VATT-KESKUSTELUALOITTEITA
VATT-DISCUSSION PAPERS

149

AIRLINE DEREGULATION: THE AMERICAN EXPERIENCE AND PROSPECTS FOR EUROPE

Jan K. Brueckner* -
Anton Goebel** -
Esko Niskanen**

Valtion taloudellinen tutkimuskeskus
Government Institute for Economic Research
Helsinki 1997

* Department of Economics and Institute of Government and Public Affairs University of Illinois at Urbana-Champaign, 1206 South Sixth St. Champaign, IL 61820, USA.

** Government Institute for Economic Research, P.O. Box 269, FIN-00531 Helsinki, Finland.

ISBN 951-561-214-4

ISSN 0788-5016

Valtion taloudellinen tutkimuskeskus

Government Institute for Economic Research

Hämeentie 3, 00530 Helsinki, Finland

Email: esko.niskanen@vatt.fi

J-Paino Oy

Helsinki, December 1997

BRUECKNER, JAN K. - GOEBEL, ANTON - NISKANEN, ESKO: AIRLINE DEREGULATION: THE AMERICAN EXPERIENCE AND PROSPECTS FOR EUROPE. Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Institute for Economic Research, 1997. (C, ISSN 0788-5016, No. 149) ISBN 951-561-214-4.

Abstract: This paper provides an exhaustive discussion of the impact of airline deregulation in the U.S., followed by a discussion of the likely effects of deregulation in the EU. The paper argues that the benefits of U.S. deregulation, as manifested in lower fares, were generated in part by the reorganization of route structures into hub-and-spoke networks. The same reorganization is identified as a means for improving airline efficiency in the EU, which is currently far below that of U.S. carriers. Such an efficiency improvement is necessary if EU deregulation is to lead to lower fares, as in the U.S. However, the paper identifies convenient rail service, which reduces the willingness of passengers to undertake circuitous airline trips, as one impediment to the formation of hub-and-spoke networks. Another impediment is airport congestion, which is more serious in the EU than in the U.S.

Key words: airline industry, deregulation, EU

BRUECKNER, JAN K. - GOEBEL, ANTON - NISKANEN, ESKO: AIRLINE DEREGULATION: THE AMERICAN EXPERIENCE AND PROSPECTS FOR EUROPE. Helsinki, VATT, Valtion taloudellinen tutkimuskeskus, Government Institute for Economic Research, 1997. (C, ISSN 0788-5016, No. 149) ISBN 951-561-214-4.

Abstrakti: Tutkimuksessa arvioidaan vuonna 1997 EU:ssa loppuunsaatetun ilmaliikenteen dereguloinnin vaikutuksia. Vertailukohtana on aikaisemmin USA:ssa toteutetun vastaavan dereguloinnin vaikutukset reitteihin, hintoihin ja viime kädessä hyvinvointiin. USA:ssa lentoyhtiöt muokkasivat dereguloinnin seurauksena reittinsä ns. hub-and-spoke -tyyppiseksi ja hinnat laskivat huomattavasti. Koko valtakunnan tasolla lentoyhtiöiden lukumäärä laski, mutta yksittäisten reittien tasolla kilpailu lisääntyi. Tilanne Euroopassa on erilainen, monesta syystä johtuen. Yksi tärkeä ero on se, että EU:ssa deregulointi koskee vain kolmasosaa markkinoista (charter-liikenne ja kansainvälinen liikenne poisluettuina). Muita tärkeitä eroja ovat ilmaliikenteen pahempi ruuhkautuminen Euroopassa sekä lyhyemmistä etäisyyksistä johtuva muiden liikennemuotojen, erityisesti rautateiden, kilpailu. Ilmaliikenteen dereguloinnin lopullisia vaikutuksia EU:ssa voidaan arvioida vasta EU:n yhteisen liikennepolitiikan valossa.

Asiasanat: ilmaliikenne, deregulointi, EU

Contents

Introduction

Almost twenty years have elapsed since U.S. airlines were deregulated. The passage of the Airline Deregulation Act in 1978 initiated a period of dramatic restructuring of U.S. carriers, and most of the effects of deregulation had emerged by the mid 1980's. Prior to 1978, the Civil Aeronautics Board (CAB) exerted substantial control over the pricing practices and route structures of U.S. carriers. Fare changes required CAB approval, and entry and exit on individual routes were subject to similar scrutiny. In a bold stroke, the Deregulation Act abolished the CAB, following a short transition period. Thereafter, airlines were free to alter their route structures and to set fares competitively. The airlines responded rapidly to these new freedoms, altering the structure of the industry.

After a series of steps begun in the late 1980's, European airlines by mid-1997 faced a regulatory structure nearly identical to that introduced in the U.S. nearly 20 years previously. Unrestricted cabotage (the right to carry domestic passengers in another country), which became available in April 1997, was the last step in the removal of restrictions on the route structures of EU carriers. With this step, the freedom of European carriers to alter their route structures within the borders of the EU became fully equivalent to that enjoyed by American carriers within the borders of the U.S. In addition, internal fares within the EU can be set with almost as much freedom as domestic fares within the U.S. Domestic fares within individual EU countries are unregulated, and an international fare within the EU can be overturned only if the oversight bodies in both countries disapprove.

Since deregulation has proceeded by stages in Europe and has only recently been completed, most of its effects have not yet emerged. However, given the similarity of regulatory changes in the U.S. and the EU, a natural question is whether the ultimate effects of deregulation will be the same on both sides of the Atlantic. There has been considerable speculation on this question, both in the press and in the technical literature. The purpose of the present paper is to offer another contribution to this important inquiry.

In order to predict the likely impact of airline deregulation in the EU, it is important to gain an understanding of the range of effects that may be unleashed by a deregulation policy. These effects are well-documented in the U.S. case, both in the press and in a voluminous academic literature. The paper begins with a detailed survey of the U.S. experience following deregulation. The discussion starts in Section 2.1 by documenting the decline in airfares. Then, the discussion describes the changes in the structure of the airline industry that led to the fare decline, including the increase in competition at the city-pair level (Section 2.2) and the growth of hub-and-spoke networks (Sections 2.3 and 2.4). Synthesizing the preceding results, Section 2.5 identifies the ultimate sources of the decline in airfares and of other deregulation's benefits.

With this background provided, Section 3 turns to the European case. To start, Sections 3.1 and 3.2 shortly summarize the features of EU deregulation and enumerate the important ways in which the EU context differs from that of the U.S. One important difference is government rather than private ownership of the EU carriers, which has contributed to low production efficiency and high labor costs. Another difference is that airport congestion is more serious in the EU than in the U.S. A third difference is that EU airlines face greater competition from train service than in the U.S., a consequence of shorter intercity distances and better railway technology.

Following this discussion of initial conditions, Section 3.3 describes the early (by the end of year 1996) response to deregulation by the European carriers. Sections 3.4-3.5 then consider the likely longer-term effects of deregulation on fares and route structures. Sections 3.6 and 3.7 discuss the roles of congestion at EU airports and of intermodal competition, both of which are more important in Europe than in the U.S. A major conclusion of the paper is that solving the airport-congestion problem may be a key to reaping the full benefits of deregulation in the EU. The discussion argues that congestion pricing at EU airports is the preferred way of attacking airport congestion. Section 4 offers conclusions.

The U.S. Experience

Effects of deregulation on fares

The ultimate measure of the success of a deregulation policy is its effect on prices.[1] The evolution of airfares in the U.S. following deregulation has been studied extensively, and the most up-to-date appraisal is provided by Morrison and Winston (1995). Their evidence shows that the average domestic fare in the U.S., expressed in 1993 dollars per passenger mile, fell from $0.21 in 1976 to $0.14 in 1993, for a decrease of 33 percent. While this decline in the "yield" per mile is noteworthy, appraising the benefits of deregulation requires a comparison between the given decline and the trend that fares would have followed in the absence of deregulation. Morrison and Winston make this comparison by using the CAB's old fare formula to generate hypothetical fares under a regulated regime for all the trips that actually occurred after deregulation.

[1] Other welfare impacts, such as those from the higher time cost of travel and greater flight frequency, are discussed in Section 2.5 below.

Morrison and Whinston conclude that constant-dollar fares in 1993 were 19 percent lower than they would have been in the absence of deregulation. Deregulation thus accounted for 58 percent (19/33) of the fare decline through 1993, with the remaining 42 percent due to other factors. Using this figure, the trips passengers actually took in 1993 would have cost $12.4 billion dollars more had deregulation not occurred. This substantial sum is one measure of consumer benefits from airline deregulation.

The fare impact of deregulation is also highlighted by Morrison and Winston´s comparison of U.S. yields with yields in airline markets in the rest of the world. In 1969, the U.S.-average yield was 4.8 percent below that in the rest of the world. By 1990, the U.S. advantage had increased to 23 percent. This widening gap between fares inside and outside the U.S. further testifies to the benefits of deregulation.

While it generated lower fares, deregulation also led to a substantial increase in the dispersion of fares. Greater dispersion has been a result of the use of "yield management" practices by the carriers. Yield management exploits a number of price-discrimination mechanisms in order to charge different fares for a given trip depending on the price sensitivity of the passenger. Price-sensitive passengers are charged low fares, while passengers with less price sensitivity are charged high fares. In addition, as the flight date approaches, the carrier's yield-management system reallocates unsold aircraft seats between the fare classes in an optimal fashion in order to extract the most revenue from the flight. This ability to adjust seat allocations (and to alter fares) on minute-by-minute basis is tied to the growth of computer-reservation systems, which became important competitive tools following deregulation.

The key to airline price discrimination is to generate market segmentation between the price-sensitive leisure traveller and price-insensitive business passenger. The main mechanism for doing so in the U.S. is the Saturday-night-stay requirement, which imposes a burden on the business passenger without affecting the vacationer. Trips involving a Saturday-night stay therefore can be priced cheaply without attracting business passengers, who pay high fares for midweek trips that are shunned by leisure travellers. Another market segmentation device is the advance-purchase discount, which is easily used by travellers planning ahead for a vacation but is unavailable to business travellers making a last-minute booking.

A number of studies have documented the increase in fare dispersion under deregulation. Evans and Kessides (1993) investigate the distribution of fares on each U.S. route over the 1978-1988 period. They compute the yield per mile for fares at the 10^{th}, 50^{th}, and 90^{th} percentiles for each route, and then average the percentile figures across routes. Their results show that while the 90^{th} percentile yield was 50 percent higher than the 10th percentile yield in 1978 ($0.30 vs. $0.20 in 1988 dollars), by 1988 the 90th percentile yield was nearly triple the 10th percentile yield ($0.40 vs. $0.15). This trend toward greater dispersion can also be seen in Figure 2.5 of Morrison and Winston (1995), which shows that the 1993 fare distribution has a flatter peak and wider tails than the 1978 distribution (it is also centered to the left, indicating lower fares). Providing a different measure of fare dispersion, Borenstein and Rose (1994) show that the expected fare difference in 1986 between two passengers randomly selected from a given route equals 36 percent of the route's mean fare. All of these findings confirm the observation, frequently encountered in the press, that the fares paid by passengers sitting next to one another on an airplane may differ by hundreds of dollars.

Although fare dispersion is often criticized by popular commentators, economists have argued that the observed dispersion is socially desirable. For example, the ability to make a seat reservation close to a flight's departure date is valuable for business travellers. However, the airline takes a chance that seats will go unfilled by holding them open until the last minute. To reward the airline for this risk, fares for last-minute bookings should be high relative to advance-purchase fares.

Effects of deregulation on competition

The decline in fares described above has resulted from a number of changes in the structure of the airline industry. First, deregulation has changed the extent of concentration within the industry, both at the national level and the route level. Table 1, which is taken from Brueckner and Spiller (1994), shows the percentage of the national market controlled by the four largest firms as well as the "effective number of competitors." The latter number is derived by first computing the Herfindahl index, which equals the sum of squares of the market shares of firms in the industry. A smaller value indicates a more even distribution of shares and thus less concentration. The effective number of competitors is computed by taking the reciprocal of the Herfindahl index, with a larger number indicating less concentration. As can be seen, the four-firm concentration ratio drops slightly in the middle of the 1978-1988 period, and the effective number of competitors jumps substantially, only to fall below its original level by 1988. This level indicates that the extent of concentration in 1988 is the same as if eight equal-size firms competed in the industry. A similar calculation reported by Morrison and Winston (1995) shows that the effective number of competitors remained roughly unchanged between 1988 and 1993, indicating little further change in concentration.

Table 1. Concentration at the National Level

	1978	1984	1988
Four-firm concentration ratio	.591	.536	.591
Effective number of competitors*	8.85	11.13	8.03

* Equal to the inverse of the Herfindahl index.

Source: Brueckner and Spiller (1994).

The increase in concentration in the mid-1980's surprised the proponents of deregulation, who had expected a growth in the number of competitors in the industry. The source of the increase was a wave of fourteen mergers in the period 1985-1987, as noted by Morrison and Winston (1995), as well as the failure of discount carriers such as People's Express and Air Florida. While the increase in concentration at the national level was unexpected, the proponents of deregulation were partly vindicated by favorable developments at the city-pair level. Competition at the level of individual city-pair markets has risen since deregulation. In other words, even though the industry contains fewer firms at the national level, the number of carriers competing in individual markets grew. This was possible because industry concentration led to an increase in the national coverage of individual carriers, so that their route structures overlapped in more city-pair markets.

The increase in competition at the city-pair level is seen in Table 2, which is also taken from Brueckner and Spiller (1994). Note that while national concentration increased between 1984 and 1988, concentration at the city-pair level did not reflect this trend, with the effective number of competitors remaining constant at a level above its value prior to deregulation. While Table 2 focuses on large markets, Morrison and Winston (1995) perform similar calculations using data from all city-pair markets. Their results reveal the same favorable pattern as in Table 2 up to 1988. Moreover, the improvement in city-pair competition was maintained between 1988 and 1993, with the effective number of competitors remaining roughly constant over this latter period.

Table 2. Concentration at the City-Pair Level

(Measured as the Effective Number of Competitors*)

	1978	1984	1988
Largest 100 markets**	1.89	2.72	2.72
Largest 300 markets	1.86	2.36	2.42
Largest 500 markets	1.71	2.23	2.30

* Equal to the inverse of the Herfindahl index.

** Markets ranked by 1988 origin and destination traffic.

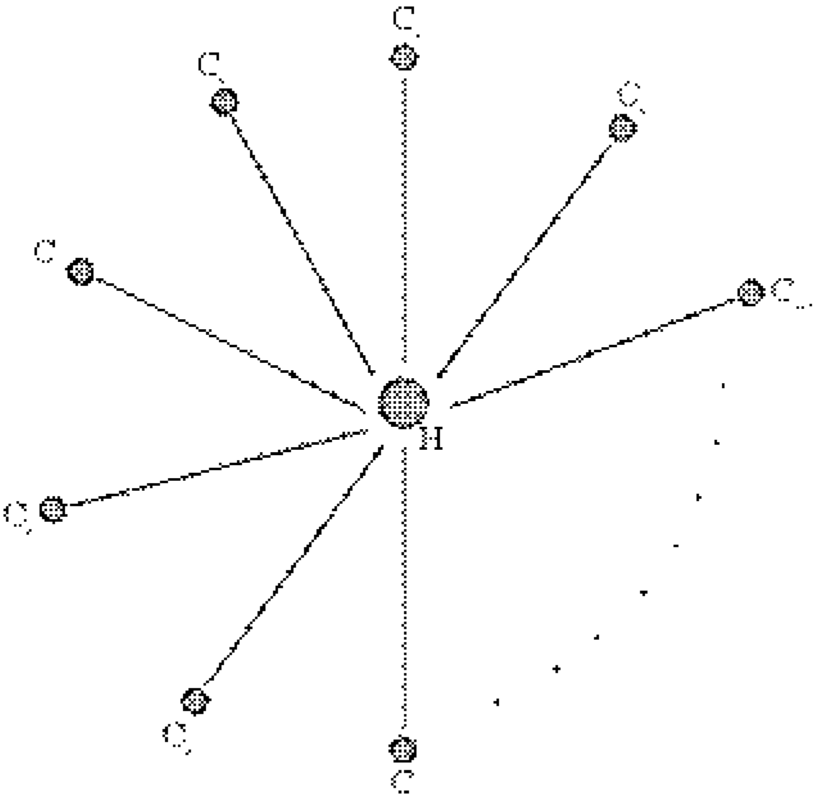
Source: Brueckner and Spiller (1994).

While actual competition is important in maintaining low prices in a market, the threat of entry may also be effective in preventing price increases. This notion was formalized in the theory of "contestable markets," which provided an important conceptual underpinning for the movement toward airline deregulation. Contestable-market theory implies that fares in an airline city-pair market should respond to the presence of "potential competitors." These are airlines that do not currently serve the market but could easily enter. Extensive research has confirmed that potential competition indeed has a restraining effect on airfares. Typically, potential competition is measured by counting the number of airlines that serve both endpoints of a city-pair market without serving the market itself. The assumption is that such carriers could easily provide service in the given market if they chose to do so. Since research shows that fares in a city-pair market fall as the number of potential competitors rises, an additional force beyond the growth in actual competition (as seen in Table 2) helps to maintain low fares in the deregulated environment.

The growth of hub-and-spoke networks

The most visible effect of deregulation was the reorganization of the carriers' route networks. This reorganization has been a major source of the fare decline in the post-deregulation period. While the pre-deregulation networks have been described as "haphazard," reflecting the intrusive effect of the CAB, the carriers were free to redesign their route structures following deregulation. The result was the widespread adoption of the hub-and-spoke network. In such a network, passengers from each city are flown to a hub airport, where they change planes before flying on to their eventual destinations. Such a network is shown in Figure 1, where H denotes the hub airport and where C_1, C_2, …, C_n denote the n cities that are endpoints of the network. A passenger travelling from city C_2 to city C_n, for example, first travels along the spoke route from C_2 to H and then, after a short layover at the hub, travels in a different airplane along the spoke route from H to C_n.

Figure 1. A Hub-and-Spoke Network



In contrast to the hub-and-spoke (HS) network, another way of connecting the cities in Figure 1 would be via a point-to-point network, in which airplanes are flown between each pair of cities. Thus, instead of travelling through the hub, the passenger going from C_2 to C_n would travel nonstop on an airplane flying directly between these cities. Since there are n+1 cities in Figure 1 (including the hub), the number of separate route segments required in a point-to-point network is equal to n(n+1)/2. By contrast, inspection of Figure 1 shows that the number of route segments (spoke routes) required in an HS network is equal to n, a much smaller value.

Assuming that traffic in the individual city-pair markets is the same under the two types of networks, it is clear that the traffic level on each spoke route of an HS network is much higher than on the individual route segments of a point-to-point network. For example, under the HS network, all the traffic in and out of city C_2 travels along the spoke to the hub, while under the point-to-point network, the nonstop segment from C_2 to city C_n carries only the traffic between these cities.

The higher traffic density on the spokes of an HS network confers a cost advantage on the airline. The reason is the existence of economies of traffic density, which means that the airline's cost per passenger on a route segment is a decreasing function of traffic density on the segment. This means, for example, that the cost of transporting 1000 passengers per day along a single route segment is lower than the cost of transporting 250 passengers per day along four separate route segments. Because the HS network concentrates traffic on relatively few route segments, the airline benefits from economies of traffic density. A disadvantage, however, is that passengers travel farther on average under an HS network than under a point-to-point network. As long as the endpoint cities are relatively close to the hub, however, the extra cost of this more-circuitous routing is dominated by the gains from economies of density, making the HS network cheaper to operate.

Economies of traffic density arise from several sources. First, high traffic density allows the use of larger aircraft, which are cheaper to operate than smaller aircraft on a per seat basis. For example, the cost per seat mile of operating a Boeing 727-200 is $0.036 while the cost per seat mile for a DC-10 is $0.028 (see McGowan and Seabright (1989)). In addition, high traffic density permits greater flight frequency, which allows more-intensive aircraft operation (more flight hours per day). Economies of density also arise from elements of an airline's costs that are partly fixed, and thus independent of traffic density. These include cost of ground facilities at the endpoints of a route and salaries for ticket agents and baggage handlers. These costs can be spread across more passengers as traffic density on a route rises.[2]

Brueckner and Spiller (1994) provide evidence on the strength of economies of density. They estimate an econometric model that shows how an airline's costs vary with the level of traffic on a route segment. Their results can be illustrated by considering how costs vary in three types of HS networks: a high-density network, such as Delta's Atlanta network, which carried approximately 36,000 passengers per quarter on an average spoke route in 1985; a moderate-density network like US Air's Pittsburgh network, which carried around 24,000 passengers per quarter on an average spoke; a low-density network like Ozark's St. Louis network, which had average spoke traffic of about 12,000. Brueckner and Spiller's results show that an airline operating a high-density network like Delta's could carry an extra passenger along a spoke route for an incremental cost

---

[2] It is often said that HS networks reflect economies of scope. Such economies arise when two products can be produced more cheaply when they are produced jointly by a single firm rather than separately by two firms. However, usage of this term is somewhat misleading in the airline context. Rather, it is better to view the HS airline as a multiproduct firm whose production process involves cost complementarities across products. The products are air travel in individual city-pair markets, and cost complementarities arise because of economies of density and the joint use of network spokes. For example, by increasing traffic density on the spoke between city C_2 and the hub, an increase in traffic in city-pair market C_2-C_n lowers the cost of providing service in city-pair market C_2-C_5, indicating cost complementarities between these two products. A theoretical analysis of HS networks is provided by Brueckner and Spiller (1991).

of $107. By contrast, an airline operating the moderate-density network would incur an incremental cost of $113, while the incremental cost in a low-density network would be $134. Thus, the incremental cost of carrying an extra passenger is 25 percent higher in the low-density network. The evidence therefore reveals a strong cost motive for achieving high traffic densities, which in turn creates a powerful incentive to form HS networks. Moreover, the results show that once an HS network is created, the carrier benefits from any steps that can be taken to raise traffic density within the network, such as addition of more endpoints.[3]

The growth of HS networks after deregulation can be seen in the changing share of direct vs. connecting routes flown by the major carriers. Diagrams in Morrison and Winston (1995) (Figures 6-2 through 6-5) show that, for American, Delta, US Air and United, the share of city-pair markets served by connecting routes was 50 percent or less for each carrier in 1978. By 1993, however, the large majority of each carrier's city-pair markets were served by connecting routes, with the share of direct service falling to around one-third in each case. However, since direct routes on average carry more passengers than connecting routes, this pattern overstates the growth of connecting traffic. In fact, Morrison and Winston's results show that the share of passengers flying on connecting flights rose only slightly from 28 percent in 1978 to 32 percent in 1993. Underlying this slight increase, however, is a dramatic increase in the number of connecting passengers who made on-line connections, staying on the same carrier. Only one-third of connections were on-line in 1978, while nearly 100 percent were on-line in 1993. Therefore, while a change of plane meant a change of airline for most connecting passengers in 1978, by 1993 almost all connecting passengers stayed within a single carrier's HS network.

While route reorganization into an HS network facilitates efficient travel within a given set of endpoint cities, network economies encourage airlines to add endpoints to the network. By adding a single spoke route to one new city (say C_{n+1}) in the network of Figure 1, the airline can provide service in n+1 new city-pair markets. As a result, network expansion is highly desirable, and this can be seen in the growth of the number of endpoints served by the major airlines following deregulation. Table 3, which is taken from Brueckner and Spiller (1994), documents this expansion through 1988, showing that the number of endpoints more than tripled for some carriers. Table 4, which is adapted from Evans and Kessides (1993), shows the resulting growth in the number of city-pair markets served by the major carriers, a consequence of the extension of service to more endpoints. As noted above, this expansion in the number of markets served increased the overlap in the route structures of the major carriers, accounting for

[3] Brueckner, Dyer and Spiller (1992) provide additional evidence on the effects of HS networks on fares.

the growth in competition at the city-pair level despite the increase in national concentration.

Table 3. Number of Endpoints Served by the Major Carriers

	1979	1984	1988
American	50	75	173
Continental	32	64	137
Delta	69	107	190
Northwest	34	42	167
TWA	49	59	94
United	80	112	169
US Air	81	92	131

Source: Brueckner and Spiller (1994)

Table 4. Routes Served by 8 Major Carriers

	Number of routes (out of top 1000 most heavily traveled routes) served by airline	
Airline	*1978:4*	*1988:4*
American	211	692
Continental	73	503
Delta	313	651
Eastern	307	349
Northwest	78	427
TWA	173	341
United	255	544
US Air	173	418

Source: Evans and Kessides (1993)

Another effect of deregulation that may partly reflect the growth of HS networks is a moderate increase in load factors, which measure the percent of aircraft seats occupied by paying passengers. As shown in Figure 2-13 of Morrison and Winston (1995), the average load factor rose slightly from around 60 percent in 1978 to just under 64 percent by 1993. It is likely that this effect is due to the adoption of more-rational route structures following deregulation.

While higher load factors make airline flights more crowded and thus less pleasant from the passenger's point of view, another loss from deregulation is the increase in the time cost of air travel. This cost has risen with the growth of HS networks because of longer flight distances and the need for a layover at the hub. Morrison and Winston (1995) show that the first effect is small, with average passenger air time increasing by only 9 minutes from 1978 to 1993 (Figure 2-12). No systematic evidence exists on aggregate time costs from layovers, but the figure is no doubt substantial and must be subtracted from Morrison and Winston's $12.4 billion welfare gain from lower fares. However, an offsetting source of benefits, which again partly reflects the growth of HS networks, is greater flight frequency. No recent estimate of the welfare gains from this source is available.

The emergence of dominated airports

In order to raise traffic densities, an airline has an incentive to create a large HS network serving many endpoint cities. In doing so, however, the carrier may end up controlling most of the traffic at the hub airport, leading to a dominated hub. Deregulation has led to the emergence of a number of dominated hubs, as shown in Table 5 (adapted from Table 4-1 of Morrison and Winston (1995)). Note that in the cases of Atlanta, Minneapolis, and Pittsburgh, the dominant carrier controls more than 80 percent of the airport's traffic.

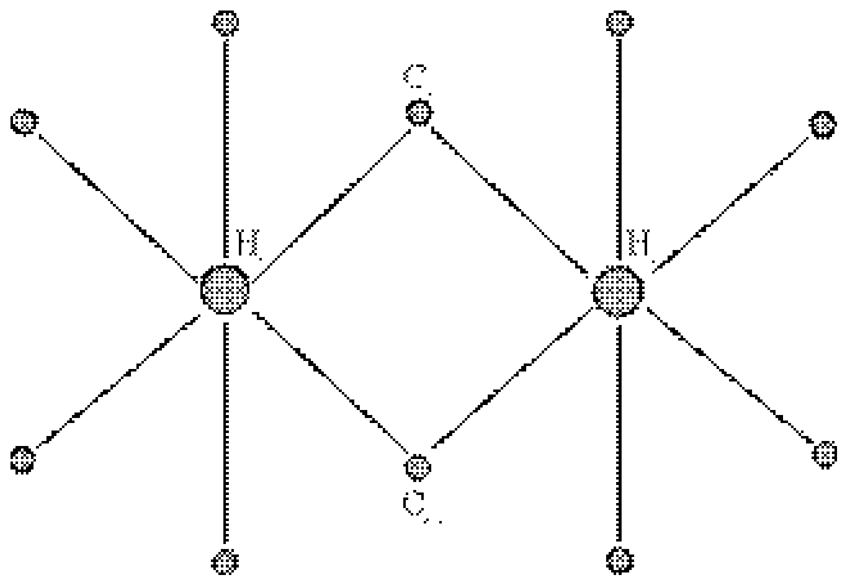
Table 5. Dominated Hub Airports

	1978		1993	
Airport	Largest Carrier	Enplanement Share	Largest Carrier	Enplanement Share
Atlanta	Delta	49.7	Delta	83.5
Detroit	American	21.7	Northwest	74.8
Memphis	Delta	42.2	Northwest	76.3
Minneapolis	Northwest	31.7	Northwest	80.6
Pittsburgh	US Air	46.7	US Air	88.9
St. Louis	TWA	39.4	TWA	60.4

Source: Morrison and Winston (1995)

While large networks are desirable for efficiency reasons, they may lead to welfare losses for some passengers when their by-product is a dominated hub airport. The reason is that, when the hub is dominated, passengers travelling to and from the hub city have little choice among airlines. As a result, the dominant carrier has market power, which may lead to higher fares for travel to and from the hub. It is important to recognize that despite its market power over local traffic, the dominant carrier still faces competition for connecting passengers from other HS networks. This is illustrated in Figure 2, which shows that the dominant carrier at hub H_1 must compete for traffic between cities C_n and C_{n-1} with another carrier operating its own HS network out of hub H_2. This interhub competition keeps connecting fares low despite the dominant carrier's market power over local traffic at the hub.

Figure 2. Interhub Competition



The emergence of dominated hubs is reflected in city-pair competition measures when these measures are disaggregated according to whether direct or connecting service is provided. Calculations presented Borenstein (1992) show that the effective number of competitors rose from 1.88 to 1.98 for all city-pair markets, regardless of the nature of service, between 1984 and 1990. However, in city-pair markets with direct service, the number of effective competitors fell from 1.69 to 1.58 over this period. Since markets with direct service include those where one endpoint is a hub airport, the unfavorable trend in this competition measure testifies to the growing problem of hub dominance.

The effect of hub dominance on fares has been studied extensively. Most studies find that airport dominance does indeed allow a carrier to raise its local fares at the dominated hub. Illustrative evidence is given in Table 6, which is adapted from Table V of Evans and Kessides (1993). The table shows the ratio between the 1988 fares of the dominant carrier and other airlines for travel to and from the dominated hubs listed in Table 5. As can be seen, the ratios always exceed unity, indicating a fare premium for the dominant carrier that averages around 10 percent. Morrison and Winston (1995) show that by 1993, this premium dropped by half, to a level closer to 5 percent. In addition, they calculate that by 1993, consumer losses from the dominated-hub premium, while still substantial, were less than 2 percent of the \$12.4 billion overall annual gain from deregulation.

Table 6. Fares at Dominated Hubs, 1988

Airport	Dominant Carrier	Ratio of Dominant Carrier's Fares to those of other Carriers
Atlanta	Delta	1.147
Detroit	Northwest	1.119
Memphis	Northwest	1.047
Minneapolis	Northwest	1.167
Pittsburgh	US Air	1.092
St. Louis	TWA	1.160

Source: Evans and Kessides (1993)

Following Borenstein (1989), many researchers argue that the dominated-hub fare premium is partly a demand-side phenomenon. The argument focuses on the benefits of frequent-flyer programs (FFPs), which constitute a major marketing innovation stimulated by airline deregulation. Since FFPs reward passengers who accumulate substantial flight miles on a given carrier with tickets for free travel, they breed loyalty to individual airlines. This loyalty is enhanced when convenient travel to a host of destinations is possible on a particular carrier. Such convenience, however, is greatest for the residents of a city that serves as the hub for a large HS network. The value of frequent-flier mileage is greatest for the residents of such a city, since it translates into convenient free travel to a multitude of destinations. The last step in the argument is the recognition that, because of the greater value of their free-travel benefits, the dominant airline can charge higher prices to the residents of a hub city for purchased tickets without losing their business. Since this argument does not rely on monopoly power, it predicts a fare premium for the hub airline even when it faces appreciable competition at the hub airport. All that is required is that the carrier operate a large network out of the hub.

While many studies find that airport dominance raises fares, supporting this idea, Berry, Carnall and Spiller (1996) provide more detailed evidence by showing that business passengers value access to a large network more highly than leisure travellers. This is logical given that business travellers accumulate many more FFP miles, raising the value of network access for free travel. As a result, formation of a large network allows the airline to raise its business fares substantially at the hub city. Since these fares are high to start with, a given percentage increase provides a substantial boost to profit.

The sources of deregulation’s benefits

With the background provided by the above discussion, it is interesting to attempt to identify the root causes of the decline in airfares over the period since deregulation. One might guess that the removal of the CAB’s regulatory apparatus would have substantially depressed airline profits, providing one source of the fare decline. In fact, one could argue that on a fundamental level, airline profitability has been largely unaffected by deregulation. As noted by Morrison and Winston (1995), airline profits were seldom strong under regulation, with their level closely following the business cycle. This pattern has been maintained since deregulation. For example, the interval of poor profitability during the Gulf War recession of 1990-1992 has been followed by the current period of robust airline profits. The absence of a fundamental change in profitability suggests that the discipline of greater competition at the city-pair level, as described above, has had roughly the same effect as CAB oversight in maintaining a balance between fares and costs.

With profitability mostly unchanged, the decline in airfares must therefore be attributed mainly to the lower operating costs of the carriers. As shown in Figure 6-7 of Morrison and Winston (1995), real operating costs declined by about 15 percent between 1978 and 1992. The root causes of the decline in fares thus can be isolated by identifying the sources of this cost decline. One source has already been identified, namely the rationalization of the carriers’ route structures following deregulation. By raising traffic densities, the adoption of HS networks lowered cost per passenger, as described above, and this gain was passed on in the form of lower fares. Another reason for decline in the carriers’ real operating costs is that labor costs in the airline industry rose more slowly than in other sectors of the economy after 1978, a response to the new competitive pressures brought by deregulation (see Morrison and Winston (1995)). Therefore, it appears that the lower airfares in the post-deregulation era can be attributed to more-efficient route structures and more-favorable input costs.

Prospects for Europe

EU deregulation

After a series of steps begun in the late 1980’s, European airlines by mid-1997 faced a regulatory structure nearly identical to that introduced in the U.S. nearly 20 years previously. For good descriptions of the process of EU deregulation, see Association of European Airlines (1997) and Commission of the European Communities (1996c). As in the U.S., deregulation removed restrictions on routes and fares. Currently, domestic fares within individual EU countries are unregulated, and international fares within the EU can be set with almost as much freedom as domestic fares within the U.S. The only remaining restriction for intra-EU fares in 1997 consisted of a “double disapproval” mechanism, which allows a fare to be rescinded if both countries find it to be ruinously low from a profit perspective or unacceptably high from the consumer’s point of view.

With the elimination of route restrictions, any EU carrier is free to offer service on any airline route within the EU, without regard to national borders. “Third” and “fourth freedom” service, where a carrier provides service between its home country and another EU country, is now unrestricted. Previously, such service was governed by bilateral agreements, and traffic levels were subject to capacity constraints. In addition, a carrier can provide service between cities in two different countries other than its home country (known as fifth or seventh freedom service). Finally, as well as offering domestic service within its home country, a carrier can provide domestic service in another EU country, connecting cities within the borders of that country (such service is known as “cabotage”). Unrestricted cabotage, which became available in April 1997, was the last step in the removal of restrictions on the route structures of EU carriers. With this step, all route restrictions within the EU had disappeared, giving European carriers, in principle, the same freedom to adjust their route structures as exists in the U.S.

The initial conditions for EU deregulation

To gauge the likely effects of airline deregulation in Europe, it is useful to begin by comparing the initial conditions that prevailed in the EU and the U.S. prior to deregulation. The differences, which will be explained in detail in the following discussion, are:

1. EU airlines are government-owned, whereas airlines in the U.S. are privately-owned.
2. EU airlines have lower technical efficiency and higher operating costs.
3. EU airlines are smaller.
4. Charter traffic is more important in Europe than in the U.S.
5. International traffic is relatively more important in Europe than in the U.S.
6. EU airlines operate radial route networks, but typically offer nonstop rather than connecting service.
7. Distances between major cities are shorter in Europe than in the U.S.
8. Airport congestion is more serious in Europe than in the U.S.
9. Rail transport is a realistic alternative in Europe.

The first key difference between the EU and the U.S. lies in airline ownership. While all U.S. airlines are privately owned, national governments own majority stakes in most EU carriers. The second difference, which is related to government ownership, is that EU airlines are less efficient than U.S. carriers, requiring higher levels of capital and labor to produce a given output. In addition, government ownership allows EU carriers to tolerate high labor costs and, in many cases, government control entitles the carriers to substantial operating subsidies paid out of general tax revenue. The differences in efficiency and labor costs are shown in Table 7, which is taken from Neven and Röller (1996).

Table 7. Wages and Productive Efficiency of European Carriers

Carrier	Technical efficiency: 1990 (% of most efficient US carrier Northwest)	Labor cost: 1989 (% of US level - Cabin crew)
Air France	47.60	273 (UTA only)
Alitalia	64.69	not available
British Airways	74.67	94
Iberia	52.60	232
KLM	53.08	not available
Lufthansa	62.45	141
Sabena	77.39	167
SAS	52.17	251

Source: Neven and Röller (1996)

Note that all the listed European carriers in Table 7 are less efficient than the most efficient U.S. carrier, while all except British Airways pay higher labor costs for cabin crews. While BA's favorable labor costs no doubt reflect the privatization of the carrier in 1987, privatization had yet to raise its technical efficiency to the U.S. level by 1990. However, as noted by Good et al. (1993), BA was alone among EU airlines in enjoying substantial improvement in efficiency over the 1980s.

Expensive labor combined with technical efficiency translates into high unit costs. Table 8, adapted from Youseef and Hansen (1994), shows operating costs measured as U.S. cents per revenue passenger kilometer (RPK). While some of the difference in operating costs between the U.S. and EU carriers can evidently be attributed to the shorter European flight distances (see below), most of the difference is due to technical inefficiency and high labor costs. The difference in cost per RPK as seen in Table 8 is reflected in yields (i.e. the average fare per passenger kilometer). Good et al. (1993) indicate that while the average yield for the EU carriers in 1991 was 22.5 cents per RPK, the average yield for the 12 major American carriers was 7.9 cents per RPK. Higher costs in Europe thus translate into appreciably higher fares.

Table 8. Operating Costs for U.S. and European Carriers, 1989

	Unit Operating Costs (U.S. cents per RPK)	Total RPK (billions)
U.S. Carriers		
American	7.81	118.3
United	7.85	112.0
Delta	8.35	95.5
Northwest	8.52	73.5
Continental	7.67	62.4
European Carriers		
British Airways	10.73	60.8
Air France	14.55	36.7
Lufthansa	18.21	36.1
KLM	12.72	24.9
Iberia	13.81	21.0
Alitalia	17.38	20.8
Swissair	17.92	15.4
SAS	20.56	15.3

Source: Youseef and Hansen (1994)

A third difference between EU and the U.S. lies in the sizes of airlines. Focusing on total RPK as a measure of size, Table 8 shows that even the largest EU carriers are small relative to their U.S. counterparts.

A fourth key difference is the substantial role of charter traffic in Europe. Such traffic accounts for 25 percent of passengers and 56 percent of RPK in Europe, while the charter passenger share in the U.S. is around 1 percent (see Commission of the European Communities (1996)). Charter traffic has been mostly unregulated in Europe and thus lies outside the scope of deregulation efforts.

A fifth difference is that international traffic to destinations outside the EU is relatively more important than international traffic in and out of the U.S. According to Good et al. (1993), such traffic accounted for 78.3 percent of the total traffic of the 10 largest European carriers in 1990. By contrast, only 28 percent of 1990 traffic was international for the 10 largest U.S. carriers. Since deregulation in the EU leaves this traffic unaffected (external international traffic is still governed by bilateral agreements between respective countries), EU deregulation affects a much smaller portion of total traffic than in the U.S. case. Berechman and de Wit (1996) claim that deregulation will directly affect somewhat less than 30 percent of total traffic.

A sixth difference between initial conditions in the U.S. and Europe is in the nature of route structures. While U.S. airline routes prior to deregulation were haphazard, most European carriers have operated orderly "radial" route networks centered at their country's capital city. These routes were originally negotiated through bilateral agreements with the destination countries. Although the radial route structure is superficially similar to the HS network, European carriers appear not to have used their networks to generate a large amount of U.S.-style connecting traffic on international trips within Europe.[4] One reason for the apparent paucity of international connecting travel in Europe is the extensive pattern of nonstop service between European cities. In addition, many commentators point to uncoordinated scheduling as an impediment to true HS trips within Europe. In other words, instead of timing their flights to arrive at the home airport in "waves," as is done in U.S. networks, EU carriers have allowed uncoordinated arrivals and departures, which has often meant long, inconvenient layovers for connecting passengers.

A seventh difference between the EU and the U.S. lies in intercity distances. Although Europe contains more people than the U.S. (1990 populations were 347 and 254 million), its major cities are closer together than in the U.S. This affects the average length of airline routes. As indicated by Good et al. (1993), the average stage length (i.e., route-segment length) for the major European carriers in 1991 was 677 kilometers, while the average stage length for the 12 largest American carriers was 1016 kilometers. The shorter distances in Europe mean that air travel is less essential as a means of intercity transportation than in the U.S.

An eighth difference is in the level of air-traffic congestion. In the U.S., airport access for the airlines is restricted by capacity constraints only in the cases of four airports: Chicago-O'Hare, Washington-National, and LaGuardia and Kennedy in New York. Landing slots at these airports are fully allocated, so that a carrier wishing to provide new service must acquire a slot from an incumbent carrier. Airport congestion is evidently more serious in Europe. Heathrow in London is the best-known example of a slot-restricted airport.

---

[4] A precise measure of the extent of such traffic is not possible using available data. Unlike in the U.S., where the Department of Transportation collects "origin-destination" data that is widely used by researchers, no such data is available for international traffic. Instead of showing the origins and destinations of travellers, international traffic data are reported only for individual route segments. Therefore, the data do not show a passenger's entire trip, which may involve several route segments.

As well as restricting airport access, congestion creates flight delays. Such delays are also caused by the unevenness of the air-traffic control system in the EU, which blends the individual systems of different countries.[5] In contrast, air-traffic control practices are uniform throughout the U.S., ensuring a better flow of traffic. These two factors combine to make flight delays a bigger problem in Europe than in the U.S. Daniel (1995) states that about 20 percent of intra-European flights arrive at least 15 minutes late. A similar aggregate number is not readily available for the U.S., but the on-time figures reported by individual carriers tend to show lower shares of late flights.

The ninth and final key difference between Europe and the U.S. is that rail transportation is much more heavily used in Europe than in the U.S., where intercity rail traffic is significant on only a few routes. As a result, EU travellers face a mode-choice decision on intercity trips that is mostly absent in the U.S. Given that air and rail travel are close substitutes, airline deregulation in the EU is likely to have spillover effects on rail traffic. Conversely, rail competition may affect the reorganization of airline route structures following deregulation. The interaction between rail and air traffic leads to a more complex environment for deregulation in the EU and suggests the need for a broader policy that treats all transport modes simultaneously.

The early (by the end of 1996) response to the EU deregulation

The early response to deregulation is documented in Commission of the European Communities (1996c). This report focuses on the period between 1993, when the "third package" of reforms was introduced (clearing away most route restrictions), and the end of 1996.

The EU report states that "contrary to what happened in the United States in the wake of air transport deregulation, there have been no across-the-board or high-profile fare reductions in Europe." Fares have continued to rise on monopoly and duopoly routes, which account for 94 percent of EU routes. However, competition has led to lower fares on some routes served by three or more carriers, notably those in and out of the UK and Belgium. Despite the general upward trend of fares, the share of scheduled tickets sold in the discount category grew from 60 percent in 1985 to 71 percent in 1995. Combined with the 56 percent charter share, this suggests that around 95 percent of EU passengers travel on discounted tickets.

As for the impact of deregulation on routes, the number of EU airline routes rose only slightly, from 488 to 518, over the period from 1993 to 1996, indicating a limited carrier response to the freedom to initiate new service. Entry of new

---

[5] See Commission of the European Communities (1996a) and Holler, Knieps and Niskanen (1997).

carriers on existing routes was also infrequent. In fact, the number of monopoly routes rose from 296 in 1993 to 329 in 1996 (from 61 percent of the total to 64 percent). However, as pointed out in the EU report, many of these monopoly routes have low density and often face charter competition. In addition, the number of routes served by two carriers fell from 182 to 158 (from 37 percent to 30 percent of the total). Encouragingly, however, the number of routes served by three or more carriers tripled, from a low level of 10 in 1993 to 31 in 1996 (a level equal to 6 percent of the total). These highly competitive routes account for a disproportionate and growing share of total EU flights, with their flight share rising from 12 percent in 1993 to 16 percent in 1996.

Fifth freedom routes, where service is provided beyond the endpoint of a third or fourth freedom market, grew from a low level of 14 in 1993 to 30 in 1996. All the major EU carriers now operate a least one such route, with one example being Finnair, which operates a number of fifth freedom routes out of Stockholm. In explaining the slow growth of fifth freedom services, Humphreys (1996) states that the "larger flag-carriers seem to have done little more than 'test the waters,' making use of spare equipment or attempting to gain incremental revenues on a route linking two thin, third/fourth freedom markets, while non-flag carriers have largely ignored the new fifth freedom opportunities."

Competition on domestic routes within individual EU countries grew as a result of the activities of domestic carriers, with the share of monopoly routes falling from 90 percent in 1993 to 80 percent in 1996. The French, German and Spanish domestic markets experienced the largest increases in competition. Cabotage service, since it remained partly restricted during the period between 1993 and 1996, was seldom offered.

To summarize, the impact of the EU deregulation on route structures as well as on fares has so far been very limited. This is in part due to the short time that has elapsed since the major reforms were introduced, although structural reasons may also play a role. These reasons, reflected in the "initial conditions" discussed in Section 3.2 above, will be described next.

Route-structure reorganization and the longer-term impact on fares

The key obstacle to fare reductions in Europe is the extremely high level of operating costs of the EU carriers, as documented in Table 8. It is evident, as Good et al. (1993) argue, that without a reduction in these costs, fares can never fall to the level enjoyed in the U.S. Lower operating costs can be achieved in part through a gradual reduction in the unit labor costs of EU carriers, following the example of British Airways. While the experience of high-labor-cost U.S. carriers such as US Air suggests that this is a slow, arduous process, the new competitive environment may provide the needed downward pressure on labor costs.

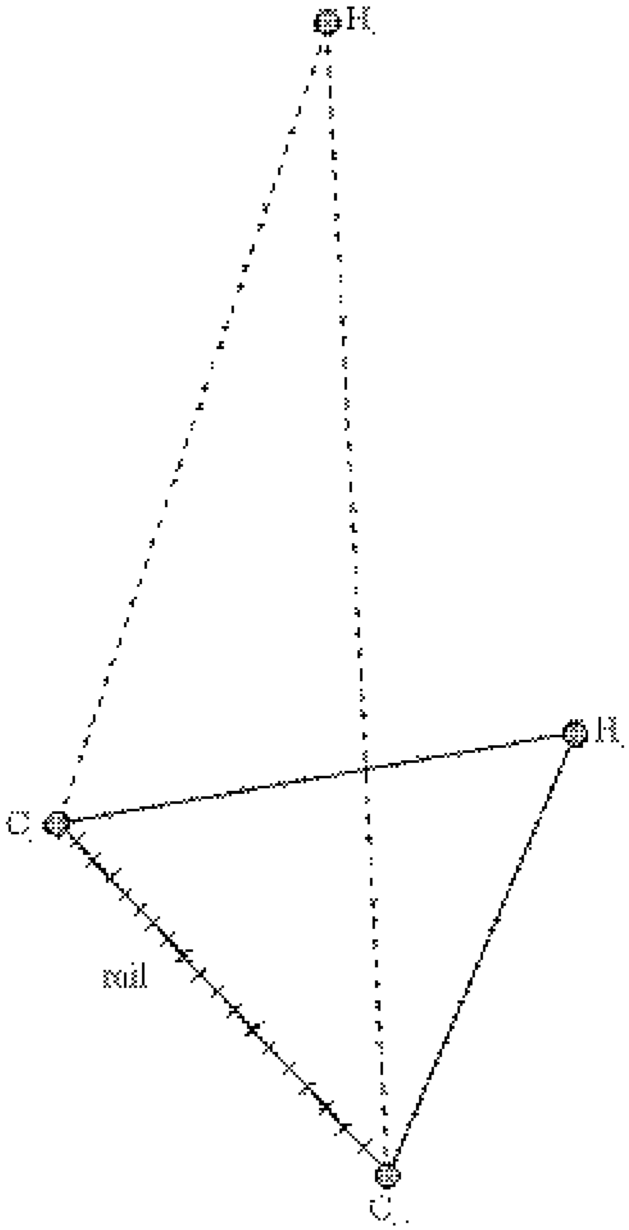
Another means of reducing operating costs is by raising the technical efficiency of EU carriers toward the U.S. level. Competitive pressure may help to achieve this goal by giving the carriers an incentive to shrink their bloated work forces. In addition, the greater operating freedom brought by deregulation may allow the carriers to reduce costs in a less-painful way by rationalizing their route structures. Such rationalization, which is likely to involve a movement toward HS networks, could lead to higher traffic densities and ultimately to lower cost per passenger.

One way of increasing the extent of HS traffic would be to improve schedule coordination within the existing radial route networks, which would stimulate connecting travel (and thus traffic densities). However, it is likely that achievement of traffic densities comparable to those in the U.S. will require that traffic be concentrated in fewer networks than currently exist within the EU.

A key to predicting which of the current radial route networks are likely to succeed as HS networks is the principle of centrality, which says that an efficient network should have a centrally-located hub airport. This operation of this principle is clear in the U.S., where major hub airports such as Chicago and Dallas-Ft. Worth are centrally located in the interior of the country. The reason why centrality is important is that, when a hub is located in a peripheral region, a connecting trip for passengers in a typical city-pair market is unacceptably circuitous. This is shown in Figure 3, where H_2 is the peripheral hub and a typical city-pair market is C_n-C_{n-1}. A connecting trip through hub H_2 is longer in terms of both distance and time than a trip through a centrally-located hub such as H_1 for passengers in this city-pair market.

The current arrangement of radial routes in the EU suggests that certain carriers may have an advantage in building HS networks. Currently, carriers such as Lufthansa, Swissair, KLM, Air France, and Sabena operate radial networks from hubs that are more-or-less centrally located, while British Airways, Alitalia, Iberia, SAS, and Finnair operate networks from peripheral airports. It is likely that the former carriers will have an advantage in converting their radial networks toward true HS operations through improvements in scheduling, increases in flight frequency, and addition of endpoints. On the other hand, it could be argued that carriers whose networks have peripheral hubs but relatively high traffic densities may have a “head start” in forming an HS network, ensuring success despite the poor hub locations. An example of such a carrier may be British Airways.

Figure 3. Limits on Route Circuity in the EU



However, carriers with small traffic densities and with networks currently centered at peripheral airports may have difficulty boosting their traffic densities. Because of the resulting failure to reduce cost per passenger, these networks may then become noncompetitive relative to the networks with central hubs. As a result, passengers in the peripheral countries may eventually find that intra-EU trips on their flag carriers are priced noncompetitively relative to trips on carriers with central hubs. Despite loyalty to their national carriers, price-conscious passengers are likely to make connecting trips on such carriers rather than travel on the “thin” and expensive nonstop routes of the flag carriers. This suggests that unless the carriers operating peripheral networks can open new hubs, they may be forced to shrink their operations and perhaps seek merger or alliance partners among the EU airlines with more favorable network structures.

To remedy such a situation, a carrier could attempt to create an HS network at a better-located airport where it does not currently have substantial operations.[6] The only such example in the EU, however, is Finnair’s attempt to establish a small hub in Stockholm. Using such an approach, an EU carrier could set up HS operations at a currently-underutilized airport, or it could attempt to start operations at a major airport where it currently has only a minor presence.

Berechman and de Wit (1996) use a simulation model to analyze the suitability of different locations for an EU hub. They conclude that London-Heathrow is the optimal choice out a number considered even though its location is moderately peripheral. This finding, however, is not supported by the less-formal claims of many other commentators, who argue that successful hubs need to be centrally located. Evidently, the question where the major EU hubs will be located is still very much open.

A related question is whether hub dominance is likely to become a problem in the EU as the effects of deregulation unfold. As noted by Good et al. (1993), enplanements at major EU airports tend to be less concentrated in the hands of a single carrier than in the U.S., with the airport Herfindahl index for the median EU airport half as large as for the median U.S. airport. This situation reflects the legacy of bilateral agreements, which matched the home carrier with a competitor from another country on each route out of the airport. Therefore, hub dominance is currently not a serious problem in the EU, although it could become an issue as route structures evolve.

Airline alliances as a means of network improvement

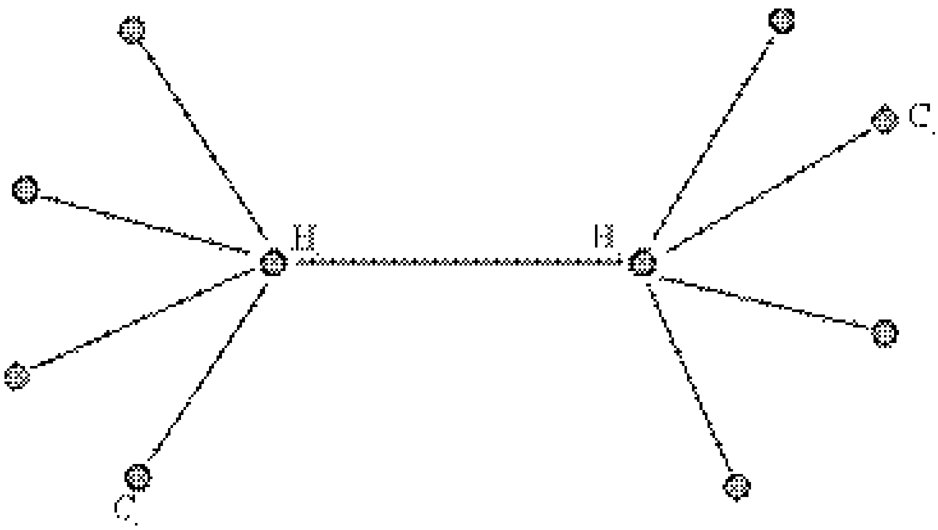
In addition to setting up a new hub, another means of remedying the problem of poor hub location is through an alliance with another airline. The key features of such an alliance are schedule coordination between the airlines and favorable joint pricing of trips that involve travel across two networks. Alliances may also involve codesharing, where an entire trip is sold as if it consists of travel on a single carrier even though equipment from the other airline is used for part of the journey.

---

[6] This was done repeatedly in the U.S., with prominent examples being Northwest’s Memphis hub, Delta’s Cincinnati hub, American’s Nashville hub, and US Air’s Dayton hub (the last two were subsequently shut down).

Such an alliance is represented in Figure 4, using a diagram that also applies to intercontinental alliances such as the one between Northwest and KLM. The figure shows a linkage between the airlines operating hubs H_1 and H_2. The carriers serve a number of cities out of their hubs, and they both serve the route between the hub airports. The advantage of the alliance arises because the two networks have little overlap. As a result, the alliance can initiate seamless service between, say, cities C_k and C_n, which were not previously connected by a single carrier. Passengers from C_k might travel along carrier 1's spoke routes as far as H_2, where they then switch to carrier 2's flight to city C_n. Coordination of schedules minimizes the layover at H_2, and the fare for the trip is chosen by the carriers in order to maximize their joint profit

Figure 4. Two HS Networks Linked by an Airline Alliance



Joint profit maximization leads to a lower fare in this city-pair market than would be charged under noncooperative pricing of a traditional interline trip. By reducing fares, cooperation thus stimulates travel in this and other city-pair markets served by the alliance. The result is greater traffic densities and lower costs per passenger within both HS networks, which allows more-competitive pricing of the single-airline trips that occur within each network. The negative effect of the alliance, however, is that competition is reduced in the interhub market between H_1 and H_2, which is now effectively served by a single airline instead of by two. Passengers in this market are likely to pay higher fares. Note that in the intercontinental context, the two networks are on different continents. In the Northwest-KLM case, H_1 would be Detroit and H_2 Amsterdam. In the intra-EU case, H_1 could be SAS's Stockholm hub while H_2 could be Swissair's Zurich hub.

Youseef and Hansen (1994) provide an illuminating analysis of the alliance between Swissair and SAS in the late 1980's, an alliance that is no longer functioning. They show that, as a result of the SAS-Swissair alliance, connecting flights from SAS hubs to endpoints of the Swissair network increased by 12 percent. Berechman and de Wit (1996), however, argue that attempts to form intra-EU alliances have so far met with limited success, with the focus now shifting to intercontinental alliances, mainly those with U.S. carriers.

Although intra-EU alliances have not met with much success thus far, it is possible that deregulation will stimulate their reemergence in the longer run. This may occur as peripheral carriers attempt to preserve traffic in the face of competition from carriers operating centrally-located hubs. Successful alliances with U.S. airlines may also improve the competitive position of EU carriers such as KLM by feeding trans-Atlantic traffic into their EU networks, thus raising traffic densities and allowing more-competitive pricing of intra-EU trips.

While the preceding discussion has indicated the nature of route reorganization that is required to improve the operating efficiency of EU carriers, several obstacles exist that may impede such reorganization The first obstacle is airport congestion, which may frustrate attempts by the carriers to build HS networks, while also limiting a general expansion of service in response to deregulation. The second is the existence of intermodal competition from rail service, which may restrict the development of HS networks. These obstacles are considered in the next two sections.

Congestion at EU airports: effects and remedies

Traffic congestion, which currently afflicts most major airports in the EU, may impede the reorganization of existing route networks as well as the initiation of new services. Airport congestion must clearly be taken into account when considering likely network structures and hub locations as well as the future competitive situation in the EU.

Because of airport congestion, the slots necessary for a new carrier to start substantial operations at a major airport will be unavailable in many cases. Congestion may also prevent incumbent carriers from expanding their operations. Thus, a carrier wishing to increase the extent of connecting traffic within its radial network by increasing flight frequency and adding new endpoint cities may find its efforts blocked by airport capacity constraints.

The emergence of lost-cost carriers such as Southwest and America West has been an important source of competition in the U.S., but these carriers have focused on undertutilized airports in gaining a market foothold. Limitations on airport access may restrict the parallel growth of new carriers within the EU.

Since private ownership makes the cost advantage of such carriers relative to the incumbents (who are government-owned) even more dramatic than in the U.S., limitations on their growth would be especially harmful. Competition from such carriers could provide a powerful force in trimming the bloated cost structures of the EU flag carriers.

This discussion suggests that by limiting the formation of new networks, by restricting the expansion of existing radial networks to provide HS service, and by potentially restricting the growth of new private carriers, airport congestion may prevent full realization of the gains from airline deregulation in the EU. Also, the problem of airport congestion may explain the sluggish response of the EU carriers in initiating new service over the 1993-1996 period, as discussed in Section 3.4 above. This suggests that an attack on the congestion problem should be an important component (or complement) of EU deregulation policy.

While a commonly proposed solution to airport congestion is investment in new airport capacity, a simpler and less-costly solution is readily available. This solution involves the use of congestion pricing, which raises the airport landing fees paid by the carriers during congested hours without affecting the fees paid at off-peak times. In response to this price differential, the airlines are likely to reschedule some peak-hour flights so that they arrive instead during the off-peak period. The result is a reduction in traffic at the airport during the most-crowded hours. In contrast to the billion-dollar expenditures required to enlarge airport capacity, implementation of this solution is essentially costless. All that is required are minor changes in the billing system under which landing-fee charges are computed.

Evidently, the standard theory underlying congestion pricing also applies to air traffic. The first step is to recognize that each airline flight using the airport during peak hours imposes, by generating delays, an externality on every other flight during the same peak hour: if an extra flight were added to the landing queue, landings would occur more slowly for the remaining flights. Each of these flights would then incur a slight increase in operating cost as well as an increase in passenger time costs because of the extra delay caused by the longer landing queue. When these costs are added across all flights, the result is a measure of the externality damage imposed by the additional flight, which equals the total cost of the added congestion it causes.

Under congestion pricing, the peak-hour landing fee for each flight is raised by an amount equal to this externality damage. Since *each* flight in the landing queue imposes congestion on all other flights, flights are treated symmetrically, with each flight arriving at a given time paying the same congestion fee. The proper congestion fee can be estimated using airline cost data as well as information on the value of passenger time.

Since congestion is absent during off-peak hours, an additional flight during this period causes no delay, and thus generates no externality damage. This implies that the optimal congestion fee equals zero. Thus, off-peak flights pay the airport's usual landing fee, while peak-hour flights pay this fee plus an incremental congestion charge.

Faced with a peak/off-peak differential in landing fees, carriers are likely to reschedule some flights away from the peak hours.[7] To see what may happen, consider afternoon peak-hour arrivals at a congested airport. These arrivals are likely to include flights from cities that are centers of business activity as well as flights returning from vacation spots. While the latter flights are full of leisure travelers who may have considerable scheduling flexibility, passengers on the former flights include many businessmen returning home at the end of a work trip to a distant business center. These passengers have considerably less scheduling flexibility because an earlier arrival cuts short a work day at the endpoint of their trip, while a later arrival means a pointless wait before returning home.

Given these differences in passenger composition between flights, the airline facing a peak-hour congestion fee is likely to reschedule the vacation flight to either an earlier or later off-peak arrival, while leaving the arrival time of the business flight unchanged. This rescheduling reduces the airport's peak-hour congestion. In a deregulated environment, where fares are determined by the carrier, these congestion fees are likely to be passed on in fares, which are then higher for peak-hour flights. As a result, flight arrival times will be guided by the wishes of passengers, taking the resulting time-of-day fare differential into account. Vacationers will not pay the higher fares associated with a peak-hour arrival, while businessmen will do so. Flight arrivals will then be shifted to off-peak hours by demand forces, taking the congestion externality into account.

No estimates of the expected benefits of congestion pricing at EU airports are available. In the U.S., such benefits have been quantified by Daniels (1995) and Winston (1991). Daniels studies the effect of congestion pricing at the Minneapolis-St. Paul airport (MSP), and concludes that such a system would reduce the costs of congestion by 24 percent. In addition, he concludes that with congestion fees in place, traffic at the airport could increase by 30 percent without raising the delay costs incurred by airlines and passengers beyond the current level. Thus, implementation of congestion pricing is equivalent to increasing the capacity of the MSP airport by 30 percent. Unlike actual capacity expansion, this outcome can be achieved with a zero resource cost. Winston (1991) provides an estimate of the aggregate welfare gain in the U.S. from

---

[7] Doganis (1992) indicates that landing fees at London's Heathrow and Gatwick airports have exhibited a peak/off-peak differential since the 1970s. However, he states that this differential appears to have had little effect on airline scheduling decisions.

congestion pricing, assuming current airport capacity. He shows that the welfare gain equals $4 billion per year, a number about one-third as large as the total passenger cost-savings from deregulation.

Because airport congestion is an even more serious problem in the EU than in the U.S., the gains from congestion pricing at EU airports would be substantial. Implementation of such a system would make it more likely that the full benefits of deregulation will be realized by EU passengers.

The effects of intermodal competition

While airport congestion may impede the formation of HS networks in the EU, another force that may limit their development is intermodal competition from rail service. To see the reason, consider Figure 3. If the only routing option for passengers in the C_n-C_{n-1} city-pair is a connecting trip through hub H_1 or H_2, then these passengers may prefer direct rail service given the high time cost of the airline trip. While this outcome is especially likely when the hub is peripherally located (as is H_2), rail competition may limit the appeal of HS trips even with a centrally-located hub such as H_1. Thus, the greater convenience of surface travel in the EU may make connecting airline trips uncompetitive in terms of time cost for a much greater share of city-pair markets than in the U.S. case. Connecting trips between cities located at opposite ends of the EU will be viable, but this may not be true for cities that are relatively close. These observations suggest that efficiency gains from route-structure reorganization may be harder to achieve in the EU than in the U.S. case, where rail competition is less important.

Because of the interaction between the air and rail service, airline deregulation and policies toward rail transport in the EU are fundamentally linked. Policies toward rail transport will help determine the long-run effects of EU airline deregulation, and deregulation will in turn affect the demand for rail service. For example, a policy of rail deregulation, which would remove government train subsidies and raise fares, without improvements in service quality, would lessen the competition faced by airlines. This in turn would reduce the constraints on the formation of HS networks, enhancing the effects of airline deregulation. But this outcome is quite unlikely, since the goal of the rail deregulation in the EU is, on the contrary, to make railways more competitive. See Commission of the European Communities (1995, 1996b).

It could be argued that an additional impediment to the formation of HS networks in Europe is the shorter average stage length relative to the U.S., mentioned above. The closer proximity of EU cities may make the stage length for the spokes of an HS network uneconomically short, so that such networks become difficult to operate. A counterargument, however, points to the fact that air travel between cities in the Eastern half of the U.S., which is about the size of the EU, often involves a connecting trip. This suggests that lower stage lengths do not represent as serious an obstacle to the formation of HS networks as rail competition and airport congestion.

Conclusion

This paper has provided an exhaustive discussion of the impact of airline deregulation in the U.S., followed by a discussion of the likely effects of deregulation in the EU. The paper argues that the benefits of U.S. deregulation, as manifested in lower fares, were generated in part by the reorganization of route structures into HS networks.

The same reorganization is identified as a means for improving airline efficiency in the EU, which is currently far below that of U.S. carriers. Such an efficiency improvement is necessary if EU deregulation is to lead to lower fares, as in the U.S. However, the paper identifies various impediments to a full-scale exploitation of the HS network structure in Europe. One impediment is airport congestion, which is more serious in the EU than in the U.S. A major conclusion of the paper is that the potential benefits of deregulation may not be fully realized unless the airport-congestion problem is solved. Congestion pricing is identified as the best tool for attacking this problem.

The most important factor in the long run, however, may be the effect of intermodal competition from rail service. By reducing the willingness of passengers to undertake circuitous airline trips, competing rail service is an impediment to the formation of HS networks. While greater airline efficiency requires higher traffic densities, the extensive train competition in the EU, by limiting trip circuity, may prevent the development of effective HS networks, which are necessary to achieve such densities.

This paper has raised questions that should be addressed more deeply in subsequent research. First, although the paper has argued that the optimal route structure in the EU is the HS network, this issue has not been analyzed in a rigorous fashion. To prove that HS networks are optimal in the presence of competitive rail service, it would be necessary to construct a detailed and realistically-calibrated network model that takes rail service into account. A related question concerns the impact on the airline industry of policies toward rail transport. As noted above, it is important to understand the effect of deregulation of rail service on the efficiency gains from airline deregulation. Again, a proper treatment of this issue should be based on a detailed model. These questions are central to the future of European transport, and additional work devoted to answering them deserves high priority.

References

Association of European Airlines, 1997, *Yearbook 1997*.

Berechman, Joseph, and Jaap de Wit, 1996, "An Analysis of the Effects of European Aviation Deregulation on an Airline's Choice of a Primary West European Hub Airport," *Journal of Transport Economics and Policy* 30, 251-274.

Berry, Steven T., Michael Carnall, and Pablo T. Spiller, 1996, "Airline Hubs: Costs, Markups and the Implications of Customer Heterogeneity," unpublished paper, University of California, Berkeley.

Borenstein, Severin, 1989, "Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry," *Rand Journal of Economics* 20, 344-365.

Borenstein, Severin, 1992, "The Evolution of U.S. Airline Competition," *Journal of Economic Perspectives* 6, 45-47.

Borenstein, Severin, and Nancy L. Rose, 1994, "Competition and Price Dispersion in the U.S. Airline Industry," *Journal of Political Economy* 102, 653-683.

Brueckner, Jan K., and Pablo T. Spiller, 1991, "Competition and Mergers in Airline Networks," *International Journal of Industrial Organization* 9, 323-342.

Brueckner, Jan K., Nichola J. Dyer and Pablo T. Spiller, 1992, "Fare Determination in Airline Hub-and-Spoke Networks," *Rand Journal of Economics* 23, 309-333.

Brueckner, Jan K., and Pablo T. Spiller, 1994, "Economies of Traffic Density in the Deregulated Airline Industry," *Journal of Law and Economics* 37, 379-415.

Commission of the European Communities, 1995, *Towards Fair and Efficient Pricing in Transport*, Green Paper, 20.12.1995 COM(95) 691 final, Brussels.

Commission of the European Communities, 1996a, *Air Traffic Management. Freeing Europe's Airspace*, White Paper, 06.03.1996 COM(96) 421 final, Brussels.

Commission of the European Communities, 1996b, *A Strategy for Revitalizing the Community's Railways*, White Paper, 30.07.1996 COM(96) 57 final, Brussels.

Commission of the European Communities, 1996c, *Impact of the Third Package of Air Transport Liberalization Measures*, Communication of the Third Package of Air Transport Liberalization Measures, 22.10.1996 COM(96) 514 final, Brussels.

Daniel, Joseph L., 1995, "Congestion Pricing and Capacity of Large Airports: A Bottleneck Model with Stochastic Queues," *Econometrica* 63, 327-370.

Doganis, Rigas, 1992, *The Airport Business*, London: Routledge.

Evans, William N., and Ioannis Kessides, 1993, "Structure, Conduct, and Performance in the Deregulated Airline Industry," *Southern Economic Journal* 59, 450-467.

Good, David H., Lars-Hendrik Röller, and Robin C. Sickles, 1993, "U.S. Airline Deregulation: Implications for European Transport," *Economic Journal* 103, 1028-1041.

Holler, M.J., G. Knieps and E. Niskanen, 1997, "Standardization in Transportation Markets: a European Perspective," in M.J. Holler and E. Niskanen (eds.), Frontiers of Standardization, EURAS Yearbook of Standardization, Special Issue of Homo Economicus, Munich: ACCEDO-Verlag, 1997.

Humphreys, Barry, 1996, "The UK Civil Aviation Authority and European Air Services Liberalization," *Journal of Transport Economics and Policy* 30, 213-220.

McGowan, Francis and Paul Seabright, 1989, "Deregulating European Airlines," *Economic Policy* 9, 283-344.

Morrison, Steven A., and Clifford Winston, 1995, *The Evolution of the Airline Industry*, Washington D.C.: The Brookings Institution.

Neven, Damien J., and Lars-Hendrik Röller, 1996, "Rent Sharing in the European Airline Industry," *European Economic Review* 40, 933-940.

Winston, Clifford, 1991, "Efficient Transportation Infrastructure Policy," *Journal of Economic Perspectives* 5, 113-127.

Youseef, Waleed, and Mark Hansen, 1994, "Consequences of Strategic Alliances Between International Airlines: The Case of Swissair and SAS," *Transportation Research* 28A, 415-431.