They competed in 26

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20. Beginning in 1989, however, mergers in the airline industry, like those in other unregulated industries, will no longer be subject to mandatory prior approval.

21. The Department of Transportation also approved the United Airlines purchase of the division of Pan American that provided air service over the Pacific Ocean.

22. The Civil Aeronautics Board explicitly rejected a proposed merger between Continental and Western. Eastern's application to acquire National Airways was rejected by an administrative law judge. Eastern, however, never pressed its application before the Board.

23. These included the Texas Air acquisition of People Express and the Southwest acquisition of Muse.

nonstop markets involving that airport and accounted for 80 percent of the airport's passengers.<sup>24/</sup> They also competed on 18 other nonstop routes and in scores of other markets. The merger of TWA and Ozark, both of which maintained hubs at St. Louis, was also approved.

### The Department of Transportation's Merger Policy

Compared with markets for most goods and services, those for airline service are served by relatively few firms. Most city-pairs simply do not have enough traffic to support service by more than one or two carriers in efficient-sized aircraft. When the Congress passed the Airline Deregulation Act, the average city-pair with nonstop flights was served by 1.4 carriers. It was understood that, even with free entry, airline markets would remain concentrated.

The Congress deregulated the airlines because it believed that carrier behavior would be sensitive to entry and the threat of entry despite high levels of concentration--that is, the Congress paid greater attention to the conditions of entry than to the current competitive structure. In evaluating mergers, the Department of Transportation has followed a similar approach. It has focused primarily on whether other carriers would be able to enter the markets served by the new carrier if it succeeded in raising prices above costs. In its analyses, the department has essentially concluded that entry into most city-pairs remains relatively easy.

But the industry has changed significantly under deregulation. The factors discussed above--route networks, frequent flyer programs, computer reservation systems, and commission overrides--were not seriously considered, or did not even exist, at the time deregulation was being debated. These developments have given large carriers certain advantages, and they have also made entry more difficult.

Factors Making Entry More Difficult. A substantial proportion of the passengers on most nonstop flights are traveling to or from other

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24. Department of Transportation, *NWA-Republic Acquisition Case*, Docket 43754, July 31, 1986. The passenger shares are based on the numbers of passengers boarding planes at the airport.

points. It follows, therefore, that an airline must attract a substantial number of such passengers to sustain a viable service on most nonstop routes. Simply having airport space and aircraft is not sufficient.<sup>25/</sup> The importance of carrying connecting passengers is the reason that the vast majority of flights either originate or terminate at the hub of the carrier that operates the flight.

Frequent flyer programs and computer reservation systems can make it difficult for an airline to attract passengers originating at another carrier's hub. Travelers tend to join the frequent flyer programs of the principal carriers serving their cities; those carriers generally offer flights to the greatest number of destinations, and travelers can earn travel awards more rapidly by using them. Passengers on their way to winning awards with a given carrier will often be reluctant to use the services of an entrant. Computer reservation systems enable airlines owning them to encourage travel agents to recommend the flights of the CRS owners. Since a CRS is clearly of greatest advantage to a carrier where it operates a hub, CRS owners often market their systems most aggressively at their hub cities.

The mergers of Northwest-Republic and TWA-Ozark doubtless decreased competition in many of the markets involving Minneapolis and St. Louis. Despite the Department of Transportation's reasoning, it is doubtful that other carriers would be able to enter many of those markets quickly if fares rose significantly. In fact, there is ample statistical evidence that, other factors being equal, passengers in more concentrated markets pay higher fares.<sup>26/</sup> There is also evidence that the greater a carrier's share of total traffic at an airport, the higher the fare it is able to charge. A possible explanation for this finding is that carriers have greater difficulty in entering markets served from concentrated hubs.<sup>27/</sup>

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25. Securing the necessary airport facilities at a reasonable price is quite difficult in some airports. This can sometimes be a barrier to competition.

26. See, for example, David Graham, Daniel Kaplan, and David Sibley, "Efficiency and Competition in the Airline Industry," *Bell Journal of Economics* (Spring 1983), pp. 118-138, and Steven Morrison and Clifford Winston, "Empirical Implications and Test of the Contestability Hypothesis," *Journal of Law and Economics* (April 1987), pp. 53-66. For a different perspective, see Franklin Fisher, "Pan American to United: The Pacific Division Transfer Case," *RAND Journal* (Winter 1987), pp. 492-508.

27. See S. Borenstein, "Hubs and High Fares."

Offsetting Factors. The reduction in competition resulting from mergers may be offset, at least in part, by certain gains in efficiency. Most notably, the merged carrier may be able to redeploy its aircraft. As part of this process, some cities will receive reduced service and higher fares, but other cities will receive new service. In fact, the number of cities receiving nonstop service from the Minneapolis-St. Paul airport has increased significantly since the Northwest-Republic merger. This provides more convenient service to passengers traveling to or from Minneapolis-St. Paul, as well as those making connections at the airport. It also makes the airport more competitive with the hubs of other carriers. Also noteworthy is the fact that Minneapolis-St. Paul and St. Louis were the two smallest airports in which more than one carrier operated a hub in 1985 (see Table 5). This raises the question

TABLE 5. AIRPORT SIZE AND CARRIER HUB OPERATIONS, 1985

Airport	Average Daily Departures	Carriers Operating Hubs (Percentage share of departures in parentheses)
Chicago O'Hare	814	United (41), American (24)
Atlanta	778	Delta (46), Eastern (42)
Dallas/Ft. Worth	577	American (52), Delta (29)
Denver	487	United (30), Frontier (26), Continental (25)
St. Louis	399	TWA (44), Ozark (32)
Minneapolis/St. Paul	307	Republic (44), Northwest (39)
Pittsburgh	300	USAir (81)
Phoenix	278	America West (35)
Houston	232	Continental (57)
Memphis	214	Republic (60)
Detroit	166	Republic (52)
Charlotte	164	Piedmont (67)
Salt Lake City	158	Western (67)
Houston-Hobby	157	Southwest (52)
Dallas-Love Field	132	Southwest 84)
Chicago Midway	68	Midway (77)

SOURCE: Congressional Budget Office, from Federal Aviation Administration, *Airport Activity Statistics* (1986).

NOTE: A carrier is considered to operate a hub if it has more than 50 flights a day at an airport, and is not located on either the east or west coast.

whether those cities could have continued to support the hub operations of two carriers.

Although there may be reason to question the analysis of the Department of Transportation in several of its merger decisions, these decisions did not play a large role in the consolidation of the industry.<sup>28/</sup> Partly because of the marketing initiatives of the carriers, and partly because of the convenience and efficiency of hub-and-spoke operations, most carriers have to be relatively large to compete effectively. And although certain markets have been adversely affected by these mergers, the airline industry seems overall to be performing reasonably competitively.

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28. For a critical review of the Department's merger policy, see statement by Kenneth Mead of the General Accounting Office before the Subcommittee on Transportation of the Senate Committee on Appropriations, April 21, 1988.



## CHAPTER III

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# AVIATION SYSTEM CAPACITY AND THE PROBLEMS OF CONGESTION AND DELAY

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Aviation infrastructure consists of two closely coordinated but separate systems, the airway system and the airport system. The airway system controls an aircraft from the time it leaves the gate at its originating airport to the time it arrives at its destination. The airport system includes over 3,000 airports with their terminal buildings, gates, taxiways, and runways.

The federal government, through the Federal Aviation Administration, constructs and operates the airway system. The FAA also provides support for and coordination among airports for the planning and development of the airport system. System users and general taxpayers fund the airway system. For the most part, airport users, along with state and local governments, fund the airports.

Congestion is the product of constraints on airport capacity, the limitations of the airway system, and the demands placed on both systems by those using them. The demand for air transportation has increased greatly over the last five years and is projected to grow steadily through the end of the century. The prospects for building new airports or greatly expanding existing airports are poor, so that without further government action congestion will most likely worsen in the future. Delays, which have been one approach to allocating capacity in the face of excess demand, may be expected to worsen as well. Attempts have been made to deal with the problem of congestion through such measures as shifting schedules or administratively allocating takeoff and landing rights. The use of prices to allocate scarce capacity is an alternative that has not been widely applied.

The current federal approach to the airways treats them like the highways: they are open and available to all who want to use them. But when highways grow congested, efforts are made to remove the congestion--by building new roads, restricting access, or imposing tolls that will rationalize their use. Given the formidable barriers to new

airport construction, the search for solutions to congestion of the aviation system must focus on the other two options.

## THE AIRWAY SYSTEM

Airways are corridors of air space analogous to highways. The FAA monitors these routes to maintain aircraft separation, advise aircraft of traffic conflicts, and warn of adverse weather conditions. Congestion and delays result from weather conditions, equipment limitations, and the peaks in demand caused by passenger travel preferences and airline hub operations.

### Description of the System

The airway system is divided into three parts: air route traffic control, terminal traffic control, and flight service stations. The FAA is modernizing, automating, and expanding its airway facilities under a program called the National Airspace System Plan. The plan aims to eliminate outmoded and obsolete equipment, and to improve the system's reliability and safety. It should also improve the system's ability to handle traffic in periods of bad weather, which is the major source of delay in the airway system.

Air Route Traffic Control. Air route traffic control is provided by 20 Air Route Traffic Control Centers (ARTCC) in the contiguous 48 states.<sup>1/</sup> These centers monitor commercial air carriers and general aviation aircraft flying under instrument flight rules (IFR) between airports. Flight into controlled airspace requires permission from the air traffic controllers monitoring the air routes at these centers.

Terminal Traffic Control. Terminal traffic control is provided at airport facilities around the country. Terminal Radar Approach Control facilities handle aircraft after they leave the control of the en route ARTCC centers until they land at their destinations. These

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1. There are four additional centers outside the continental United States in Anchorage, Honolulu, San Juan, and Guam.

facilities maintain aircraft separation, space arrivals at the airport, and align aircraft for approach and landing on the proper runway. Airport Traffic Control Towers handle the approach at airports without radar facilities, and control aircraft on the ground from runway touchdown to arrival at the airport gates.

Flight Service Stations. The third element of the airway system consists of over 300 flight service stations, providing services primarily to general aviation aircraft. These services include filing and closing (after trip completion) of aircraft flight plans, weather briefings, communication with pilots flying under visual flight rules (not flying IFR under ARTCC control), and aid to pilots in distress.

At present, all three parts of the airway system are quite labor intensive. Basic data are provided by an extensive system of radars, computers, and radio communications equipment. Yet, the handling of aircraft and transfer of information between pilots and ground facilities and among ground facilities has not been automated to a significant degree. Moreover, operation and maintenance costs for the system's obsolescent equipment are high.

#### Funding of the Airway System

The system is funded in part by the Airport and Airway Trust Fund and in part by appropriations from the general fund of the Treasury.

The Trust Fund. The Airport and Airway Trust Fund receives revenue from aviation excise taxes paid by users of the aviation system and from interest on its cash balance (invested in Treasury securities). The taxes consist of an 8 percent tax on domestic passenger tickets, a \$3 international departure tax, general aviation fuel taxes of 12 cents per gallon on gasoline and 14 cents per gallon on other fuels, and a 5 percent waybill tax on air cargo shipments. The 8 percent ticket tax has accounted for nearly 88 percent of annual trust fund tax receipts over the last five years. Figure 5 shows the average contribution of each revenue source in that period (see first pie chart).

The trust fund finances about half of Federal Aviation Administration spending (see second pie chart, Figure 5). The airport grants-

Figure 5.  
Trust Fund Revenues and FAA Outlays

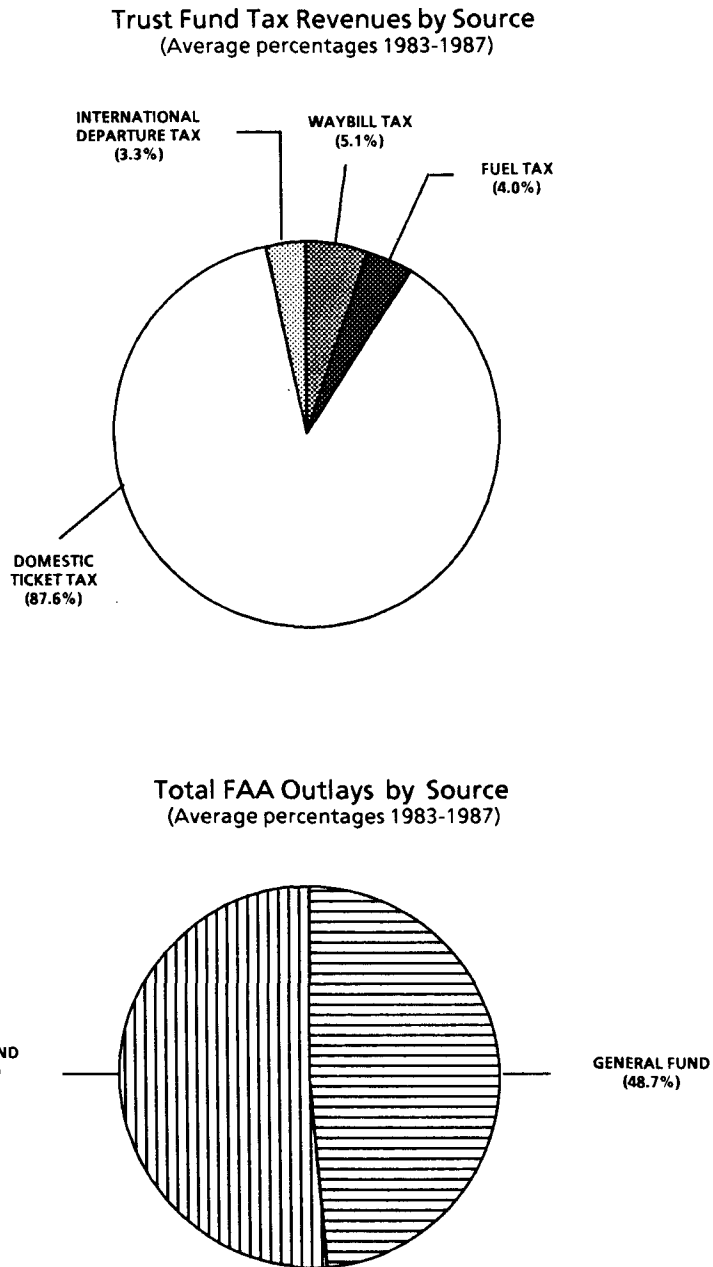
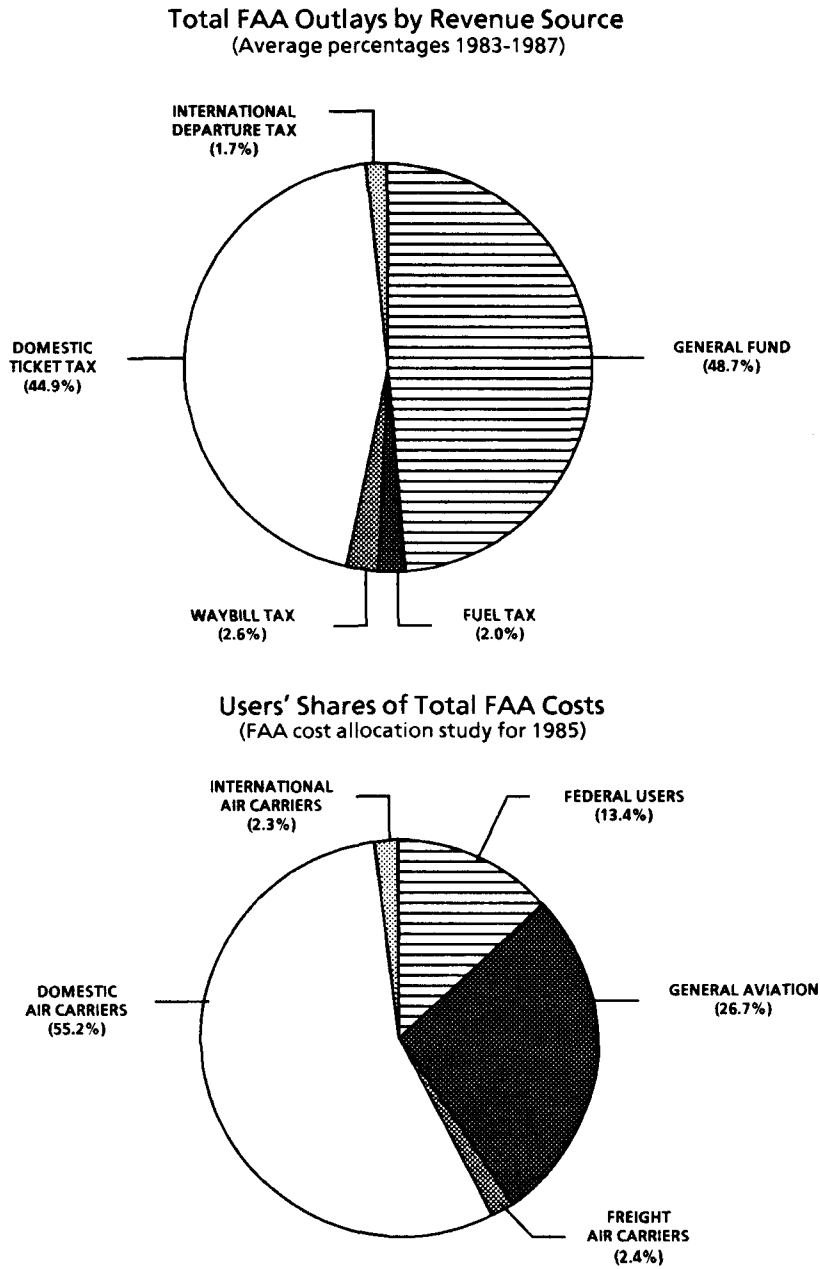


Figure 5.  
Continued



SOURCE: Congressional Budget Office, from Department of Transportation data and the Appendix to the Budget of the United States.

in-aid program and capital expenditures for the airway system (for research, engineering and development, and facilities and equipment) are fully financed by the trust fund. The trust fund also makes transfers to the National Oceanic and Atmospheric Administration for the Aviation Weather Services program.

FAA operating costs include the operation and maintenance of the airway system and safety regulation. The trust fund covers only part of these costs, however. And because of limits imposed in the trust fund authorizing legislation, the percentage of FAA operations funded by the trust fund varies each year. Over the last five years, the trust fund has paid for 25 percent of FAA operations, and the remainder has come from general fund revenues.

Nonfederal users of the aviation system do not pay all the costs incurred by their use. Taxpayers have been subsidizing nonfederal users since the trust fund was established. In fact, this subsidy has helped to create a surplus in the trust fund. General aviation has benefited most from the subsidy, while airline passengers have paid nearly their full costs. The third and fourth pie charts in Figure 5 show user contributions to FAA outlays and the FAA estimates of each user's actual share of FAA costs. The shadings in the top chart, showing the sources of revenue, correspond to those of the users in the bottom chart who supply that revenue. While nonfederal users of the system are demanding increases in system investment to reduce the trust fund surplus and increase capacity, the excise taxes they pay are clearly insufficient to finance the costs of the system. Moreover, since taxes do not vary with the demands placed on the system, they do not serve to regulate excess demand.<sup>2/</sup>

### Capacity Problems in the Airway System

Airway system delays account for only about 20 percent of all delays experienced by air travelers. Of the airway system delays, about 70 percent are caused by bad weather; the rest result from congestion in

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2. For a complete analysis, see the forthcoming Congressional Budget Office study on the Airport and Airway Trust Fund.

the traffic control systems.<sup>3/</sup> Airline hubbing practices, air traffic control equipment, and staffing problems contribute to and exacerbate this congestion. (Airline hubbing practices are examined more fully in the airport section below.)

The 1981 air traffic controllers' strike, and the firing of three-fourths of the controller work force, led to severe staffing shortages within the airway system. Until 1983, limits were placed on air traffic at the nation's 22 busiest airports, handling more than half of air travelers. The FAA assigned each of these airports an hourly quota of takeoffs and landings--commonly referred to as "slots." The number of slots available at each airport was determined by the level of operations that could be handled safely by both the terminal control facilities and the en route control centers. The controller work force has now been largely rebuilt, and the constraints have been eliminated at these airports.<sup>4/</sup>

At the same time that traffic has been growing and the airway system has suffered from staff shortages, the traffic control equipment in place is obsolescent and increasingly difficult and expensive to maintain. The FAA's plan to modernize its equipment has fallen behind schedule because of developmental problems and funding constraints. While the program is being accelerated, the system will for some time be hampered by equipment that is less reliable and has less capacity than current demands on it may require. In order to preserve the level of safety in the system, the FAA has no choice but to limit traffic, especially in periods of bad weather.

## THE AIRPORT SYSTEM

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While some of the present congestion can be ascribed to the limitations of the airway system, much of it stems from capacity and operational problems at large commercial airports. These airports handle

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3. While weather problems are the immediate cause of the majority of delays, increased capacity in the airway system would enhance the ability of air traffic controllers to handle traffic and reduce delays during periods of bad weather.
  4. Slot restrictions that existed before the controllers' strike remain in place at the four capacity-controlled airports.

nearly all commercial passengers, and have borne the brunt of the rapid changes in airport demands resulting from deregulation. The development of hubbing, and rapid traffic growth, are straining the peak capacity of many of these airports.

### Structure of the Airport System

Over 3,000 airports make up the airport system.<sup>5/</sup> These are grouped into three categories, depending upon their use:

- o Commercial service airports, which serve scheduled commercial airline traffic and handle at least 2,500 passengers per year. There are 550 commercial service airports.
- o Reliever airports, which serve general aviation traffic (private, noncommercial planes, such as business and pleasure fliers). Their name derives from their function: relieving a nearby commercial service airport of this traffic. There are 244 reliever airports.
- o General aviation airports serving business, corporate, and pleasure fliers. There are 2,449 general aviation airports.

Nearly all commercial air travelers use 72 large commercial airports.<sup>6/</sup> In 1986, these airports handled 89 percent of all passenger enplanements.

### Financing the Nation's Airports

The airports are generally owned and managed by local authorities. Financial support, however, is provided by a combination of federal,

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5. Much of this discussion is based on the Federal Aviation Administration's *National Plan of Integrated Airport Systems (NPIAS) 1986-1995* (November 1987). There are over 16,000 public and private airports in the United States. But only airports that are open to the public, that are considered of national interest, and that are eligible for federal grants are included in the National Plan of Integrated Airport Systems (NPIAS) and are discussed here.
  6. These include airports classified by the FAA as large or medium hub airports. Large hub airports are commercial service airports that handle 1 percent or more of commercial passenger enplanements; medium hub airports are commercial service airports that handle between 0.25 percent and 1 percent of passenger enplanements.



state, local, and private resources. Airport operating costs are financed by fees charged to users of the airports. These include landing fees and rental of terminal space for air carriers; income from concessions on airport property such as parking, food service, and car rentals; and charges to general aviation for landing, tie downs, and terminal and hangar use.

Airport investment costs are funded primarily by a mix of federal grants and private bonds backed by air carrier agreements and guarantees. The specific sources of investment financing, and the percentage of funding from any one source, vary between airport size categories and among airports of the same size. Table 6 shows the range of sources of airport investment.

Large commercial airports finance most of their investment themselves. Though the federal government accounts for only about 20 percent of the outlays at these major airports, they absorb over half of all federal airport investment. Other commercial airports rely to an increasing degree on federal support as their level of commercial passenger traffic declines. Reliever and general aviation airports also rely heavily on federal support, receiving three-fourths of their investment funds from federal grants. As with the smaller commercial airports, their revenue sources may not be secure enough to induce private investors to finance a substantial proportion of their capital investment with long-term bonds.

Federal Investment. Federal support for airport investment is provided through grants awarded under the Airport Improvement Program. Airport grant assistance can be used only for planning and construction of "airside" improvements (including runways and taxiways, public terminals, and noise and safety-related investments) and for planning and coordination with other local airports.

The airport program distributes annual grants according to an allocation formula. Up to 49.5 percent of funds go to primary, commercial service airports as entitlements based on annual passenger enplanements, with 3 percent of total grants earmarked for cargo airports. An additional 12 percent of annual funds go to the states for distribution to general aviation airports. And at least 38.5 percent of funds go into a discretionary fund for distribution by the Secretary of Transportation.

TABLE 6. SOURCES OF AIRPORT INVESTMENT

Airport Category	Number of Airports <sup>a</sup>	Percent of National Investment	Percent of Investment from:		
			Federal Grants	Bond Proceeds	Other
<b>Commercial Airports</b>					
Primary					
Large hubs <sup>b</sup>	29	43	20	80-100	0
Medium hubs <sup>c</sup>	43	19	25	60-80	Under 15
Small hubs <sup>d</sup>	67	13	40	20	40
Nonhubs <sup>e</sup>	139	5	60	20	20
Other Commercial <sup>f</sup>	272	5	80	20	0
<b>General Aviation Airports</b>					
Relievers <sup>g</sup>	244	6	75	8-10	Over 17
Other General Aviation <sup>h</sup>	2,449	10	75-80	i	Under 25
All Airports	3,243	100	35-40	50-65	Under 15

SOURCES: Congressional Budget Office, *Financing U.S. Airports in the 1980s* (April 1984) and Federal Aviation Administration, *National Plan of Integrated Airport Systems (NPIAS) 1986-1995* (November 1987).

- a. Includes airports classified by the FAA as in the national plan of integrated airport systems.
- b. Large hubs enplane 1 percent or more of national revenue passengers.
- c. Medium hubs enplane between 0.25 percent and 1 percent of national revenue passengers.
- d. Small hubs enplane between 0.05 percent and 0.25 percent of national revenue passengers.
- e. Nonhub airports enplane between 0.01 percent and 0.05 percent of national revenue passengers.
- f. Other commercial airports are all other airports having more than 2,500 annual revenue passenger enplanements.
- g. Reliever airports are airports in metropolitan areas that are intended to reduce congestion at large commercial service airports by providing alternative landing areas. Most relievers handle only general aviation; some also handle commercial flights.
- h. Other general airports are all other airports handling nonscheduled flights.
- i. Negligible.

Another requirement is that at least 10 percent of all funds go to reliever airports, 10 percent to noise abatement projects, 2.5 percent to small, commercial service airports, and 0.5 percent for integrated airport system planning grants. The discretionary funds are used to assure that these limitations are met, given the projects approved in the first two categories of the grant program.

Private Investment. Air carriers provide much of the support for private investment in airports, generally through financing agreements negotiated between airports and their tenant airlines. These "airport use agreements" assure the airports of sufficient revenue to cover their operating and maintenance costs and to retire the debt incurred to finance terminals, parking facilities, roads, and the portion of "airside" investments not financed by federal grants. The financing agreements for large commercial airports are generally either residual cost or compensatory agreements. In the residual cost approach, tenant airlines collectively agree to cover any airport costs that cannot be attributed to and recovered from other airport users. In the compensatory cost approach, the airports set fees for the use of airport services and facilities, taking the risk that traffic may not be high enough to cover costs.

About half of the large airports use residual cost agreements. While these agreements limit the airports' financial risk, they give tenant airlines a large voice in the operation of the airport and in any new investment that, while increasing capacity, would increase their costs. Airports financed in this fashion may act like local monopolists, providing less than optimal capacity and charging prices higher than would otherwise be realized. While these agreements provide an incentive to maximize the revenue earned from nonairline sources, they offer less incentive for properly pricing the services that airlines use.

### Capacity Problems in the Airport System

Congestion in the aviation system arises from many sources. On the demand side, the principal factors are hubbing and peaks in travel. On the supply side, the principal constraints are airport capacity, airway staffing, and the outdated and limited capability of airway equip-

ment. The latter two were discussed above in the airway section, while airport congestion is examined more fully below.

Traffic has grown tremendously since deregulation of the airline industry began in 1978, from 267 million passengers a year in 1978 to 444 million passengers in 1987. Airport congestion and delays are concentrated at large commercial airports: weekly airplane departures have grown by 64 percent at these large airports as compared with 47 percent at the small commercial airports.<sup>7/</sup> Further, the FAA forecasts that passenger enplanements at large airports will grow another 85 percent by the year 2000, and that aircraft operations will grow by 41 percent. The FAA considers 13 large airports to be congested, and expects an additional 34 to become congested by 2000. In total, the FAA expects 58 airports (47 of which are large airports), handling 76 percent of all passengers, to be congested by the turn of the century.<sup>8/</sup>

Traffic Peaks. An important contributor to airport congestion has been the growth in airline hub-and-spoke operations. The hub-and-spoke system creates local, peak congestion problems. At certain times each day, numerous flights arrive in quick succession; passengers transfer to other aircraft; and again, in quick succession, planes leave for their destinations. Figure 6 shows this peaking pattern at four representative large airports, while Figure 7 shows the percentage of flights delayed during each hour at these same airports.<sup>9/</sup> While the correlation between airport peaks in Figure 6 and delays in Figure 7 is not perfect, there is an apparent relation between the two.

The growth of hub-and-spoke route systems has led to a substantial increase in the percentage of flights controlled by the leading carrier at a number of airports. While some critics have expressed concern about the ultimate effect of this increase in concentration on competition, it may help alleviate congestion. An airline that controls

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7. Small commercial airports in this study include those airports classified by the FAA as small hub, nonhub primary, and other commercial service airports. There are 478 small commercial airports.
  8. For a discussion of how the FAA defines congested airports, see Federal Aviation Administration, *National Plan of Integrated Airport Systems*, p. 12. Also see Office of Technology Assessment, *Airport System Development* (August 1984), pp. 45-55.
  9. Atlanta is one of the busiest airports in the country with two airlines hubbing there. Memphis and Pittsburgh are each hubs for one major airline. San Francisco is a major origination and destination airport, but not the center of a significant hub-and-spoke operation.

most of the flights at an airport tends to bear a large share of the costs of the added delay that arises from scheduling more flights--the flights of the dominant carrier are the most likely to be delayed. In contrast, an airline with a small share of operations at an airport faces little of the cost of the added congestion.

Peaks in traffic also result from passenger travel preferences. People generally want to travel either early in the day or late in the day. This can lead to morning and evening congestion even at airports that may not otherwise be congested. Peaks can also occur because of weekly and seasonal travel patterns. And since airlines tend to schedule their flights to leave on the hour and half hour, there can be peaks within the hour as well as within the day.

Expansion of Capacity. The prospects for new commercial airport capacity are limited by a number of factors. First, in large urban areas, land is scarce and relatively expensive. This generally limits the expansion of existing airports and requires new airports to be built far from urban centers. Moreover, public concern over airport noise may lead to efforts to prohibit airport development or to delay development if a site is found. Some increase in runway capacity may be obtained, at existing airports by improving aprons, taxiways, lighting, and ground control of airplanes.

In addition, airlines using congested airports often prefer marginal, less costly improvements in the current airport to the much more costly alternative of building a new airport. A major expansion of capacity may also be seen by an airline as facilitating the entry of other carriers into its markets.

Even in areas where new airports are currently planned (Denver, Farmington, N.M., Austin, and San Diego) or under consideration, the time between the beginning of planning and the opening of an airport can stretch to several decades because of the abovementioned problems. For these reasons, new airport construction is unlikely to have much effect on capacity or congestion in the near future.

Greater potential for increasing capacity at some airports may be offered by changes in operating practices. For example, the installation of microwave landing systems may permit fuller use of runway