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Airline Economics:
Foundations for Strategy and Policy

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Canadian Cataloguing in Publication Data
Tretheway, Michael W.
Airline economics

Includes bibliographical references.

ISBN 0-88865-516-9

1. Airlines--Economic aspects. I. Oum, Tae Hoon. II. University of British Columbia. Centre for Transportation Studies. III. Title.
HE9780.T74 1992 387.7'1 C92-091593-0

Printed in U.S.A.

That is, adding more flights or more seats per flight on a given route will result in lower "per seat" costs. However, once the minimum efficient traffic density level is reached, the curve is flat over a wide range, indicating that there are no more gains associated with greater traffic density.

Intuitively, this makes sense. Adding a city to a network involves a set of fixed operation costs: airline counters, station managers, mechanics, ticket offices, advertising, etc. Every time a new city is added, another set of these costs must be incurred. On the other hand, once a set of cities are being served, additional traffic does not require any increases in the fixed operation costs; advertising need not be increased, etc. Thus, the fixed operation costs can be spread out over more traffic, allowing unit costs to fall.

Economies of traffic density are illustrated in **Figure 5**. Here, cost per passenger declines as the number of passengers per station increases. At some point declines in cost per passenger *may* taper off, and the curve may start to flatten. The traffic density where this occurs is referred to as the minimum efficient traffic density level. This is indicated in the figure.

Chapter 3

Airline Economics: Consumer Demand

A. Basic Elements of Demand for Air Service

When economists refer to the "determinants" of consumer demand for air services, they mean the set of factors which influences an individual's decision as to whether or not to travel by air, and how much travel by air they will do in a given year. The main determinants of airline demand are:

- *Price.* Lower airline prices induces people to travel more.
- *Income.* Higher disposable income influences consumers to travel more.
- *Price and convenience of other modes of transport.* An individual living in Kingston, Ontario will be less inclined to fly to Toronto if the automobile is cheaper and/or more convenient.
- *Frequency of service.* More frequent service is more convenient service, increasing the willingness of the consumer to travel by air. A once-a-day flight from London, Ontario to Toronto would not generate as much traffic as a schedule with hourly flights. With the former, several travellers will be induced to either drive or not travel at all.[7]

[7] An hourly service makes it easier to accommodate "quick trips."

- *Timing of service.* In general, consumers prefer to fly first thing in the morning, or late in the afternoon. Flights offered at these times will induce consumers to fly by air, whereas flights at inconvenient times (such as 3 a.m.) tend to discourage consumers from air travel.

- *Day of the week.* Consumers are more likely to fly on certain days of the week than others. Typically, Sunday evenings are very popular, with business travellers leaving home for their first appointment of the week. Similarly, Friday afternoons are also a busy time, as travellers are returning home.

- *Season of the year.* July and August are popular travel times, whereas November and February are unpopular times. There are variations, of course, by market (sun spot destinations are winter peaking) and continent (e.g. Australia, New Zealand).

- *Safety and company goodwill.* A good safety record is good for business. Air travel drops whenever there is a major air disaster.

- *Demographics.* Age is often a factor in the travel decision. College students, for example, are notorious for airline pilgrimages to Europe, popular ski resorts, and holiday trips to home. Individuals raising children tend to travel less, while empty nesters seem to travel more. There are other demographic factors as well. New immigrants tend to travel back to the old country several times.

- *Distance.* The longer the travel distance involved, the fewer trips will be made. Business and leisure travellers make relatively fewer trans-oceanic trips than trips across the

country. At the other end of the scale, few air trips are made over very short distances.[8]

- *In-flight amenities.* Consumers are somewhat influenced by how cramped seats are, the quality of food, the availability of in-flight movies, etc. On average, these factors are less important in the decision of whether or not to fly, but more important in the choice of air carrier.

- *Customer loyalty.* As in any industry, once the consumer has made the decision to purchase a service or product, loyalty factors may come into play in determining which carrier or firm will be chosen. In air transport, frequent flyer reward programs are especially important in fostering customer loyalty.[9]

- *Travel time.* When jets were first introduced, there was a noticeable increase in consumer demand for air travel. The reduction of transcontinental flying time from ten to five hours made air travel far more convenient. It was easier, for example, for businesses to justify meetings which might not have taken place previously. On time performance is also a factor here, especially when the consumer chooses which carrier to use.

[8] Transportation economists refer to the *gravity law of travel demand.* This indicates that travel demand falls with the square of the distance between origin and destination. Mathematically, this can be expressed as $Q_D = f(1/D^2)$, with D = distance and Q_D = travel demand, a formula which is similar to the gravity law of physics. This law is considered to be relevant for almost all modes of transportation, although not applicable for air transport over short distances.

[9] See Tretheway (1989).

B. Which Elements of Demand Are Most Important

The previous section listed a number of elements of consumer demand. All of these are, of course, important. Some of the factors are beyond the control of air carriers. Carriers cannot influence the level of income a consumer has, nor the price and convenience of other modes of transport.

Of the elements which the carrier can control, certain are of special importance. Clearly, price is one of the most important determinants of consumer demand. One of the greatest lessons of airline deregulation was that lowering price induces consumers to travel more often. Discount airfares opened a whole new market segment for air travel. In a series of studies of airline demand, Oum and Gillen found that a 10% drop in price would increase demand for air travel in Canada by 11-13%.[10] Another important variable is frequency of service. This is especially important for business travellers, for whom the ability to maximize their time productivity is very important. In a study of U.S. air travel demand, Morrison and Winston found that a doubling of the frequency of air service would lead to a 21% increase in demand for air services by business travellers.[11] For pleasure travellers, who are less sensitive to the availability of frequent flights, the increase would only be 5%. The importance of frequency of service is underscored by the observation that in the top 25 domestic city pair markets in Canada, the number of flights doubled between 1983 and 1989.[12]

While income is a consumer demand determinant outside of the control of the carriers, it is important to comment on its importance. In their study of Canadian airline demand, Oum and Gillen (1983) found an income elasticity in the range of 1.6-2.5. This means, that if the economy were to grow by 10%, then airline demand would increase between 16-25%. Very few goods in the economy are as responsive to income as is air transport. The negative side of this is that in an economic contraction, of say 3%, air travel is likely to fall off

[10] Oum and Gillen (1983), and Gillen, Oum and Noble (1986).

[11] Morrison and Winston (1986), p. 17.

[12] NTA (1990), p. 31. This was intended to measure the impact of regulatory freedom on service offerings by carriers.

somewhere in the range of 5-7%. Air travel is then, not just cyclic but procyclic. This procyclic behaviour has likely been exacerbated by airline deregulation. Gillen, Oum and Noble (1986) in a study of U.S. air travel, were able to distinguish between business travellers and leisure travellers. Business travellers had an income elasticity of only 1.5 whereas leisure travellers had an elasticity of 2.1. As deregulation, with its lower prices, has made the proportion of leisure travellers grow, the average income elasticity for the industry has been creeping more and more toward the leisure traveller extreme. This procyclical behaviour of air travel contributes to the financial challenges the industry faces. These are discussed in Section VII.D.

A recent study in the U.S. focused on four key factors in the consumer's choice of airlines. These are shown in ? Selection factors were determined separately for leisure versus business travellers. As can be seen, price is the key determinant for leisure travellers, although schedule convenience is close behind it. For business travel, schedule convenience is clearly of main importance. Price and frequent flyer programs (to be discussed further in Chapter 5) are virtually tied and have less than half the importance of flight schedules.

C. Market Segmentation

As has already been alluded to, air travellers are not a homogeneous group. There are at least two broad submarkets. The traditional bread and butter of the industry has been the business traveller. This traveller, whose ticket is typically paid for by an employer, is concerned with maximizing the productivity of his or her time. As a result, this individual is very sensitive to the frequency with which service is offered. This traveller also needs an airline service which is flexible, in the sense of accommodating last minute changes in plans. Thus, high probabilities of being able to obtain a seat at the last minute are essential, as is convenient air service with the shortest possible elapsed trip time. Business travellers are generally willing to pay for the higher quality of service, and thus tend to be less responsive to prices.[13] On time performance and reliability of the airline to its published schedule are also important to this

[13] For example, Gillen, Oum and Noble (1986), found that in the U.S., the price elasticity for business travellers was only 1.15 whereas that for leisure travellers was 1.5.

Factor	Leisure Travel	Business Travel
Price	3.9	2.1
Schedule Convenience	3.2	4.5
Frequent Flyer Program	1.5	2.0
Airline Reputation	1.5	1.5

Source: P.L. Ostrowski and T.V. O'Brien (1991), "Predicting Customer Loyalty for Airline Passengers," Dept. of Marketing, Northern Illinois University, June.

Table 1 Airline Selection Factors (mean value on a ten point scale)

group of consumers.

The second broad segment of airline consumers is generally referred to as the leisure traveller. This traveller is travelling on personal time, and is not quite as concerned with maximizing time productivity. Thus, these individuals are less sensitive with respect to how frequent service is offered, or to the total elapsed time of the air trip. However, these individuals are very sensitive to prices, as already been discussed. Schedule reliability is also less of an issue for these travellers. Another important characteristic of this consumer segment is that they tend to make their travel plans well in advance. As a result, they can be induced to book and pay for their airline tickets weeks before the actual airline flight. In contrast, the business traveller may not know until a few hours prior to the trip that the trip is necessary.

Airlines have been able to exploit this fundamental difference in the two consumer segments by tailoring different types of service for the two groups. Leisure travellers are offered a service at a low price, but which requires advance booking and has limited flexibility for accommodating change in travel plans. The business traveller is offered a service with relatively good seat availability at the last minute, and with no restrictions on the ability to change plans. They are charged a higher price for this more expensive service. They cannot avail themselves of the lower prices offered to leisure travellers, as they cannot abide by the advanced booking requirement, and/or the restriction on changing plans.

There are, of course, various sub-segments of consumers within these two broad groups. Some business travellers need complete flexibility and are willing to pay for it. Other travellers, such as those going to pre-planned business conferences, tend to be somewhat more sensitive to price, and have an ability to accommodate the airline by booking early. Leisure travellers can also be broken into several subgroups. One distinction is between leisure traveller to holiday resorts, versus leisure travellers to visit friends and relatives (VFR). Some leisure travellers, for example retired grandparents, are willing to make their travel plans months in advance and will travel at inconvenient times of the day, week or year in order to get a better bargain. There are also non-business trips which must be booked at the last minute, such as visiting a sick family member or attending a funeral. Like business travellers, these individuals tend to be price insensitive.

D. Demand Side Forces Favouring Large Carriers

Market equilibrium and therefore market structure is determined by the interaction of both supply (i.e. costs/production) and demand. In airline markets there are demand forces such that consumers prefer large airlines over small ones, all other factors such as prices being the same. In this context, large airlines mean those that serve a large number of points. Some of these forces have been present for some time, while others have been stimulated by marketing practices introduced since U.S. deregulation.

In practice, there are at least three reasons why consumers prefer large airlines. One reason is due to information costs. A traveller knows that a large carrier can get him or her to just about anywhere in the country, while smaller carriers serve only a limited number of communities. Travel agents act as intermediaries for the consumer, but even here large network airlines have an edge, such as when an agent in one region needs to book flights in other regions.

A second reason why consumers favour large airlines is attributable to the higher quality of service these airlines offer. If connections must be made, less of the traveller's time will be required with a single airline than when the trip involves switching airlines because single airline flight connections are more likely to be timed to minimize waiting time at intermediate points (hubs).[14] Consumers are also aware that there is a lower probability of baggage being lost or delayed with a single airline, as well as a higher probability that the same airline's outbound flight would be held for a traveller on a delayed inbound flight.

The third factor causing consumers to favour larger over smaller carriers is the existence of frequent flyer programs. These programs reward the *individual* for patronizing a single carrier (even though the fare for business travellers may be paid by their employers). It is much easier to accumulate points with an airline that flies to a large number of destinations.[15]

In sum, there are natural market forces favouring large airlines in spite of evidence of constant returns to "scale." These are economies of traffic density, and in addition, the demand side factors such as information costs, higher quality travel, and reward programs inducing consumers to favour large over small airlines. It appears that economies of traffic density can be fully exploited by an airline the size of Air Canada and thus further consolidation is unlikely to reduce its cost per seat kilometre by very much.[16,17]

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[14] Using the results of Carlton, Landes and Posner (1980), the value of an on-line connection to travellers can be estimated to be about $31 (1989 Canadian dollars). I.e., the average consumer is willing to pay up to $31 to avoid a flight itinerary requiring a change of airline.

[15] See Tretheway (1989) for a discussion of the potential anti-competitive effects of frequent flyer programs.

[16] See Gillen, Oum and Tretheway (1985), especially Chapter 8.

E. Travel Time and Consumer Demand

One of the consumer demand factors that has been found to be important is the total elapsed time from origin to destination. A carrier which can offer a noticeable reduction in the elapsed time will be more successful in attracting passengers. Airline economists have found it useful to break up total elapsed time into four separate components. The four components are:

- *Schedule wait time.* This is the time from when the consumer desires a departure to the availability of an actual departure.[18]

- *Airport access time.* This is the time for the traveller to get from their home or place of business to the airport, check in at the airport, clear security and customs, etc.

- *Flight time.* This is the actual time from scheduled departure to arrival at destination. This might be broken up into three separate components:

    - Deviation from scheduled times. Flights take longer than published because of late departures and/or arrivals.

    - Actual in-air time. This is the actual time spent flying in the aircraft. It is affected by type of aircraft (jet versus propeller), air traffic control and other delays, and degree of route circuity with hub and spoke systems.[19]

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[17] Some would point out that the higher quality of service offered by a larger air carrier can be viewed as reducing quality adjusted cost. Cost per seat kilometre is the same, but the seat kilometre of a larger carrier my be viewed by the consumer as being a higher quality.

[18] For example, a sales manager may conclude negotiations in Toronto at 1:30 and would like to immediately return back to the office in Thunder Bay. However, if the next departure is not until 5:00 pm, then the traveller will incur a "schedule waiting time" of 3.5 hours.

[19] In Europe, flight circuity is a major factor due to air space restricted for military purposes.

- Hub connection time. This is the time spent on the ground at a hub airport making connections from one spoke of a flight to another spoke.

- *Denied boarding time.* Occasionally, a passenger must wait from their originally scheduled departure until the next departure because the original flight was overbooked and they were denied boarding of the aircraft.

The segmentation of total elapsed time allows identification of opportunities for reduction. For example, more frequent flights reduces schedule delay time. Use of a close-in or downtown airport, provision of door to door limousine services, or expedited check in procedures can reduce airport access time. Use of faster aircraft (jets versus turbo props, Concorde versus traditional jets) allows for reductions of actual in-flight time. Procedures asking for volunteers when aircraft are overbooked help shift the denied boarding time component to those travellers less sensitive to total elapsed time. Sometimes, there are trade-offs between the various time components. The next section discusses one of the most important trade-offs: that between frequent air service with a one-stop hub connection versus infrequent but non-stop service.

F. Effects of Hubs on Passenger Travel Time, Schedule Delay Time, and Passenger Demand

This section discusses the effects of hub and spoke routing networks on passengers' travel time and schedule wait time. A more complete discussion of hub and spoke systems can be found in Chapter VI, Section B.

Effects on Passenger Travel Time and Schedule Delay Time. As compared to non-stop flights, a hub and spoke network increases the average passenger's in-flight time because of the need for extra connecting time at the hub and the circuitous routing of the passenger's trip. On the other hand, it can also reduce the passenger's "schedule wait time," in the sense of Douglas and Miller (1974), due to the increased frequency of service on each route.

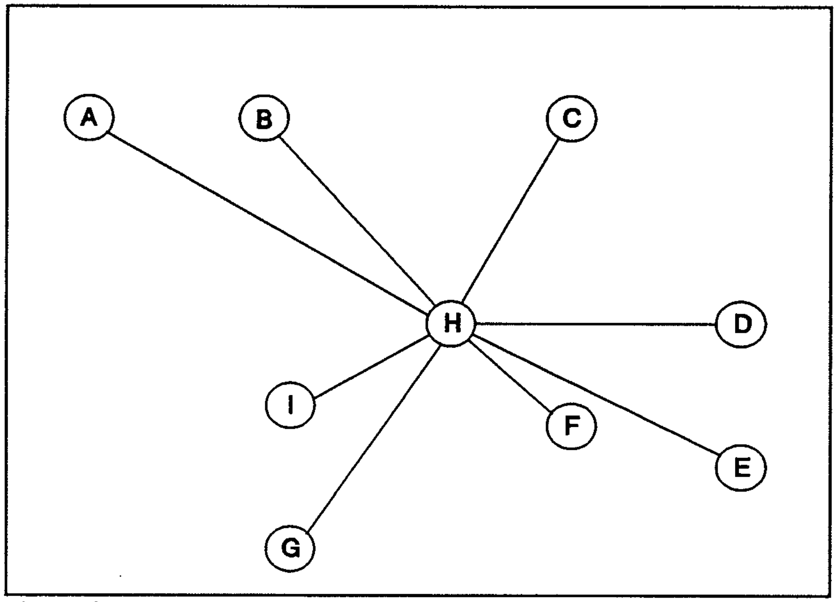


Figure 6: Hub and Spoke Network

As compared to a non-stop flight, a passenger flying from city A to city D via hub H (see **Figure 6**) faces an additional time penalty of the following magnitudes:

1) Roughly 30 minutes due to the *additional descent and ascent* at the hub.

2) Perhaps an average of 60 minutes for *time to connect* from one flight to another at the hub (Kanafani and Ghobrial [1985] use 60 minutes).[20]

[20] This is an average. Some passengers may be able to obtain connections of as little as 25 minutes, while at least a few others will need to wait more than an hour. An inspection of Figure 30 reveals that for Delta's Atlanta hub, the start of the arrival bank and the start of the departure bank in a complex are roughly separated by one hour.

3) *Extra cruise time* required for the circuitous routing. This extra cruise time depends on both the angle between the spokes connecting two stations through the hub and the relative distances of the two cities from the hub. This is shown by the law of cosines in **Figure 7**. A large angle (e.g. linking cities B to E through H in Figure 6) adds very little time, whereas a small angle with an equal distance (e.g. linking cities C to D via H in Figure 6) adds a great deal of extra time. As the distance on one spoke shortens, the circuitous routing time penalty will drop (e.g. A to F in Figure 6). Because of the time penalties of circuitous routing, passengers will be unlikely to fly via a hub when the penalty is high. Thus, in Figure 6, routings such as F-H-E and C-H-D may not be "viable."

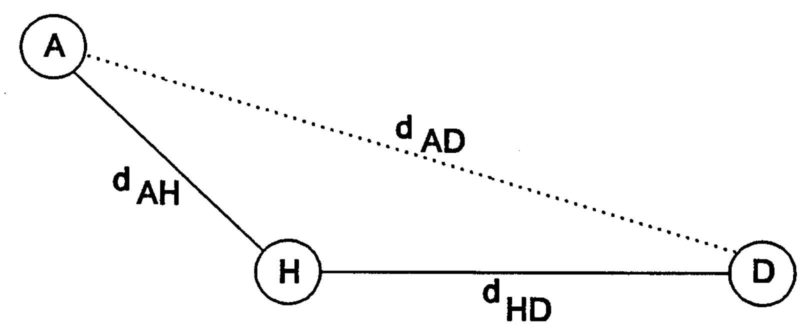
The total time penalty of a hub versus non-stop flight is thus approximately 90 minutes plus the circuitous routing time. For purposes of exposition, let us assume the average angle through the hub of viable city pairs to be 125°. With spoke lengths equal, on average, this implies a circuitous routing penalty of roughly 25%. Assuming a typical flight through a hub involves two hours of flying time, the circuitous routing penalty is 30 minutes. The total time penalty is thus 120 minutes as compared to a non-stop flight.[21]

However, a hub and spoke system could allow the airline to increase schedule frequency.[22] The increased frequency reduces the passenger's "schedule wait time," the time between the passenger's desired departure and the actual departure time. The reduction in schedule wait time depends on the increased frequency with the hub and spoke system versus a system of non-stop flights. Assuming consumers' desired departure time are uniformly distributed over 14 hours per day,[23] one flight per day means that the expected frequency

[21] Prior to hubbing, airlines sometimes built up sufficient traffic to justify a flight by making multiple stops. Where this was the case, one stop hubbing may actually reduce travel time.

[22] This is discussed in Section VI.B.

[23] In reality, desired departure times tend to be at the beginning or end of the business day. Airlines try to schedule flights at desired times, but due to limitations to equipment availability not every low traffic point will receive an early morning flight.



$$d_{AD} = \sqrt{d_{AH}^2 + d_{HD}^2 - 2\, d_{AH}\, d_{HD} \cos(H)}$$

where cos(H) = cosine of angle from AH to HD

Figure 7: Hub and Spoke Networks and the Law of Cosines

delay is seven hours for an average passenger.[24] As the departure frequency increases to two, three and five flights per day, the schedule wait time decreases to 3.5, 2.3, and 1.4 hours, respectively. For the case when a move to a hub and spoke system increases frequency from one to three flights per day, schedule wait time is reduced from seven to 2.3 hours, a saving of 4.7 hours.

The total effect on travel time is thus the difference between the time penalties (extra ascent/descent, connect time, extra cruise time) and the

[24] Assume the single flight per day is at 11 a.m. Some passengers would prefer a 7 a.m. flight, and thus have a schedule delay of 4 hours. Some would prefer a 10 a.m. flight for a delay of one hour. Some would prefer a 6 p.m. departure and will need to wait 17 hours for the flight the next day. Alternatively, they could take the earlier flight, but nevertheless will experience disutility because of it.

reduction in schedule wait time.[25] For the example worked out above, this comes to a net decrease of 160 minutes: time penalties of 120 minutes offset by a reduction in schedule wait of 280 minutes (4.7 hours). Actual reductions will vary for each route (and passenger), of course.

Effect on Passenger Demand. The move to a hub and spoke system will affect passenger demand in several ways. As discussed, the hub system will affect passenger travel times; negatively for routes already with high frequency and those involving backtracking, and positively for routes which previously had infrequent service or involved multiple steps. However, there are other effects as well. These include the disutility of making connections, the effect on price and the effect of allowing the airline to serve many more city pair routes when new stations are added. Each of these are now discussed.

Hub Disutility. A hub and spoke system can increase the number of transfers required to get from origins to destinations. This reduces the comfort and convenience of the passenger. We are all familiar with the "joy" of getting off one crowded airplane and boarding another. There is the potential to miss a connection if the inbound flight is late. These factors create "disutility" for the passenger. Disutility can be valued; the passenger is generally willing to pay to avoid these hassles (i.e. willing to pay somewhat more for a non-stop rather than a one-stop flight). The route choice model estimated by Kanafani and Ghobrial (1985) can be used to show that the revealed value of one transfer to a connecting flight is worth about 1.75 hours of transit time. Since the time required for a passenger to make a connection, one hour, was taken into account in Section A, the pure disutility of making a transfer is equivalent to a time delay of about 45 minutes. Assuming that the value of time is $30 per hour, then the value of the hub connection disutility is $22.50.[26]

[25] Typically, "schedule wait time" can be used more productively than other delay times, thus the former should be given a lower weight than the latter in aggregating for the total time effect. With schedule wait time, for example, a businessperson can be productive working in the office, making phone calls, etc. In-flight time cannot always be used to full productivity.

[26] The value of $30 was estimated by Kanafani and Ghobrial (1985). De Vany (1974) estimated a value of $10 per hour. This would translate into roughly $27 in 1987. If these figures for the value of time appear high, recall that the typical airline passenger has a higher income than the population at large.

Effect on Price. Passenger demand for travel is highly responsive to price. Oum, Gillen and Noble (1987) as well as De Vany (1974) estimate the air travel price elasticity at about -1.2. Adoption of hub and spoke systems can affect price in several ways.

First are effects on costs. A move from non-stop to hub flights increases flight times, hence fuel and crew costs, etc. These extra costs can be offset in a number of ways. The move to hub and spoke systems can lead to increases in average traffic densities with a resulting drop in unit costs (e.g. spreading fixed station costs over more passengers).[27] The frequent routing of aircraft through the hub could allow more opportunities to increase aircraft utilization, achieve economies in maintenance, etc.

Second, the adoption of hubs and the resulting increase in city pairs served (see Section VI.B) can allow the carrier to better utilize its inventory of unsold seats via modern seat management techniques [see Kraft, Oum and Tretheway (1986)]. This may result in offering deep discounts for lightly travelled segments that can now be connected to popular destinations with a resulting increase in system-wide passenger demand.

Effect on City Pairs Served. If a new station (let's call it K) had been added to the non-hub route structure in **Figure 8** via a flight to say F, then only a handful of new city pairs would be viable. If viable city pairs are those involving one stop, then the addition of K to F opens up three new city pairs (KF, KD, and KI). In contrast, adding a new station to a hub already serving (N-1) cities, opens up service to N new origin-destination pairs (including the OD pair from the new station to the hub).[28] Theoretically, a hub system with N stations (including the hub) will provide zero or one stop service to N(N-1)/2 stations. This greatly "levers" the effect of adding stations to an existing hub. For example, by increasing the number of stations connected to a hub from 9 to 14 (total stations including the hub rise 50% from 10 to 15), the number of OD pairs served more than doubles from 45 to 105.

[27] This was discussed in Section II.B.

[28] Of course due to backtracking, not all N new city pairs will be viable. This shows the advantage of adding stations in directional hubs where more OD pairs will, on average, be viable for a given N. See Section VI.B.

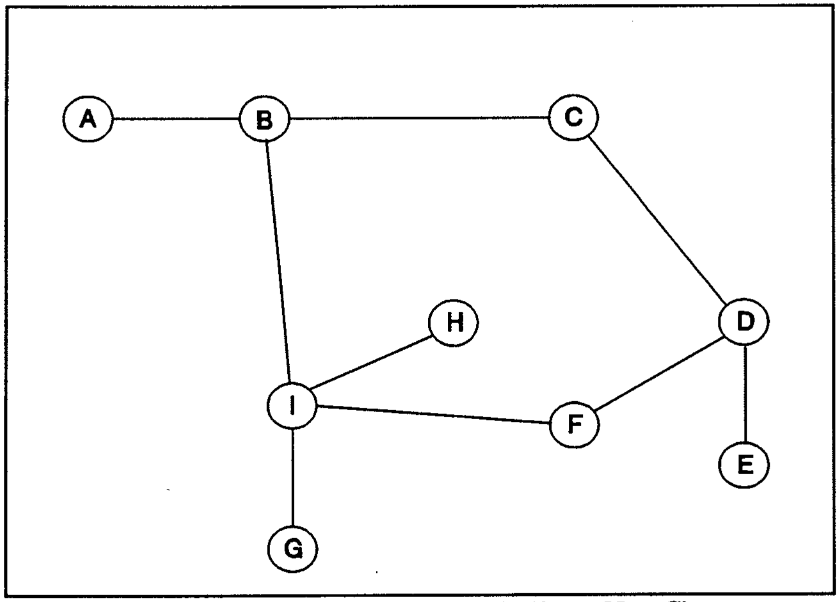


Figure 8: **Non-Hub Route Structure: Adding a New City**

One of the important consequences of this leverage is that it can make service to smaller communities viable. A community which generates as few as two passengers per day to each of 30 cities in a network can justify a daily jet flight. If, on average, it can generate six passengers per day in each OD pair, then three jet flights a day may be possible. This seems to have been a major "discovery" for some carriers after deregulation. Immediately after the regulatory reigns were loosened, some of the major carriers dropped service to small communities. As hubs have been established, however, they restarted jet service to small communities by tying them into their hubs.

Summary of Demand Effects of Hubs. In summary, hub systems have both positive and negative effects on demand. They involve some important time penalties as well as disutility associated with making a connection rather than flying non-stop. On the other hand, they can significantly reduce the

passengers' schedule wait and add many OD pairs to the network. Costs can go down due to higher traffic densities, but these are offset by the circuitous routings sometimes involved in hub operations.

G. The S-Curve Effect of Flight Frequency

The importance of flight frequency as a key determinant of the consumer's choice of airline has been expressed by aviation economists in an S-curve. **Figure 9** shows this phenomena. It shows that as a carrier adds flights in a market it can gain a disproportionate share of total market traffic. For example, in a two carrier market, the one with 60% of the flights may receive 80% of the passengers.

This phenomena is consistent with the earlier data on the importance of schedule convenience in the consumer's choice of carrier. This is especially important for the business traveller. The power of the S-curve is further enhanced because the business traveller also tends to pay higher airfares. Evidence in Section 5.B suggests that business travellers account for two-thirds of industry revenues.

The S-curve effect may be an important factor in the strategic power of hub and spoke systems. As described in the previous section, hubs have considerable traffic generating power. As a hub carrier adds flights on a spoke, it will likely pick up increasing portions of the traffic on the route, making it more difficult for a competitor to maintain its share of the market. As this effect takes place on an increasing portion of the spokes from a carrier's hub, the carrier's strength in the market becomes formidable. This phenomena is sometimes referred to as *fortress hubs*.

H. Overbooking

One final aspect of consumer demand is that some travellers do not always show up for flights they have booked. In 1961, it was estimated that 10

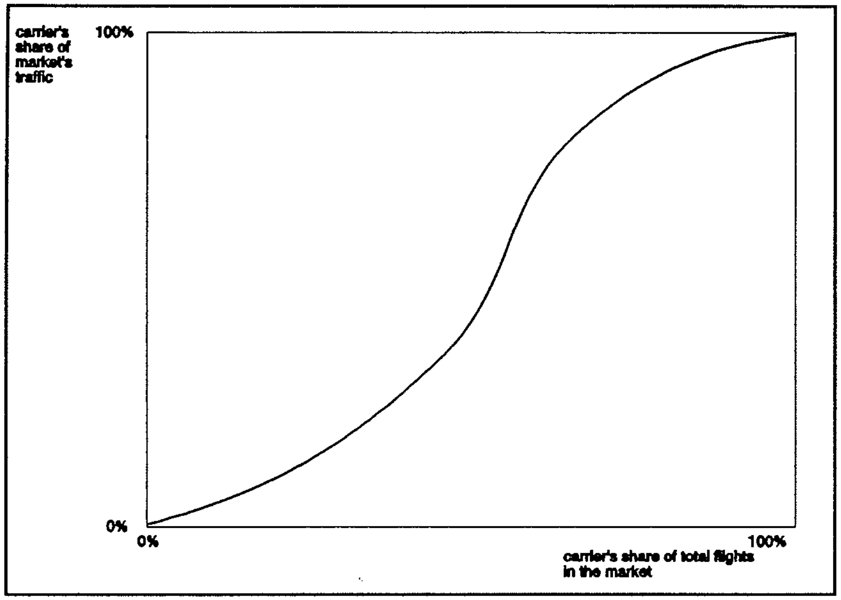


Figure 9: The Flight Frequency S-Curve

percent of passengers did not show up for their flights,[29] and in 1982 it was suggested that this figure was 20 percent.[30] Business travellers frequently fail to show up for flights, as their plans change from moment to moment. While leisure travellers flying on discount tickets tend to be more reliable in their travel plans, they too miss flights due to ground traffic, illness, etc.

Because of this stochastic (random) nature of consumer demand, airlines have offset the resulting loss of revenue by the practice of "overbooking"

[29] Economic Regulation Docket 11683, Civil Aeronautics Board, Washington, DC, 20 July 1961. See Discussion in Ruppenthal and Toh (1983).

[30] James (1982), p. 285.

flights.[31] Thus, if experience shows that Flight 147 has an average 15 percent no-show rate on Thursdays, then the airline may actually sell 108 seats even though the aircraft only has 100 seats.[32] This works fine for both airline and consumer if the actual number of "no-shows" is the same or higher than the average. Sometimes, however, all the booked passengers show up, and some must be turned away due to a lack of seats.

Prior to deregulation, carriers dealt with this "denied boarding" situation using a "first come-first served" rule.[33] However, the passengers who show up early tend to be those who are more willing to shift to a later flight. Business travellers, whose time is highly valued, tend to show up at the last minute. Recently, airlines have been given some freedom to change the rule as to which passenger will be denied boarding. While first come-first served remains the ultimate rule of last resort, they first attempt to solicit volunteers to wait for the next flight. As incentives, they may offer volunteers free travel, discounted travel or cash. This approach is generally acknowledged as being superior for all concerned.

I. Air Cargo

Thus far, the demand for airline services has been discussed only in the context of passenger transportation. Carriers also provide significant amounts of cargo services. Air Canada reported that cargo accounted for 11% of its 1989 revenues while Canadian Airlines International's cargo accounted for 8%.[34] Just as passengers can be broken into two main market segments, cargo is segmented into air freight and air express. Air express generally consists of small size shipments which are very time sensitive. Air freight generally

[31] It should be noted that the loss of revenue is attenuated or eliminated for some discount tickets which attach penalties for change of plans or failure to show up for flights.

[32] The setting of the ratio of allowed oversales to the *average* no-show rate is very complicated. It varies by airline, city pair market, day of the week, hour of the day, etc.

[33] Government regulations in North America stipulated (and this is still the case) minimum compensation levels carriers would have to pay bumped passengers. In much of the rest of the world, there are no such minimum requirements for denied boarding compensation.

[34] Source: 1989 carrier annual reports.