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AIRLINE ALLIANCES AND THEIR ECONOMIC IMPACTS

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LENTOYHTIÖIDEN VÄLISET ALLIANSSIT JA NIIDEN TALOUDELLISET VAIKUTUKSET

Tutkimuksen tavoitteet

Tutkimuksen tavoitteena on antaa kokonaiskuva lentoliikenteen viimeaikaisesta kehityksestä sekä rakenteellisista muutoksista joita ala on kokenut lentoliikenteen kilpailun vapautumisen jälkeen. Keskeisenä tarkastelun kohteena ovat lentoyhtiöiden väliset allianssit, jotka ovat viime vuosina lisääntyneet kiihtyvällä vauhdilla. Tavoitteena on kartoittaa syitä joiden takia lentoyhtiöt solmivat yhteistyösopimuksia keskenään sekä hyötyjä joita yhteistyöstä odotetaan olevan yrityksille. Tutkimuksessa pyritään selvittämään millaisia taloudellisia vaikutuksia allianseilla on sekä lentoyhtiöille itselleen että niiden asiakkaille ja minkälaisia vaikutuksia allianseilla on alan yleistä kehitystä ajatellen.

Lähdeaineisto ja tutkimustapa

Tutkimuksen lähdeaineisto koostuu pääasiassa ulkomaisista tutkimuksista, julkaisuista sekä lehtiartikkeleista. Lisäksi materiaalina on käytetty lentoliikenteen kehitystä ja kilpailua sekä organisaatiotaloutta käsittelevää kirjallisuutta. Johtuen lentoyhtiöallianssien nopeasti tapahtuvasta kehityksestä ei alan tutkimusmateriaalia ole vielä julkaistu runsaasti. Tutkimuksessa tarkastellaan aihetta sekä teoreettisella tasolla että viimeaikaisten tutkimusten valossa. Tutkimus on rajattu koskemaan EU-maiden ja Yhdysvaltalaisten lentoyhtiöiden välisiä allianssеja.

Tulokset

Tutkimuksessa todettiin allianssien tuovan yhteistyökumppaneille niin taloudellista kuin kilpailullista etua. Resursseja yhdistämällä lentoyhtiöt pystyvät laajentamaan reittiverkostoaan, kasvattamaan markkinaosuuksiaan sekä lisäämään matkustajamääriä. Näiden yhteisvaikutuksena tutkimuksessa mukana olleet allianssit olivat kasvattaneet tulojaan merkittävästi. Matkustajille palveluetuja syntyi lisääntyvien lentoyhteyksien ja lentovuorojen muodossa. Yksimielistä tulosta siitä, vaikuttaako lentoyhtöiden yhteistyö lentolippujen hintaan alentavasti, ei tutkimuksessa saatu selville. Mikäli allianssilla on dominoiva asema jollakin lentokentällä, sen voidaan olettaa näkyvän myös lentolippujen hinnoissa niitä korottavasti. Tutkimuksessa todettiin myös allianssien suora vaikutus markkinoiden kasvavaan keskittymiseen. Tämän todettiin rajoittavan kilpailua ja olevan huono suuntaus lentoliikenteen kehityksessä.

Avainsanat

Allianssi, deregulaatio, code sharing, hub-and-spoke-järjestelmä ja markkinoiden keskittyminen

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1 INTRODUCTION

1.1 Increasing Competition in Air Travel Markets

Of all forms of transport, aviation is obviously amongst the most global and that is increasingly evident as demand for intercontinental travel expands. As the wider markets for air travel open up, airlines have been anticipating the competitive challenge by creating co-operating units called alliances, which form intercontinental and even global networks. The alliance between the airlines will give them a much more efficient worldwide network, enabling them to stand up more effectively to competition from other airlines. Alliances may assist airlines to lower their costs, improve their revenues and increase their profitability. This is a particularly important benefit in the face of low profitability for the industry in recent years. Consumers will also derive benefit from the cooperation between airlines, firstly, by having much more extensive services available, notably as regards network size, better connections and the availability of a joint frequent-flyer programs and, secondly, by benefiting indirectly from the airlines' lower costs.

After deregulation the airline industry has gone through major structural changes and market concentration is one of these. It has been criticized that alliances tend to limit the competition and increase the market concentration, although the purpose of deregulation was quite opposite. This in turn has raised questions, whether markets should been regulated again.

1.2 The Aim of the Study

The study tries to give comprehensive picture of the development of the airline industry and the structural changes it has undergone after deregulation, which started first in the United States and continued later in Europe. The aim of the study is to find out what kind of economic impact alliances have on the airlines themselves and on the customers.

The study also tries to examine what kind of impacts alliances have to the development of the airline markets as a whole.

1.3 Limitations

The study is concentrated only on the alliances between EU carriers and U.S. carriers. When talking about cooperation between airlines in theoretic level, the study can be applied to alliances in general.

1.4 Outline

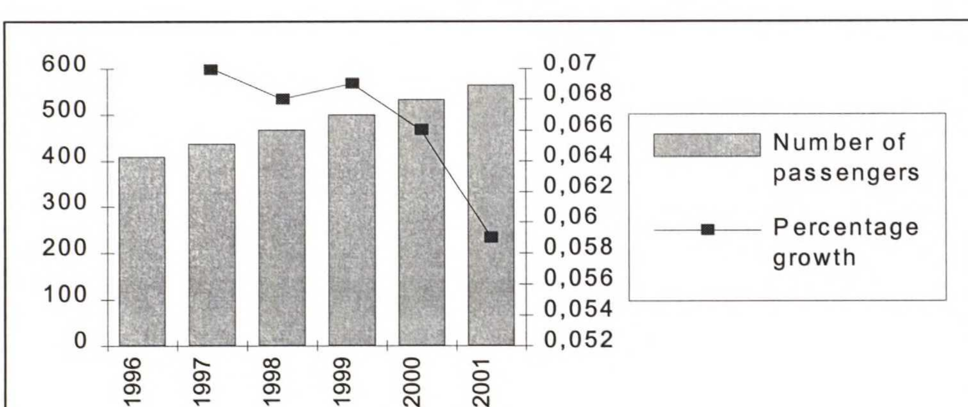
The structure of the study is as follows: first the background and development of the airline industry is discussed. Next the concept of alliance is introduced and their economic impacts are examined. Chapter 2 describes the development in the airline industry in recent years and gives the background to alliance activity. In Chapter 3 it is explained the reasons why airlines are so anxious to form alliances and the advantages they can achieve with cooperation. The chapter describes also the barriers to entry that airlines may overcome with alliances. Also concepts of economies of scope, density and scale are introduced. Chapter 4 introduces the concept of code sharing and the pro-and anti-competitive effects it may stimulate. This chapter focuses on some studies that have attempted to quantify the impact of code sharing on airline revenues, traffic and fares. Also market share estimates and producer and consumer estimates are presented. Chapter 5 describes the hub-and-spoke network system and examines the cost savings airlines can achieve with such a system. This chapter also concentrates analyzing the strategic advantage airlines can have when using the hub-and-spoke network system instead of linear route system. In addition hub dominance is discussed and possible effects it may have on fares, are examined. Finally, Chapter 6 describes the market concentration that airline industry has undergone in recent years and introduces some indices that can be used to measure market concentration. Also some studies concerning market concentration are presented.

2 BACKGROUND TO ALLIANCE ACTIVITY

2.1 Air Traffic Development

The air transport industry plays a major role in world economic activity. Over 1.25 billion passengers per year rely on the world's airlines for business and vacation travel. The demand for air transport has increased steadily over the years, averaging 6 % per annum during the 1980s and most of 1990s. (International Air Transport Association, IATA 1994) For the period 1997-2001 the world average forecast passenger growth is at 6.6 per cent per annum. If the data is applied to the 1996 ICAO total of international scheduled passengers appearing in IATA's "World Air Transport Statistics" (WATS), the number of passengers is expected to grow from 409 million in 1996 to 563 million in 2001. This passenger growth is illustrated in Figure 2.1. Highest average annual passenger growth rates are expected on routes involving Asia at 7.4 per cent per annum, followed by the South Pacific at 7.3 per cent, Latin America and Africa at 6.6 per cent, Europe 6.2 per cent, North America 6.1 per cent and Middle east 5.1 per cent. If this rate of growth were to remain steady the volume of traffic would double every 11 years and air transport thus remains one of the world's fastest growing economic sectors. (IATA 1997)

Figure 2.1 Traffic Forecasts 1997-2001



Source: IATA 1997

IATA (1996) statistics forecast trends of aviation traffic in Europe as follows. The international scheduled passenger traffic in Europe has increased at an average rate of 4.7 % per annum between 1980-1987 and 5.5 % per annum between 1987-1993. It reached 187 million passengers in 1993. Forecast for the growth is estimated to be 5.7 % per annum between 1993-2000 and between 2000-2010 the growth is expected to be 4.7 % per annum, showing one percentage unit slow down compared to the previous period. Applied to these forecasts Europe will reach 276 million passengers in 2000 and 436 million passengers in 2010. Europe's share of total world scheduled passengers will slightly decline as other world regions grow faster.

Although the structure of the world's airline industry can be expected to continue changing, The United States will retain its predominant position in commercial air transport. By the Year 2010, IATA (1994) expects that the number of international passengers traveling to and from the U.S. will reach 226 million, an increase of 187% over the 1993 figure of 78.8 million. Around 58% of these, some 131 million passengers, are expected to travel on U.S. carriers. IATA expects that Atlantic passenger traffic will exceed 45 million persons by the year 2000, 61 million in 2005 and 81 million in the year 2010. U.S. airlines will carry nearly 24 million persons over the Atlantic in the year 2000, 30 million in 2005 and the number is estimated by IATA to reach 38 million in 2010.

Besides the rapid growth of the world air transport there have been fundamental structural changes in the airline industry. The liberalization of the air transport started rapidly in the United States in 1978 by the Air Transportation Regulatory Reform Act. Instead in Europe, the airlines responded to the three liberalization "packages"[1] intended to create competition within a single EU aviation market. European carriers have made a

[1]The deregulation of the European air transport can be attributed to the stepwise approach. In December 1987 the Council of Ministers adopted the so called "First Package" of measures followed in 1990 by the "Second Package" and in 1992 by the "Third Package". Since the beginning of 1993 the Third Package has been in operation.

major strategic change from forms of protectionism through efforts at intra-European cooperation to an emphasis on alliances with US carriers.

Both the rapid growth of the world air transport and the liberalization of the European aviation industry have imposed pressures on the airlines. As the aviation sector expands new entrants are attracted to compete for the same markets thus increasing the competition. At the same time liberalized aviation markets create new opportunities for both old and new competitors. Both these factors operate in the same direction making competition more vigorous and attracting new competitors to the aviation sector. Obviously, as the wider markets for air travel open up airlines have been anticipating the competitive challenge by the creation of alliances, which form intercontinental and even global networks. Global competitiveness has become the key to commercial survival. During the past few years alliances have become the fastest growing area of competitive advantage and airlines see their future depending on strategic alliances and cooperation that comes with it. The European airlines need to widen their market base to be competitive and to survive in a deregulated environment.

2.2 European Commission and Alliances

In its XXVth Report on Competition Policy (1995), the European Commission (EC) mentioned its favorable attitude towards cooperation between airlines. Such cooperation can facilitate the healthy restructuring of air transport in Europe and lead to an improvement in the quality of consumer services and better cost control. While the Commission does not intend to impede the restructuring of European air transport, it is monitoring operations to ensure they do not lead to restrictions of competition that are not indispensable and do not rule out opportunities for real competition from new operators on the main routes.

For a long time there were no implementing regulations for air transport. At the end of 1987, however, such regulations were introduced, but only as regards international air transport between Community airports. Their scope was subsequently extended to all air transport within the Community. The principal EC competition rules are contained in Articles 85 and 86 of the EC Treaty. Article 85 prohibits and makes void agreements and concerted practices which prevent, restrict or distort competition within the common market and may affect trade between EC Member States, unless they are exempted under Article 85(3), basically on the grounds of supervening consumer benefits. Article 86 prohibits an abuse of dominant position within the common market which affects trade between EC Member States. In contrast to the position under Article 85, no exemptions are possible. (Balfour & Bischoff 1997)

A number of European airlines have concluded alliance agreements with US airlines as follows: KLM with Northwest; British Airways with American Airlines; Lufthansa with United Airlines; SAS with United Airlines; and Swissair/Sabena/Austrian Airlines with Delta. But these strategic alliances involving EC and non-EC carriers fall outside the scope of European regulations, and this legal gap is opening the door to complex controversies. The industry still operates within the framework of a fifty-two-year-old trade agreement (the 1944 Chicago Convention) and of the several thousand bilateral Air Service Agreements (ASAs) to which it led. Such agreements stipulate which carriers may fly on what routes and with what frequency. They may also contain limits on capacity (the number of seats available) and provisions for regulating fares.

In the EU-US context, two separate regimes, namely, EU law and policy on the one hand and US law and policy on the other, govern the behavior of alliances which have an "EU-US dimension". Airline behavior can be characterized as having an EU-US dimension when it affects air transport in all of the following markets: the EU domestic market, the US domestic market and the transatlantic market connecting the two domestic markets. So far, a limited number of decisions on competitions cases with an EU-US dimension have been taken. (Business World 1997)

In the EU/US case The European Commission's competition authority may be at odds with competition authorities in individual EU states, which may in turn be in conflict with the competition policies of US authorities. A case in point is the alliance between American Airlines and British Airways, in which the European Commission has taken a position on competition policy which differs markedly from that of the United Kingdom and which is likely to be at odds with policies concerning the same alliance by the US authorities. The result is confusion and uncertainty for airlines and users.

The question is: "Whose antitrust law is applicable to these alliances?". According to the European Court of Justice, the universally recognized territoriality principle must be applied. Nevertheless, the EC claims jurisdiction over transcontinental agreements affecting European Union (EU) member states' trade and competition. (Sparaco 1997) The question of the European Commission's external competence on airline competition questions has not yet been resolved. The Commission claims competence under Article 89 of the Treaty of Rome, but this is not universally accepted by national competition authorities. According to this Article the Commission shall ensure the application of the principles laid down in Articles 85 and 86. The Commission shall investigate cases of suspected infringement of these principles. If it finds that there has been an infringement, it shall propose appropriate measures to bring it to an end. (Balfour & Bischoff 1997)

In the US, the Department of Transportation (DoT) has the power to grant immunity from the application of the anti-trust laws. The DoT has determined, in particular cases, that otherwise prohibited activities of airlines which would reduce competition on air services to and from the US are nonetheless in the public interest and have sufficient transport benefits so that they can be excluded from the application of anti-trust laws. This means, that in markets where other nations have signed "open skies" agreements with the United States, they are provided the antitrust immunity, that allows the partner carriers to fix prices and divvy up capacity on routes they serve together. Under certain conditions, anti-trust immunity has been granted by the DoT in several transatlantic alliances, namely, KLM - Northwest alliance in 1993, United Airlines-Lufthansa alliance in 1996 and the grouping of Swissair, Sabena, Austrian Airlines and Delta in 1996. (Business World 1997)

On both sides of Atlantic, the markets are already penetrated. That is how the national carriers have protected themselves in the face of the liberalization and deregulation that governments have forced on them and of the competitive pressures they apply to each other. Policy-makers will now have to deal with the implications of highly-rationalized alliance systems in which traffic is fed through a selection of international fortress hubs on both sides of the Atlantic. On 24 June 1996 The European Union's transport ministers authorized the European Commission to begin negotiation of a multilateral aviation agreement with the United States. The meaning was to create a framework for a "common aviation area", meaning the establishment of some broad principles which will allow air carriers of both sides to provide their services in the European and US markets on purely commercial principles. Although the legal position is yet far from clear, the Commission is expected to give it's opinion of the cooperation between EU and US carriers in the near future.

2.3 Growth in Alliance Activity

Airlines have joined together in partnerships for decades, ranging from interline relationships to servicing each other's aircraft at far outposts and sharing spare parts, developing joint marketing programs, fixing fares, setting capacity and sharing revenues on individual routes. The first alliances between airlines appeared thirty years ago, but it's only since the late 1980s that their prevalence has soared. The world airline industry is undergoing a major structural transformation in response to increasing trade liberalization and air transport liberalization and deregulation. In order to better response to these changes airlines have in recent years entered into the alliances as well as between countries, regions and on a global basis.

With dozens of new agreements formed, old ones canceled and existing ones expanded, the airline alliance movement is today more fluid and competitive than ever. Overall survey of Gallacher (1997) shows a slight decline in the number of accords, from 390 in 1996 to 363 in 1997 (see Table 2.1). After the frenetic alliance-building of the past few years, it is natural that carriers should take time to consolidate their agreements and try to reap some benefits. The lull in the expansion of alliances also suggests that carriers now have higher expectations from their alliances and are becoming more willing to cancel pacts and switch partners if agreements do not perform. In 1997, therefore, for the first time the number of new accords was lower than the number of agreements which have been canceled outright. The number of new agreements implemented since May 1996 and not registered as planned in same year's survey remained significant but static at 72, compared to 71 in 1995/1996. Most new agreements 1997 were made by American Airlines, which had 8 new agreements followed by Finnair and Swissair both with 7 new agreements. Whereas Lufthansa had overall most agreements with 26 contracts. Next ones were Air France and Malaysia Airlines with 25 agreements each.

Table 2.1 Alliance Summary 1994-1997

	1994	1995	1996	1997	%change ('94-'97)
Number of alliances (a)	280	325	390	363	29,6%
With equity stakes	58	58	62	54	-6,9%
Without equity	222	266	327	309	39,2%
New alliances (b)	(na)	50	71	72	(na)
Number of airlines with alliances	136	153	159	177	30,1%

(a) includes new alliances
(b) alliances started that year
(na) not available

Source: Callacher 1997

Lindquist (1996) analyses the success of airline alliances based on surveys made by Boston Consulting Group (BCG) in 1992 and in 1995[2] (see Table 2.2). According to his analysis, equity alliances are three times more likely to survive, irrespective of the geographic scope. Most non-equity alliances are dominated by code sharing agreements alone, and lack elements such as cost sharing and joint marketing that are characteristics of broader strategic alliances. In contrast, equity investments generally form part of a wider ranging partnership. There is a shared financial interest in success and often there will be board level commitment to implementing mechanisms which will secure the benefits of the alliance.

Table 2.2 Alliance Survival Rates 1992-1995

	Non-equity	Equity
Domestic	(na)	65%
Regional	36%	80%
Intercontinental	23%	77%
Total	26%	73%

(na) not available

Source: Lindquist 1996

Nevertheless BCG's survey outcomes that the decline in the number of equity investments by airlines in other carriers has continued. Although some significant new equity ties were formed, there was a 7 per cent decline in the number of alliances with equity. Consequently only 14.9 per cent of the alliances in the survey involve equity stakes, compared to 15,9 per cent last year and 21 per cent in 1993/1994. (Gallacher 1997) This may imply to the fact that airlines do not want to engage themselves to the other airline in case the alliance does not work in the way they expected and they have

[2] The surveys are not publicly available

to find another partner. In that case it is easier to call off the deal without equity involvement.

Specific strategic benefits and commitment are the keys to successful alliances. These factors can be listed as follows:

- shared vision and clear strategic goals;
- commitment of resources and persistence;
- complementary route networks;
- specific realizable cost savings;
- compatibility of product and service standards; and
- chemistry between the key managers and similar corporate styles.

The literature concerning alliances highly points out the importance of chemistry between the partners. Lynch (1993) clarifies it as follows: without chemistry, the energy, vitality and trust of the alliance will be missing, and no matter how good the strategy or operations, the venture will fail. Chemistry is the psychological contract and it is far more important than the written, legal contract.

Alliances tend to fail because of poor process, in both design and implementation, and the changing priorities and strategies of the partners. These failure factors can be listed as follows:

- objectives are set too broadly or they are not congruent;
- asymmetry between the partners;
- unrealistic expectations;
- differing product and service standards;
- conflicting or competing priorities; and
- contrasting corporate styles.

As alliances proliferate, the relative benefits will decline and finding partners which share objectives and have similar long-term goals will become increasingly difficult especially in an environment characterised by shifting priorities. Intercontinental alliances are particularly vulnerable. Only one in three of the intercontinental arrangements BCG looked at in 1992 survived until 1995. Domestic and regional alliances also experienced a substantial degree of failure.

During the last few years airlines of different countries have increasingly entered into supranational alliances, which accelerate the globalization of airline industry. The formation of airline alliances and centralization between them has expanded to such measures, that in the future we can expect the air transportation to be operated by few global mega-alliances. Suddenly we are talking about groups of airlines rather than individual carriers. Raivio (1998) has identified four such mega-alliances between airlines in Table 2.3 below.

Table 2.3 Mega-Alliances Between Airlines

ALLIANCES	TOTAL PASSENGER VOLUME PER YEAR (mio)	TOTAL AIRCRAFT CAPACITY
STAR Alliance	184	1446
United Airlines (USA)		
Lufthansa (German)		
SAS (Scandinavian countries)		
Air Canada (Canada)		
Thai (Thailand)		
Varig (Brasil)		
BA - AA	141	1054
British Airways (Great Britain)		
American Airlines (USA)		
Iberia (Spain)		
Finnair (Finland)		
Swissair - Delta	128	829
Swissair (Switzerland)		
Delta (USA)		
Aua (Austria)		
Sabena (Belgium)		
KLM - Northwest	94	680
KLM (Holland)		
Northwest (USA)		
Alitalia (Italy)		
Braathens (Norway)		

Source: Raivio 1998

3 AIRLINE ARGUMENTS FOR ALLIANCES

In an increasingly competitive global market, alliances offer airlines significant competitive advantages. While airlines see alliances as a way to build and solidify international networks in the long run, alliances also permits carriers to achieve many of their international business goals in the short run. These goals include, for example, entry into new markets, increased traffic feed into established gateways and reduced operating costs. Alliances can also be an effective way for airlines to share risk, coordinate overcapacity and to overcome problems associated with legal and infrastructure barriers to entry.

3.1 Forms of Alliance Activity

The term "alliance" is often used to describe an agreement between airlines to cooperate in the provision or operation of some of their services on a route, regional or global basis. Alliances between international airlines are becoming increasingly prevalent as carriers seek to extend the range of their networks and access new markets. The core of most alliances is a practice known as "code-sharing". This is when an airline sells a seat on another carrier's flight but issues a ticket carrying its own two-letter code. The advantage of code-sharing is that airlines can sell flights to destinations they do not serve. Code-sharing can be limited to one-off deals on a single route or they can cover a wide range of routes served by two airlines. Although it can be traced back 25 years or more, code-sharing became a major marketing activity only relatively recently and it has been the fastest growing type of alliance in the past few years. For example, the growth of code-sharing agreements between 1994 and 1996 was 62.2 per cent.

In addition to jointly operated flights, cooperation between airlines can take many forms of activity. Alliances may allow airlines to:

- coordinate scheduling of aircraft arrival and departure times;

- coordinate the location of arrival and departure gates;
- coordinate frequent flier programs;
- share airport lounges and other ground facilities;
- coordinate services such as baggage handling, check-in and ticketing;
- coordinate support services including maintenance and catering; and
- share distribution and retailing functions.

Alliances may be route-specific, involving the coordination of activities or flights between specific city-pairs. More complex alliances have sought to closely coordinate cost sharing and marketing initiatives over a larger geographical area such as between countries or regions. In some cases the networks of international carriers are so interlinked as to provide the appearance of a seemingly global network.

Some alliances have gone further, with airlines taking equity stakes in their partners. This exchange of equity yields a vested interest of each carrier in making certain that the marketing and operating agreements that define their alliance are effective and successful. The ability of carriers to enter into alliances is limited by laws governing foreign ownership of airlines, as well as the nationality clauses of bilateral air service agreements which require that carriers exercising rights under a country's bilateral be owned and controlled by citizens of that country. The European Union limits foreign ownership of its airlines to 49.9 per cent and the USA to 25 per cent (Skapinker 1998).

3.2 The Concepts of Economies of Scope, Density and Scale

For a multiproduct firm, economies of scope imply that it is less costly to produce two or more product lines in one firm than to produce them separately . The sources of scope economies are joint and common costs which are created by production processes that share resources so that the use of a resource by one process leaves capacity for use by another process. (Keeler and Formby 1994)

Formally, if C denotes cost and Q output, economies of scope can be gauged from the relation:

$$S = \frac{C(Q_1)+C(Q_2)-C(Q_1+Q_2)}{C(Q_1+Q_2)}$$

where $C(Q_1)$ is the cost of producing Q_1 units of the first product alone, $C(Q_2)$ is the cost of producing Q_2 units of the second product alone, and $C(Q_1 + Q_2)$ is the cost of producing Q_1 units of the first product in combination with Q_2 units of the second product. Where there are economies of scope $S > 0$ because the cost of producing both products together is less than the cost of producing each alone, i.e. $C(Q_1 + Q_2) < C(Q_1) + C(Q_2)$. The larger the value of S the greater the economies of scope. (Hanlon 1996)

In the air traffic economies of scope occur, because it is less expensive to expand an airline's route network than for a new airline to serve the additional routes. An airline might find, for example that increasing the number of city-pairs it serves by 25 per cent increases the direct cost of its entire network by only 20 per cent. Such economies of scope are possible because airlines can often use their capital more effectively. For instance, adding a new route might not involve buying a new aircraft but rather rescheduling the existing fleet to cover more routes. The new route may not need additional baggage handling or gate capacity either if the airline has existing stations at both points. (Gellman Research Associates 1994)

The most important source of economies of scope are the economies of route traffic density airlines can reap by configuring their networks in the hub and spokes pattern. By combining passengers and groups of passengers an airline can carry the total more cheaply than if it carried the passengers separately. This is what might be achieved by routing passengers through hubs, which has the effect of increasing traffic density on each sector flown. The impact of hub and spokes networks is discussed more fully in Chapter 5

The reasons for economies of density are similar to economies to scope. Economies of density refer cost savings as the same traffic volume is carried in geographically more concentrated patterns, for instance, an airline might fly larger aircraft on a given route. In general, larger aircraft have lower seat-mile costs than smaller ones. Caves et al. (1984) define returns to density as the proportional increase in output made possible by a proportional increase in all inputs, with point served, average stage length, average load factor and input prices held fixed. This is equivalent to the inverse of the elasticity of total cost with respect to output:

$$RTD = \frac{1}{\varepsilon_y}$$

where ε_y is the elasticity of total cost with respect to output. Returns to density can be increasing, constant or decreasing, when RTD is greater than unity, equal to unity or less than unity, respectively. Increasing returns to density, that is, economies of density exist if unit costs decline as airlines add flights or seats on existing flights for instance, through larger aircraft or a denser seating configuration, with no change in load factor[3], stage length or the number of airports served. Economies of density occur when it is less expensive to increase service on the existing network than it would be for some other carrier to provide additional service on the same routes. For example, an airline might increase the capacity in a city-pair market by 25 per cent, but find that the direct costs of all flights on that route increase by only 20 per cent.

Caves et al. (1984) also define returns to scale as the proportional increase in output and points served made possible by a proportional increase in all inputs, with average stage length, average load factor and input prices held fixed. this is equivalent to the inverse of the sum of the elasticities of total cost with respect to output and points served:

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[3] Load factor = the percentage relationship of revenue load carried to capacity provided.
(RTK/ATK) = Revenue Tonne Kilometres/Available Seat Kilometres

$$RTS = \frac{1}{\varepsilon_y + \varepsilon_p}$$

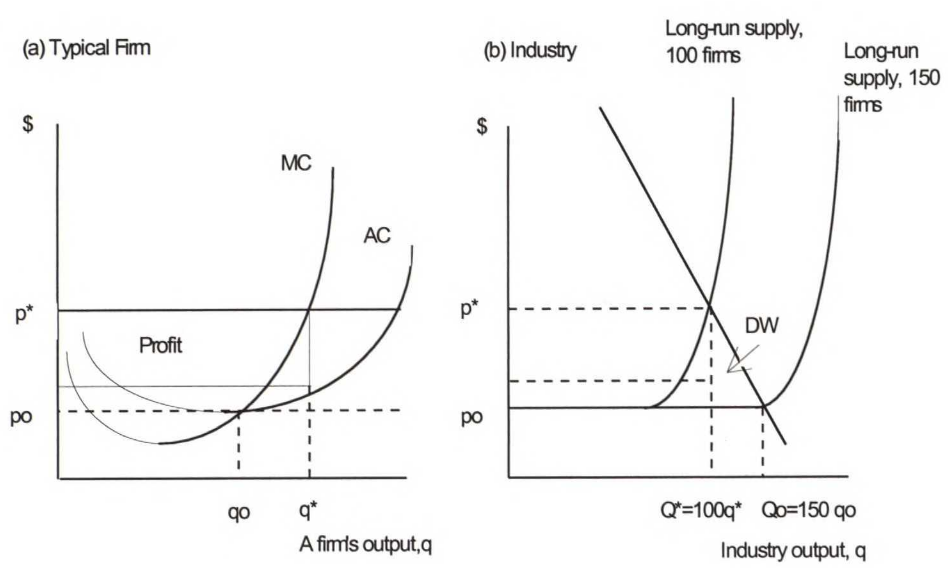
where ε_p is the elasticity of total cost with respect to points served. Increasing returns to scale, that is, scale economies occur, when RTS is greater than unity. Scale economies exist if unit cost decline when an airline adds flights to an airport that it had not been serving and the additional flights cause no change in load factor, stage length or output per point served. Airlines might achieve economies of scale for example, if they jointly purchased advertising, handled baggage together or combined their airport staffs.

3.3 Barriers to Entry

Literally, a barrier to entry is anything that prevents new entrepreneur from instantaneously creating a new firm in a market. This definition does not cover the time or cost it takes to enter into the market, but only legal or other barriers that hamper an entrepreneur to take his actions. In this context barrier to entry can be seen as any legal, institutional or economic factors that limit the ability of potential and existing airlines from commencing new services on routes which they do not currently operate, or from expanding the frequency of services. Barriers to entry are essential to the existence of non-competitive behavior. If firms that are as efficient as those already in the industry cannot easily enter, existing firms can exercise market power and set prices above competitive levels.

Carlton & Perloff (1994) explain how a restriction on entry can generate a price above the long-run competitive equilibrium (see Figure 3.1). In this industry there are a large number of firms that could produce with identical cost curves, shown in Figure 3.1a. Figure 3.1b shows two long-run supply curves for an industry with identical firms. One is the supply curve for 150 firms, the minimum number of firms necessary to supply the market at minimum average cost. The equilibrium price is p_O. The second supply curve is for 100 firms due to a restriction on entry. When the industry is limited to 100 firms, the competitive equilibrium price is p^*. The entry restriction therefore results in consumers paying a price p^*, higher than p_O and consuming a quantity Q^*, less than the quantity Q_O that would have been consumed in a competitive equilibrium with no entry restrictions.

Figure 3.1 Long-Run Equilibrium with an Entry Restriction



Source: Carlton & Perloff 1994

The entry restriction is inefficient for two reasons. First, there is a loss in efficiency due to restricting output from Q_O to Q^*. Second, the average cost of production is greater with entry restrictions. With free entry, each firm produces q_O and the average and marginal cost of production is p_O. With the restriction, firms produce q^* units at a marginal cost of p^* and an average cost above p_O (see Figure 3.1a). The area between the two supply curves between 0 and Q^* in Figure 3.1b is a measure of this increased cost. The area marked with DW in Figure 3.1b, is the deadweight loss caused by both sources of inefficiency from the entry restriction. A firm that is among 100 firms allowed into the industry is better off than if there were no entry restrictions. The elevated price raises the profits of each of these 100 firms (area marked with "profit" in Figure 2a) above the level that would have existed had the equilibrium number of firms 150 been allowed to enter. With free entry each firm produces at minimum average costs and profits are zero. The outcome of this kind of behavior is that entry restrictions transfer money from consumers to firms that were able to enter, and while it makes these firms better off, at the same time it makes consumers and those firms that were not able to enter worse off.

In many air transportation markets, the available aviation infrastructure is limited and various forms of rationing occur. Some carriers may obtain a competitive advantage, thereby, if they have rights to use the limited infrastructure. Alliance cooperation may be pro-competitive, if it allows carriers to circumvent these barriers to entry or expansion. On the other hand, alliance cooperation may be anti-competitive, if it allows a carrier to solidify its position behind such barriers. Key types of infrastructure barriers are airport landing and take-off slots, limited gate capacity and restricted access to airport ground services. The effects of these barriers to entry are discussed more detailed in next two sections.

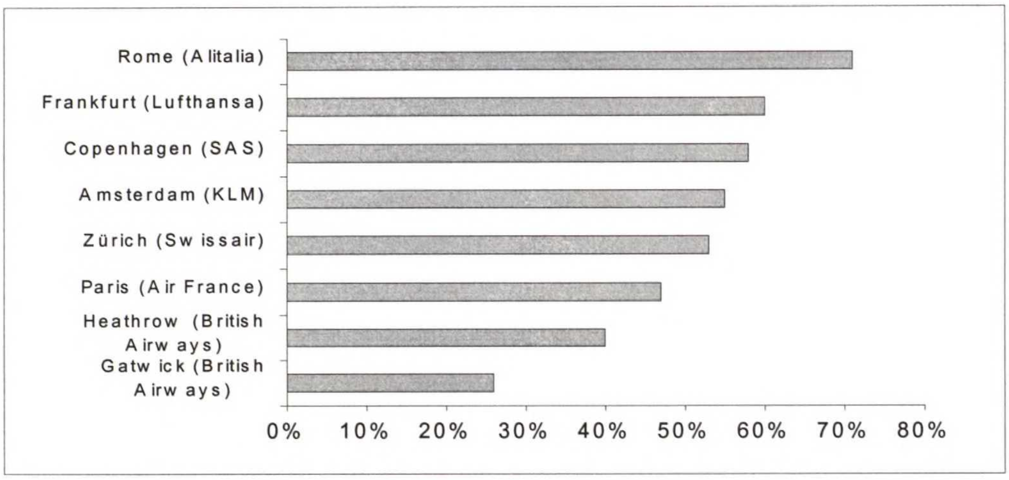
3.3.1 Landing and Take-off Slots

Because of excess demand to use some airports, the available landing and take-off capacity is allocated by awarding landing and take-off rights. This means that a carrier has the right to land and/or take-off from an airport at a specified time. In some countries, for example in the United States, the slots are bought and sold by the airlines, often at very high prices. The price paid per slot at some US domestic airports has reportedly varied between $ 300 000 and $ 3 000 000 (Industry Commission 1997). In

European Union, slot trading is not permitted. Slots are normally allocated by airport scheduling committees which apply a set of rules developed by International Air Transport Association (IATA). These rules provide for "grandfathering" which allows airlines which previously had a slot to automatically get it again. A carrier can be forced to surrender a slot only if it fails to use it.

At most big European airports, the national carrier controls the largest number of slots (see Figure 3.2). From an economic perspective, this system makes little sense. With the majority of slots held under grandfather rights, it is hard to judge whether customers would prefer a slot to be switched to a different route, or whether another airline could serve the same route more efficiently. Airlines have an incentive to use every slot they control rather than see a slot lost. And while some slots are set aside for new entrants, this does little to encourage competition. New carriers can usually get only a handful of slots and small-scale entry is often not worthwhile, because passengers seem to prefer airlines that offer frequent services. (Economist 1997)

Figure 3.2 Airlines with Biggest Share of Take-off and Landing Slots at European Airports 1995



Source: The Economist 1997

If slots have to be given away instead of being sold, incumbents will simply hang on to them making it impossible for new entrants to break into the market. The EU is currently considering options for improving slot allocation at member country airports, including a secondary market in slots. If an airline buys a take-off slot and cannot find a desirable place to land, it could sell the slot to another airline that could use it better. The slots would end up with the carriers that are prepared to pay the most for them and those who expect to make the most profit from the additional flight. That would have the clear benefit of bringing more competition on the most lucrative routes. These benefits, however, are not without costs. If slots are expensive, airlines will be disinclined to use them to operate less profitable routes, such as commuter plane trips, that may be vital to particular communities. For example, the ownership of Heathrow slots is worth some $ 2.5 billion to the airlines.

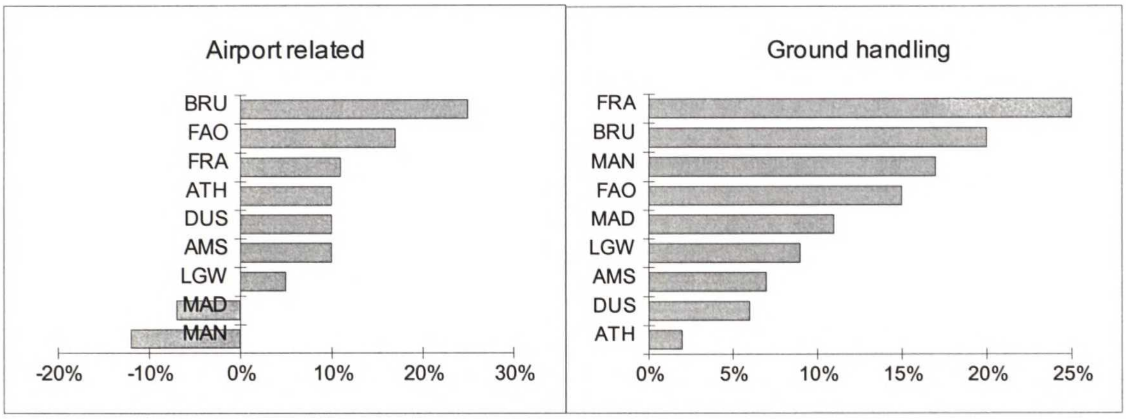
3.3.2 Access to Ground Services

Another barrier to entry is how ground services are provided at some airports. Many airports will not allow foreign carriers to employ their own baggage handlers, caterers and so forth. Instead the airport authority or the national airline has a monopoly on such operations. The result is that foreign carriers pay very high prices for ground services. Lack of available terminal space at international airports and difficulties in securing access to terminal space may affect competition for international air services. Airlines with rights to terminal space which are able to effectively restrict competition may be able to exercise market power and thereby charge higher fares for air services at those airports.

Airport related charges are those associated with aircraft movements, the provision of terminal services such as airbridges and per capita charges levied on passengers. Ground handling covers passenger and ramp handling and the cost of employing agents to supervise these activities. At most airports ground handling charges are negotiable and agreed rates depend not only on the times and frequencies of operation, but also on the carrier's negotiating power, the extent to which ground handling arrangements may be reciprocal and the geographic spread of the contract.

Cranfield University has made two surveys concerning aircraft turnround fees at European airports between 1993-1995. These surveys were made in 1994 and 1996. A comparison of charges in 1993 and 1995 shows that fees have risen by more than 10 % at the nine airports covered by both surveys (see Figure 3.3). Ground handling at Frankfurt shows an increase of over 25 %, while Athens recorded a modest 2 % rise. Both Frankfurt and and Athens increased airport related charges by around 10 %, but at Brussels where the operating companies are attempting to recover their investment in the new passenger terminal and apron, charges shot up by almost 25 %. Manchester and Madrid where unique in reducing their airport related charges. At Manchester the fall was around 12 % and at Madrid around 7 %. (Stockman, 1996)

Figure 3.3 Changes in Turnround Costs at Selected European Airports 1993-1995 (percent)



AMS Amsterdam
ATH Athens
BRU Brussels
DUS Düsseldorf
FAO Faro
FRA Frankfurt
LGW London
MAD Madrid
MAN Manchester

Source: Stockman 1996

According to Stockman (1996) the explanations why airports are restricting the supply of handling services to a single provider are: congested aprons, the need to ensure availability of handling services throughout an airport's opening hours and a requirement for high levels of service. But at the same time the state owned carriers of southern Europe, given monopoly status as ground handling suppliers at state-controlled airports, tend to offer the poorest levels of service at relatively high cost. That for many of these airports the monopoly provider is the national carrier and the provision of ground handling services represents the only profit making activity carried out by the airline, is not normally advanced as an explanation for the lack of competition. For an airport to deny that a monopoly exists because carriers can carry out their own ramp and passenger handling is disingenuous, because the investment in equipment required to support a ramp handling operation is prohibitive for a carrier with less than about five turnrounds per day, unless it can sell services to other airlines.

The operations of most airlines are restricted by lack of airport capacity. Some airline chiefs think that part of the future solution will be provided by "downtown" terminals, using monorail links to runways, rather than today's traditional airports.

3.4 The Structure of Airline Costs

The costs of supplying airline services are an essential input to many decisions taken by airline managers. Doganis (1991) has identified the structure of airline costs as shown in Table 3.1.

Variable costs are costs which are directly escapable in the short run. They are those costs which would be avoided if a flight or a series of flights was canceled. They are immediately escapable costs, such as fuel, flight crew overtime and other crew expenses arising in flying particular services, landing charges, the costs of passenger meals and so on. Variable operating costs, which may represent up to 50 per cent of total operating costs, can be escaped in the short term by cancellation or withdrawal of services. Airlines can make direct cost savings by entering into alliances which allow them to rationalize services or to establish a presence on a route without actually operating on it. For example, code sharing will enable an airline to save fuel, labor and other variable costs.

Table 3.1 Cost Allocation Based on Escapability

DIRECT OPERATING COSTS	INDIRECT OPERATING COSTS
Variable direct operating costs	Station and ground expenses
Fuel and oil costs	Passenger service costs
Variable flight and cabin crew costs	staff costs,insurance expences
subsistence,bonuses	Ticketing,sales and promotion
Direct engineering costs	General and administrative
related to number of flying cycles and hours	
Airport and en route charges	
Passenger service costs	
meals and hotel expenses,handling fees	
Fixed direct operating costs	
Aircraft standing charges	
depreciation or rental,insurance	
Annual flight and cabin crew costs	
fixed salaries,administration	
Engineering overheads	
fixed engineering staff costs,administration	

Source: Doganis 1991

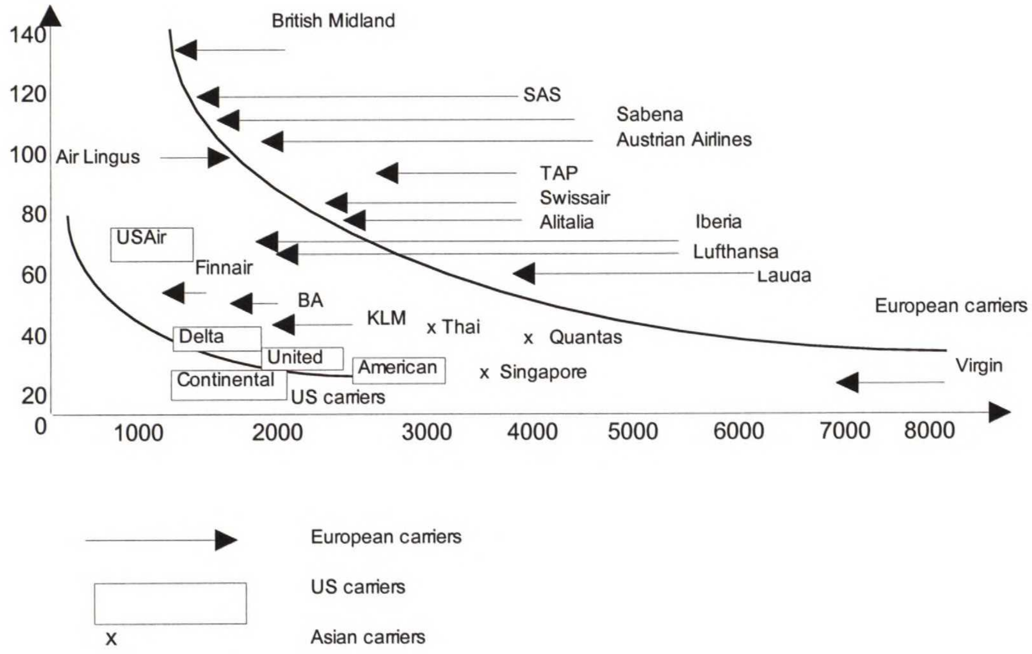
Fixed costs are those direct operating costs which in the short run do not vary with particular flights or even a series of flights. They are costs which in the short or medium term are not escapable. If an airline has planned its schedules for a particular program period and adjusted its fleet, staff and maintenance requirements to meet that particular schedules program, it cannot easily cut back its schedules and services, because of public reaction and its own obligations towards the public. If an airline decided to cut back its frequencies when the next schedules program was introduced, it could reduce its fleet by selling some aircraft, reduce its staff numbers and cut its maintenance and other overheads. Alliances may allow airlines to reduce these costs. Alliances which affect airlines' variable direct operating costs in the short term, could impact on the fixed direct operating costs if they continue to the medium term. Long-term alliances could have an impact on airlines' decisions on fleet composition, staffing and other fixed operating costs.

Indirect operating costs are the costs associated with the airline business but not directly related to the operation of aircraft. They are escapable in the medium term. Costs including to this category are for example, station and ground expenses, the costs of passenger service and ticketing. All these costs can be reduced by alliances. Airlines can coordinate for instance, ground handling and check-in facilities.

3.4.1 Overall Operating Costs

One of the most crucial factors affecting airline operating costs is the average stage length (ATK) over which it flies its aircraft. Other things being equal, the longer the stage length the lower the cost per unit. Unit cost levels among international airlines vary widely. Figure 3.4 shows a horizontal line through the overall operating costs per average stage length costs for all carriers listed. The L-shaped relationship between unit cost and stage length is a fundamental characteristic of airline economics. The figure illustrates both the wide range in cost levels between airlines and the existence of marked regional variations. European airlines lag far behind their competitors in adapting their cost structures to prevailing market conditions. European airlines' unit operating costs are between 40 and 50 percent higher than those of comparable airlines in the United States (Hanlon 1996). Thus European air carriers suffer from specific handicaps in the global market.

Figure 3.4 Unit Operating Costs as a Function of Stage Length



Source: Hanlon 1996

There is a widespread belief that high salary levels and high social costs in Europe represent a major impediment to better cost efficiency. However, the weakness of the European airline industry in the area of labor costs stems overwhelmingly from low labor productivity rather than from higher salary and social costs. Both the European and the US aviation industries pay higher than average salaries and there is no substantial difference between US and European salary levels. In 1992 the average salary was \$40 543 in the US industry and \$44 493 in Europe, while the average social charge was actually slightly higher in the United States at \$11 722 as against \$10 513 in Europe (Hanlon 1996). The real difference between the two continents is in labor productivity. According to Comité des sages (1994) European labor costs per employee are 5.38% higher than in the US, but due to much lower labour productivity in Europe the total labor costs in Europe per available tonne kilometre (ATK) are nearly 37% higher.

Over recent years the airline industry worldwide has experienced a significant increase in costs beyond management control, notably landing charges and en route charges. Moreover the European region suffers from extraordinarily high user charges. Airport charges for scheduled European airlines represent 4 to 6% of the operating costs, compared with less than 2% in the US. With regard to airport charges, US domestic flights do not require expensive border control procedures. Many US carriers own terminal buildings so that they incur airport costs themselves and pay less fees. In addition US airlines have much control over airport investments and charging policies, which make efficient cost-management more possible. Recent trends in airport charges are an additional problem for the airline industry. At certain airports, increases in charges have been clearly above the overall inflation rate thus hampering the efforts of airlines management to improve internal cost-effectiveness. (Comité des Sages 1994)

The European airline industry suffers from 15% higher fuel costs compared to the US industry. In 1991/1992 European airlines' fuel price per gallon was 10 US cents higher than the US price. Three to four cents of this total are attributable to differences in distribution costs, a different market structure, a relatively weaker negotiating power, and perhaps contracting and hedging skills. Fuel handling charges at European airports account for another one to two cents. Differences in airline networks add another cent while basic oil market differences account for four cents a gallon. (Comité des Sages 1994)

The impact of poor cost-efficiency of the European airline industry has been additionally accentuated by declining yields. Overcapacity created by overly optimistic forecasts and world-wide economic recession, have put downward pressure on the average level of air fares and rates and has reduced operating margins.

The current economic and financial impasse of the European airline industry results from both the impact of recession and the industry's own major structural problems. The cost of a number of key airline inputs is determined by external economic variables that are largely outside the control of individual airline managements. Since the external variables vary between countries and regions, the input prices of different airlines may also vary significantly. While airlines can try to reduce the prices of their inputs, in the case of some key inputs they can do so only to a limited extent. They have to accept the general level of these input prices as given, for instance, wage levels and airport charges and they have only limited scope to negotiate downwards from that given level. Another feature of these input prices is that they are subject to sudden and often marked fluctuations, for example, fuel price fluctuations. (Doganis 1991) Low profitability in the airline industry has placed increasing pressure on airlines to control and reduce their costs. Alliances have represented one way for airlines to achieve these objectives.

4 IMPACTS OF CODE SHARING

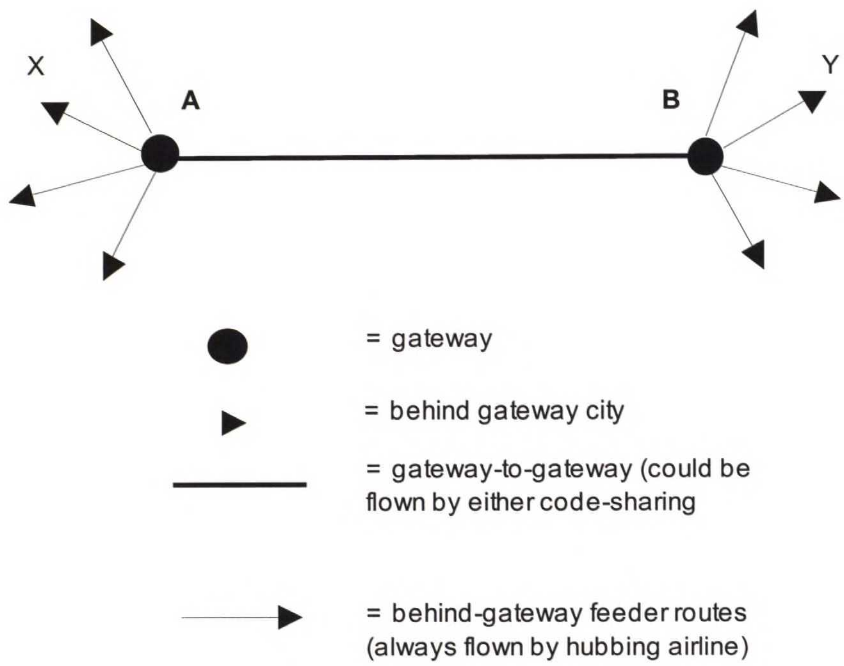
4.1 The Concept Of Code Sharing

Code sharing involves putting one airline's code on another's flight. The airlines operate independently in other respects and each markets the flight as if it were its own. The advantage of this basic form of code sharing is that travel agents' computer reservation system (CRS) displays will show two or more listings for the same itinerary. For example, an itinerary with two flight segments is listed as an online connection on one of the carriers, an online connection on the other carrier and an interline connection between the two. Because the agent sees the same flights several times there may be greater chance that she/he will book the customer on these flights. To achieve the full benefits of code sharing, the service must be similar to online service. This is the goal of broad airline alliances where the carriers cooperate in many aspects of their operations.

There are two types of code sharing: "parallel" and "complementary". Parallel code sharing refers to code sharing between two carriers operating on the same route. For example, Finnair and British Airways code share their flights on the Helsinki/London route, mainly to offer a higher flight frequency to their customers than would be the case without the code sharing. Complementary code sharing refers to the case where two carriers link up with each other to provide connecting services for an origin-destination city pair. Most of the transatlantic strategic alliance carriers have used complementary code sharing arrangements extensively in order to link up their services beyond gateways in the US and Europe.

Code sharing may be used on gateway-to-gateway operations or on behind-gateway operations that connect at the gateways. Gateway-to-gateway flights connect principal origin and destination cities for international travelers. Figure 4.1 depicts a code-sharing alliance and illustrates the various operations to which code sharing may apply.

Figure 4.1 An Alliance



Carrier A operates out of Hub A In the United States, while carrier B centers its operations on Hub B in Europe. It can be identified three different possible types of code-sharing flights that the two carriers can engage in.

-Type 1: Behind-U.S. code sharing in which carrier B put its code on carrier A's spoke flights, for example from A to X;

-Type 2: Behind-foreign country code sharing in which carrier A put its code on carrier B's spoke flights, from B to Y for example; and

-Type 3: Gateway-to-gateway code sharing in which carrier B puts its code on carrier A's transoceanic flight between B and A or vice versa.

A major objective of code-sharing airlines is to gain entry into new markets. Often these markets are too small to support additional service, so code sharing is the only way for another carrier to serve the route. In other cases, the market might support additional service, but the airline cannot afford the start-up costs for the new route. The second goal of code sharing is to increase market share in markets that already being served. Code-sharing airlines could increase market share if code sharing resulted in enhancements to service such as better connections. Code sharing might reduce connecting times, eliminate multiple check-ins and improve baggage handling. Airlines may also be able to gain market share if they can lower their fares. The final goal of code sharing is to reduce operating costs. Code sharing may reduce average operating costs if it generates more traffic and the airline can achieve some economies of density.

4.2 Pro- and Anti- Competitive Effects

It is widely expected that the growing number of alliances will result in the airline industry continuing to get more and more highly concentrated. Forecasts may vary on how many airlines will survive and how far the industry will be dominated by just a few large carriers or consortia of carriers, but what is generally agreed is that the number of major airlines operating as separate entities will fall quite sharply. This raises the question of what will happen to inter-airline competition. The dilemma of airline alliances is that they can create both anti- and pro- competitive effects at the same time.

Code-sharing is most often used to show connecting flights as occurring on one airline. In displaying connecting flights airlines try to list them as *"online"* , which means that flights are operated by the same airline rather than *"interline"*, which means that flights are operated by two airlines. In doing so, they are responding to consumers' preferences for booking connecting flights on the same airline. Generally consumers prefer online over interline connections. The reason for this is that consumers believe that same carrier connections involve shorter distances between gates in the terminal, thus making transfers to connecting flights easier and are less likely to result in lost luggage.

Consumers will benefit if code sharing encourages carriers to offer a better service at the same fare or the same service at a lower fare. Coordination activities under code sharing alliances may affect passengers directly by improving the flight attributes that consumers care about, such as the number of available flights, the ease of connections, total travel times, reliability of baggage handling, close schedule coordination between partners, shorter layover times, one-stop check-in for passengers etc. Or they may do so indirectly by reducing the costs of already efficient interline service that is subsequently reflected in lower fares. Consumers may even benefit from code sharing on what is, by all other attributes, an interline flight if they can earn frequent flyer mileage credits on both segments rather than just one.

In markets where demand is relatively thin and where it may not be profitable for any one carrier to offer online service, code sharing may allow consumers to enjoy the benefits of single-carrier service without either code sharing partner needing to introduce any additional flights. Code sharing may effectively create a route that did not previously exist, increasing consumers' choices. Code sharing can also have pro-competitive effects if it allows carriers to avoid bilateral restrictions. For example, Continental can offer service to Rome through its alliance with Alitalia. These services would not have been offered without code sharing because of constraints in bilateral agreements.

Increased concentration is often associated with a higher risk of collusion or with firms being able to set wider price-cost margins, whether because of enhanced market power exerted by individual firms or because of the umbrella effect under which market power carries over to other firms in the industry as well. This may well be the case in many international markets where restrictive bilateral agreements thwart the competitive discipline that comes from either actual entry or the threat of entry. In a study of the market power effects of alliances, Youssef and Hansen (1994) examined the alliance between Swissair and SAS (the alliance that is no longer functioning). What they found was that in hub-to-hub markets (between Copenhagen-Stockholm-Oslo and Geneva-

Zurich) competition was virtually eliminated and that on nonstop hub-to-hub routes fares increased much more than fares on other non-alliance non-stop routes in the same region over the same period. The conclusion drawn was that the airlines had taken advantage of the decreased competition in hub-to-hub markets to earn higher profits on these routes. Anti-competitive behavior also could occur where infrastructure constraints are a barrier to entry.

When two airlines serving the same route enter into an alliance it is only to be expected that they will take steps to coordinate their marketing of that route. The alliance usually includes reciprocal arrangements for the carriers to act as sales agents for one another at each end of the route. In these circumstances there is a natural suspicion that the airlines will not compete against each other and will prefer to fix mutually acceptable fares, to schedule services at mutually convenient times and to arrange joint listings in computer reservation systems (CRS). There is then some fear that competition will be curtailed in some important travel markets. There are, for instance, some hub-to-hub markets in which the majority of passengers flying the route have both origins and destinations in the hub cities concerned. Where entry is restricted and where alternative routings are of much greater circuitry and consequently involve much longer journey times, the alliance partners could be left with considerable market power on the route in question.

There is also anti-competitive potential, if the code sharing partners are the only ones offering online service in thin markets. They may be able to utilize their market power to extract monopoly rents. In such situations, any agreement for code sharing or service coordination could reduce competition by allowing competitors to essentially engage in a market-sharing arrangement that restricts flight offers. In practice, then, the overall net welfare impacts may depend significantly on the nature of existing competition in the city-pair market in question.

The potential for anti-competitive behavior is presumably somewhat less in more competitive, larger markets where more than one carrier offers comparable service. In such markets, the discipline imposed by competition may inhibit code sharing partners from extracting supra-normal profits from their code sharing flights. On the other hand, if the partners were the primary competitors prior to a code sharing agreement, the overall impact on market welfare could be adversely affected.

4.3 Impacts on Airline Revenues and Traffic

Alliances may assist airlines to lower their costs, improve their revenues and increase their traffic. This is a particularly important benefit in the face of low profitability for the industry in recent years. Increased revenues from airline alliances generally arise from the increased marketability of an airline's services, that is increased traffic. The available evidence suggests that some airlines participating in alliances have made significant revenue gains in recent years (see Table 4.1).

Table 4.1 Impact of Code Sharing on Revenue

Alliance	Period	Impact on revenue
Northwest	1994	Increase of $ 125 million-$ 175 million
KLM	1994	Increase of $ 100 million
British Airways	April 1994-March 1995	Increase of $ 100 million
USAir	1994	Increase of $ 20 million

Source: GAO 1995

The extent to which airlines participating in alliances benefit from them varies greatly and depends on the geographic scope of the code-sharing arrangement, level of operating and marketing integration achieved by the airlines. For example, the Northwest/KLM alliance produced between $125 million and $175 million in added revenues for the Northwest in 1994. These revenues represent about one-third of Northwest's $455 million in transatlantic passenger revenues and about 5 percent of its $3 billion in total international passenger revenues in 1994. Similarly, it is estimated that KLM earned approximately $100 million in added revenues as a result of the alliance during 1994. The added revenues constitute 18 percent of KLM's transatlantic passenger revenues and 3 percent of its overall international passenger revenues. In comparison, British Airways estimated that between April 1994 and March 1995 , the alliance produced $100 million in revenues for the airline; $45 million from the code-share traffic and $55 million from the increased interline traffic, linked frequent flyer programs and cost savings. USAir, on the other hand, earned about $20 million in added revenues from the alliance in 1994; approximately $8 million from the code-share traffic and $12 million from the increased interline traffic and the wet lease arrangement. (U.S. General Accounting Office, GAO 1995)

Whilst alliances have increased revenues for participating airlines, these increases have generally been at the expense of other carriers. For example, Continental Airlines estimated that the airline lost about $1 million in revenues in 1994 because traffic it would normally fly between the United States and Europe shifted to the Northwest/KLM alliance. Delta Airlines also estimated that in 1994 it incurred revenue losses of around $25 million as a result of the British Airways/USAir alliance. (The Industry Commission 1997)

The GAO (1995) noted that alliances are more likely to generate an increase in traffic when the geographic scope of the alliance is wide. Similarly the greater the extent that alliances coordinate activities, such as scheduling, check-in, baggage handling, maintenance and frequent flier programs, the higher the volume of traffic generated. As a result of an alliance between Northwest/KLM, both airlines' passenger volumes have increased over the last few years. Northwest's data indicate that for the year ended June 1994, over 353,000 passengers traveled on Northwest aircraft as part of the alliance, compared to 164,450 passengers traveling on connecting Northwest and KLM interline flights in 1991. In addition to this increase of nearly 200,000 passengers on Northwest aircraft, KLM estimated that about 150,000 passengers traveled on code-share flights in which only a KLM aircraft was involved during this period (see Table 4.2).

Table 4.2 Impact of Code - Sharing on Traffic

Alliance	Period	Impact on passenger numbers
KLM **Northwest**	1994	Increase of 350 000 (Northwest 200 000;KLM 150 000)
USAir **British Airways**	1994	Increase of 150 000
Lufthansa **United Airlines**	June 1994-June 1995	Increase of 219 000

Source: GAO 1995

Also the International Civil Aviation Organisation, ICAO has examined the effects of code sharing on traffic. ICAO examined 12 trans-Atlantic alliances in place between 1988 and 1994 covering 42 different city pairs. It found that these alliances generated increased traffic for the partners in 40 percent of the cases. However, there was no evidence of a strong traffic increase in 45 percent of the alliances examined. (The Industry Commission 1997)

As with revenue, according to the Industry Commission (1997) there is evidence that traffic growth among alliance partners often comes at the expense of other carriers. For instance, a comparison of 1993 and 1994 data for the period between April and December revealed that US carriers operating interlining agreements with British Airways lost up to 15 percent of their traffic to the British Airways/USAir alliance.

4.4 Market Share Estimates

In order to obtain quantitative estimates of the impacts of code sharing, Gellman Research Associates, Inc. (GRA) developed an econometric market share model using U.S. Origin and Destination (O&D) Survey ticket sample data from the first quarter of 1994 (1994Q1) and flight alternatives as shown in the Official Airline Guide. The next two sections (4.3 and 4.4) are based on a study of International Airline Code Sharing made by GRA in 1994.

The econometric market share model that GRA developed, identifies how consumers choose among competing flight alternatives. The method entails estimating a "discrete choice" conditional logit model over a sample of city-pair markets where passengers must make a choice between two or more flight options. The results of the model are then employed to generate predictions of the market share gained by each flight option under a variety of scenarios relating to how code-sharing options are treated in each market.

Under the logit specification the predicted market share for k^{th} alternative is given by :

$$p_k = \frac{\exp\left(x_k \beta\right)}{\sum_j \exp\left(x_j \beta\right)}$$

The model is estimated by relating the observed market shares of the choices available in each market to a set of explanatory variables x. The explanatory variables used in the model are each alternative carrier's seat share for online, interline and code-sharing flights, average time between departures, the average fare, average elapsed time of flights, a service quality proxy presented by the percent of first class or business seats offered and whether the flight connects to a carrier's hub. Seat offers are divided into five different categories in order to distinguish code-sharing offerings from other types of service. Passengers are assumed to choose the alternative that makes them best off, based on which alternative provides the combination of attributes they prefer.

For an example, assume that there are three carrier choices available in a given market and that there are just two explanatory variables, labeled as variable 1 and variable 2. Define x_{11} as the value of variable 1 for alternative 1 and x_{21} as the value of variable 2 for alternative 1 and so on. The associated coefficient estimate from the model for variable 1 is given by β_1 and β_2 is defined similarly for variable 2. Then under the logit specification employed here, the predicted market share for alternative 1 is given by:

$$p_1 = \frac{e^{\beta_1 x_{11} + \beta_2 x_{21}}}{e^{\beta_1 x_{11} + \beta_2 x_{21}} + e^{\beta_1 x_{12} + \beta_2 x_{22}} + e^{\beta_1 x_{13} + \beta_2 x_{23}}}$$

By repeating this calculation for all alternatives the predicted market shares collectively add up to one, as they should.

In order to estimate market shares two alliances were chosen. These were BA/USAir and Northwest/KLM, because they have the most developed code-sharing arrangements of the existing major agreements. The sample used in the model estimation has the following composition:

number of markets:	91
number of code-sharing markets:	50
number of NW/KLM code-sharing markets:	25
number of BA/USAir code-sharing markets:	21

The study has also some limitations. First, the model assumes a fixed market size, as such it assumes no increase in the overall size of the market from service quality improvements associated with code sharing. In addition, the model does not measure any response by carriers competing with the code sharing alliances. In combination, one would expect these two factors to result in a larger market and a lesser impact on a market share than that observed.

Estimated market shares for two major alliances with and without code sharing are shown in Table 4.3 below.

Table 4.3 Sample Carrier Choice Model Market Share Results (based on 1994 Q1 data)

Scenario	Description	BA/USAir (in percent)	KLM/Northwest (in percent)
B	Without Code Sharing	2,9	34,4
A	With Code Sharing (Baseline)	11,2	45
C	Interline Code Sharing Equivalent to Online	19,2	46,4

Source: GRA 1994

The data in the first column reflect BA/USAir's predicted market share across all BA/USAir code-sharing markets which are in the estimating sample. Likewise the data in the second column reflect Northwest/KLM's predicted market share across all Northwest/KLM code-sharing markets which are in the estimating sample. The first row reflects the shares that would be expected, if the code-sharing partners continued to offer the same number of flights as observed during the first quarter but without the benefit of code sharing. The second row shows predicted shares under the baseline scenario where code-sharing alternatives are left as is. The last row shows the predicted shares when interline code-sharing service is viewed just as favorably as true online service.

The scenario results indicate that code sharing has a significant impact on market share. Across BA/USAir code-sharing markets in the sample, the projected market share for code-sharing flights falls by about 8 percentage units when code sharing is "turned off". In the other scenario where interline code sharing was assumed to have the same effect as true online service, the model predicts that BA/USAir shares would increase by about 8 percentage units. If the effectiveness of a code-sharing alliance is viewed as the ability of the partners to offer a service that is as close to true online service as possible, it can be said that current BA/USAir code-sharing effectiveness (as of 1994Q1) is about 50% (the relative distance of scenario A between scenarios B and C, that is: $\frac{(A-B)}{(C-B)} \times 100$). Across Northwest/KLM code-sharing markets in the sample, projected market share for code-sharing flights falls about 10.5 percentage units when code sharing is turned off. In contrast, if interline code sharing had the same attributes as true online service, the model predicts that Northwest/KLM shares would increase about 1.5 percentage units, thus their current code-sharing effectiveness is almost 90%.

According to GRA's study alliances really have a positive impact on partners' market shares. Also ICAO found that of the 12 trans-Atlantic alliances studied, participating airlines increased their market share in 48 per cent of the cases. Of the 20 instances where alliances increased market share, European carriers increased their market share in 16 cases and US carriers increased their market share in the remaining 4 cases. However, there was little evidence of the magnitude of the increase in market share. (The Industry Commission 1997)

4.5 Producer and Consumer Surplus Estimates

Both consumers and producers of airline services can enjoy benefits or suffer losses from code-sharing agreements. The impact of code-sharing agreement on each country's welfare is the net effect of these gains and losses. Policymakers must be concerned with these economy-wide net benefits while code-sharing partners and their competitors are concerned with only the net benefits that accrue to them from these agreements.

The previous model allows direct computation of consumer surplus by calculating the change in consumer welfare based on an estimate of the value of time between the baseline and counterfactual cases. A formal measure of the effects on consumers is available using the economic concept of "compensating variation" (CV). For a given change in the price or some other attribute of a given product or service, the compensating variation is defined as the amount of income that must be given to or taken from a consumer to make him or her just as well off after the change as before. If income effects are small, then CV can be accurately approximated by the change in consumer surplus. An advantage of the logit specification used here is that it allows direct computation of consumer surplus impacts that arise when moving between any two scenarios.

$$\text{CV} = \frac{-1}{\lambda} \int_{W_j^0}^{W_j^f} p_j(W_1,\ldots,W_j)\,dW_j$$

Source: Small & Rosen (1981)

where λ is the marginal utility of income, W_j^0 is the mean utility associated with alternative j before the change, W_j^f is this same utility evaluated after the change and p_j is the probability of choosing alternative j . Equation shows that the difference in utility between the initial and final points is multiplied by the negative of the inverse of the marginal utility of income.

The effect on producer surplus is measured as the change in carrier net profits for each alternative (revenues minus costs) when moving between any two scenarios. Given the assumption of no change in market sizes, gross revenue for a given alternative an any sample market is computed using the following formula:

Gross revenue = Fare (excluding tax) x Estimated market share x Market size

Carrier specific cost data are used to estimate impacts. As noted earlier, the model assumes that the market size is fixed and there is no change in capacity, so the only incremental costs incurred are passenger related: ticketing, sales and promotion costs (measured as a percentage of the fare) and passenger services costs (measured as a percentage of revenue passenger miles).

Both consumer and producer welfare effects apply on a per capita basis for each passenger in a given market, so the overall welfare impacts can be found by scaling the results by overall market size. Table 4.4 shows the estimates of the annualized BA/USAir code-sharing impacts based on traffic data from the first quarter of 1994.

Table 4.4 Estimated Annualized Impacts of the BA/USAir Code-Sharing Alliance

Carrier	Producer Revenue ($Mil)	Producer Cost ($Mil)	Net Producer Surplus ($Mil)	Consumer Surplus ($Mil)	Net Social Surplus ($Mil)
USAir	7,9	-2,3	5,6		
Other U.S. Carriers	-41,7	14,9	-26,7		
U.S. Total	**-33,8**	**12,6**	**-21,1**	**4,9**	**-16,2**
British Airways	45,8	-18,6	27,2		
Other Foreign Airlines	-1,3	0,5	0,8		
Foreign Total	**44,5**	**-18,1**	**26,4**	**5,4**	**31,8**
Grand Total	**10,7**	**-5,5**	**5,3**	**10,3**	**15,6**

Source: GRA 1994

The results show that the consumer benefits are significant for both U.S. and foreign consumers, but the alliance has benefited foreign carriers at the expense of U.S. carriers. The annual decline in U.S. producer surplus is estimated to be about $21.2 million. Even after accounting for benefits to U.S. consumers, the overall net impact on the U.S. is negative. This is not suprising given the one-way nature of the code-sharing (BA puts its code on USAir flights, but not vice versa) and the fact that BA does virtually all of the long-haul flying between the U.S. and London.

In contrast, as shown in Table 4.5, the Northwest/KLM alliance provides sizable benefits to both U.S. and foreign passengers and small but positive benefits to U.S. and foreign carriers as a group.

Table 4.5 Estimated Annualized Impacts of the Northwest/KLM Code-Sharing Alliance

Carrier	Producer Revenue ($Mil)	Producer Cost ($Mil)	Net Producer Surplus ($Mil)	Consumer Surplus ($Mil)	Net Social Surplus ($Mil)
Northwest	24,6	-8,5	16,1		
Other U.S. Carriers	-25,6	9,9	-15,7		
U.S. Total	**-1**	**1,4**	**0,4**	**13**	**13,4**
KLM	18,6	-8	10,6		
Other Foreign Airlines	-16,5	7,9	-8,6		
Foreign Total	**2,1**	**-0,1**	**2**	**14,1**	**16,1**
Grand Total	**1,1**	**1,3**	**2,4**	**27,1**	**29,5**

Source: GRA 1994

Since the estimates were produced, Northwest has begun flying more of the long-haul passengers in the KLM/Northwest alliance, which suggests that the benefits are now even more favorable to U.S. interests. It is important to emphasize that the results presented here may be understated, because they are based only on a single "snapshot" of code-sharing markets at a relatively early point in their development.

4.6 Effects on Fares

Airline alliances may enable airlines to achieve cost savings, through for example, cost sharing, better capacity utilization or process streamlining. Where those airlines face a significant degree of competition, these costs savings and efficiencies may be passed on to passengers in the form of lower fares or a greater availability of discounted seats. The level of competition on a route or given market will have an important influence on the extent to which airlines may pass the cost savings achieved through alliances to passengers in the form of lower fares. Indeed, where alliances allow airlines to exercise market power, they may seek to restrict capacity and increase the level of fares. (The Industry Commission 1997)

There is a little evidence of the impact of code sharing on passenger fares. The study made by GAO (1995) argued that insufficient data exist to determine whether consumers are paying higher or lower fares as a result of alliances and whether alliances will reduce or increase competition in the long term and thereby lead to higher or lower fares. The quantitative study by Oum, Park and Zhang (1996) examined the effect of code sharing agreements. They examined the effect of complementary code sharing by "non-leader" airlines on the "leader" (the airline with the highest passenger share on a route) airline's passenger volume and equilibrium price in the context of oligopoly. The data used in their analytical model consist of 57 transpacific air routes over the period 1982-1992. Their analysis indicated that the presence of this type of code sharing had a tendency to increase the passenger volume and decrease the fares of the leader airline. These results are quite different compared to the findings presented earlier in the text.

This section concentrates to the study made by Oum et al. The model starts by determine the leader's residual demand function and supply relation. Let us first consider the leader's demand function, which means total demand minus other firms' supply. The difference of these two is then the supply that the leader faces.

a) Demand equation

$$Q = a_0 + a_1 P + a_2 F + a_3 NF + a_4 NW + a_5 FEED + a_6 CS + \varepsilon_d \qquad (1)$$

where

F = the number of non-stop flights served by the market leader on the route
NF = the total number of non-stop flights provided by other carriers on the route
NW = an input price index of the non-leaders
$FEED$ = a dummy variable indicating that one or more non-leader carriers use their feeder carriers in order to provide connecting services on the route
CS = a dummy variable which equals one for complementary code sharing between non-leader carriers and zero otherwise
$a_i s$ = unknown parameters to be estimated
ε_d = random error term

b) Supply relation

The market leader's supply relation consists of marginal cost (MC) and conduct term (t). The marginal cost is expressed as follows:

$$MC = b_0 + b_1 Q + b_2 W + b_3 D + \sum_{i=1}^{10} d_i YR_i + \sum_{i=1}^{2} e_i RG_i + \varepsilon_1 \qquad (2)$$

where

W = an input cost index of the leader
D = distance between the two cities
$YR_i s$ = year dummy variables
$RG_i s$ = route group dummy variables
$b_i s$, $d_i s$ and $e_i s$ = unknown coefficients
ε_1 = random error term

The conduct term in general depends on market structure as well as other firm's exogenous variables, which vary from route to route. The conduct term t is specified as follows:

$$t = c_0 + c_1 COM + c_2 MS + c_3 FEED + c_4 CS + \varepsilon_2 \quad (3)$$

where

COM = competing airlines in the non-stop market
MS = the leader's market share in the non-stop market
$FEED$ = connecting services between a carrier and its subsidiary
CS = code sharing
c_is = unknown coefficients
ε_2 = random error

From the marginal cost and conduct term functions can be drawn the following form of leader's supply relation:

$$P = b_0 + (b_1 + c_0)Q + b_2 W + b_3 D + c_1 COM \bullet Q + c_2 MS \bullet Q \quad (4)$$

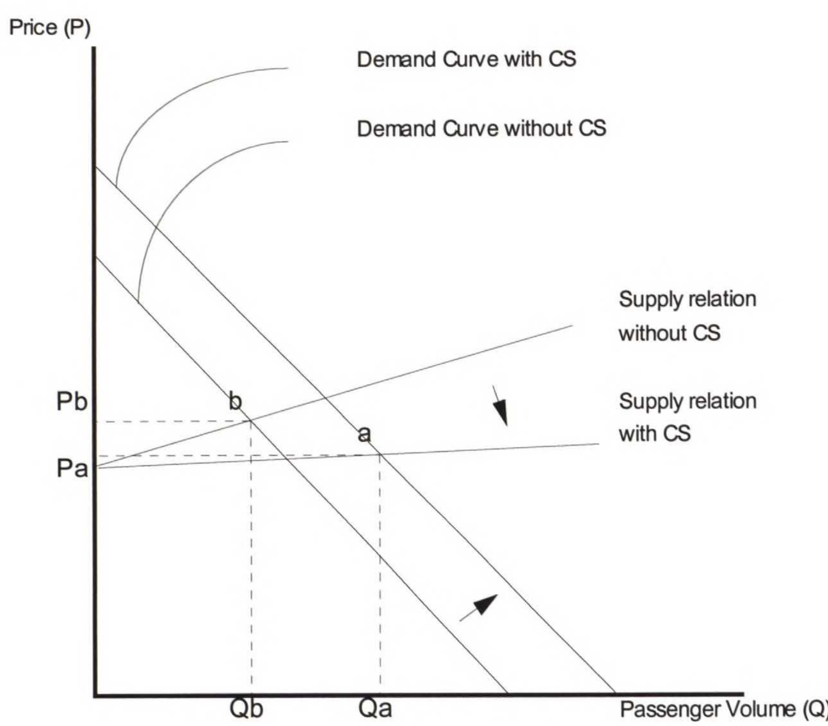
$$+ c_3 FEED \times Q + c_4 CS \times Q + \sum_{i=1}^{10} d_i YR_i + \sum_{i=1}^{2} e_i RG_i + \varepsilon_s$$

where ε_s represents the random error term in the supply relation.

The model consisting of demand equation and supply relation is estimated using Non-linear Three-Stage Least Squares (N3SLS). A few important results of the model are discussed here with graphical illustration.

The estimation of the variables in the supply relation shows that the sign of the coefficient of passenger volume (Q) is positive (0.00419) suggesting that the market leader's supply relation curve is positively sloped as shown in the Figure 4.2 below. The coefficient of code sharing is -0.00085 with a t-ratio of -2.4. This implies that code sharing between non-leaders causes the slope of the leader's supply relation curve to change. More specifically, the slope of the supply relation curve is 0.00419 in the absence of code sharing while it decreases to 0.00334 when code sharing occurs. In other words, code sharing between non-leaders rotates the leader's supply relation curve in a clockwise direction. This implies that the leader's pricing conduct becomes more competitive in the presence of code sharing between non-leaders.

Figure 4.2 Effects of Code Sharing between Non-Leaders on Leader's P and Q



Source: Oum et al. 1996

The examination of variables in demand equation shows that the coefficient of price (P) is -26 implying that a dollar increase in a market leader's air fare is estimated to reduce its residual demand by about 26 people a year. The coefficient of the leader's flight frequency (F) shows that an increase in frequency would increase demand by reducing passengers' delay. Finally the coefficient of code sharing (CS) is estimated at 7490 indicating that code sharing between non-leaders would shift the market leader's residual demand curve upward. For this traffic enhancing effect Oum et al. found the following reasons. First, code sharing between non-leaders often leads to the replacement of an existing single carrier service by the code shared connecting services. In such a situation code sharing between non-leaders would shift the leader's demand upward because the code shared connecting service is less attractive than the single carrier service that previously existed. Second, for the case where code sharing does not replace a single carrier service but improves services by replacing interline services, the service improvement may increase prices as the improved services are capitalized. This would in turn increase demand for the market leader as a secondary effect.

Since code sharing raises the leader's demand curve and lowers the supply relation curve, it is clear that the leader's equilibrium passenger volume will increase. This still does not give the answer whether the leader's equilibrium price will increase or decrease. In order to measure the effects of code sharing on the market leader's price and quantity numerically, Oum et al. derived from equations (1) and (4) the following reduced-form equations for leader's price and passenger volume .

$$P = CQ + B,\ Q = (a_1 B + A) / (1 - a_1 C) \tag{5}$$

where

$$A \equiv a_0 + a_2 F + a_3 NF + a_4 NW + a_5 FEED + a_6 CS,$$

$$B \equiv b_0 + b_2 W + b_3 D + \Sigma d_i YR_i + \Sigma e_i RG_i,$$

$$C \equiv (b_1 + c_0) + c_1 COM + c_2 MS + c_3 FEED + c_4 CS.$$

Equation (5) is used to measure the change in the leader's equilibrium prices and passenger volumes with and without a code-sharing arrangement. $P(1,\Sigma)$ and $Q(1,\Sigma)$ are defined as the leader's price and passenger volume which prevail under the code sharing situation and $P(0,\Sigma)$ and $Q(0,\Sigma)$ as those in the absence of code sharing. Σ denotes the set of all other variables except the code sharing variable under consideration. $\Delta P =$

$P(1,\Sigma)$ - $P(0,\Sigma)$ and $\Delta Q = Q(1,\Sigma)$ - $Q(0,\Sigma)$ are calculated for each route and each year. Table 4.6 shows summary statistics of sample mean, standard deviation, minimum and maximum of ΔP and ΔQ. Mean values for ΔP and ΔQ are estimates as -83 and 10,052 respectively, indicating that code sharing between non-leaders is expected to decrease the leader's equilibrium price by $83 per passenger and increase the leader's annual passenger volume by 10,052 persons.

Table 4.6 Changes in the Leader's Equilibrium Price and Passenger Volume (with and without code sharing)

Statistic	Mean	Standard Deviation	Maximum Observation	Minimum Observation
Δ P	-83,2	58,27	7	-318,6
Δ Q	10052	1522,1	16081	7584,5

Source: Oum et al. 1996

5 HUB - AND - SPOKE NETWORK SYSTEM

The most visible effect of deregulation in U.S was the reorganization of the carriers' route networks. The result was the widespread adoption of the hub-and-spoke (HS) network, which also has been adopted in Europe since deregulation. Alliances have also noticed the importance of this network structure. Hubs are essential for international alliances, because they operate their code-sharing flights through them. It appears that a hub-spoke network provides important advantages to its operator in the production and marketing of air travel services.

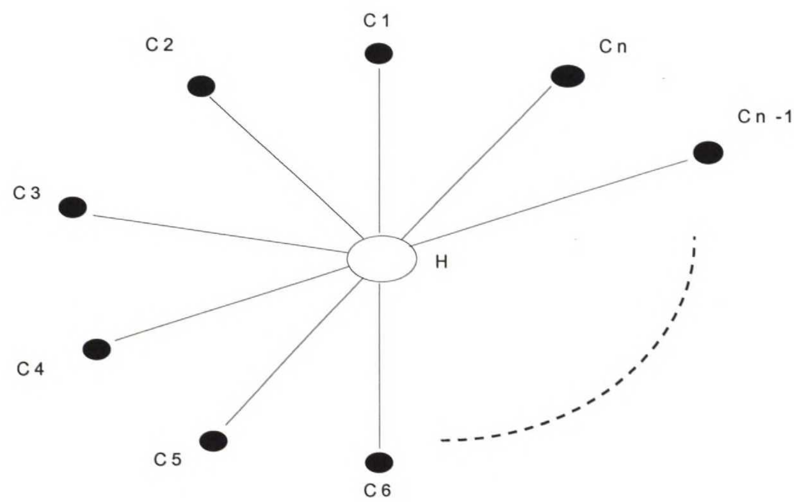
On the production side, hubbing reduces costs by taking advantage of the economies of route traffic density. These economies arise from a reduction in the cost per passenger on a given route as the number of passengers traveling on the route rises. By routing passengers trough a hub an airline is able to achieve a higher traffic density than would be possible under a linear route structure. On the marketing side, routing flights through a hub facilitates more direct flights and more frequent departures to a large number of cities, thereby making services more attractive to travelers. For example, Morrison and Winston (1986) reported, using U.S. data, that a doubling of the frequency of air service would lead to a 21 per cent increase in the demand for air service by business travelers and a 5 per cent increase by leisure travelers.

5.1 The Network Structure

In hub and spoke network, passengers from each city are flown to a hub airport, where they change planes before flying on the their eventual destinations. Such a network is shown in Figure 5.1, 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 traveling 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 5.1 A Hub-and-Spoke Network

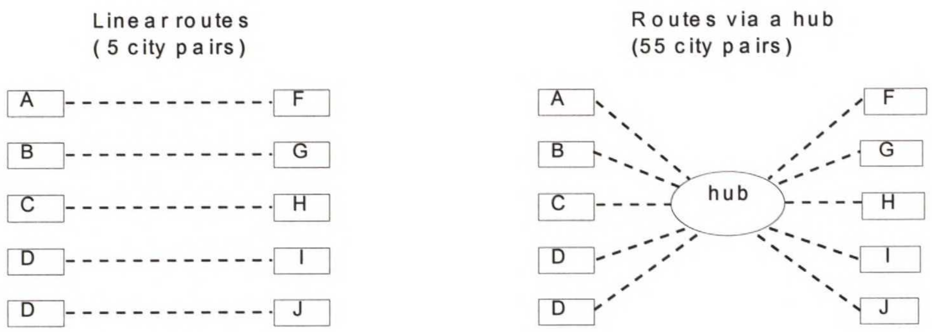


Source: Brueckner et al. 1997

In contrast to the hub-and-spoke (HS) network, another way of connecting the cities in Figure 8 would be via a point-to-point network, in which airplanes are flown between each pair of cities. Instead of traveling through the hub, the passenger going from C_2 to C_n would travel nonstop on an airplane flying directly between these cities.

An important advantage in hub and spokes networks, in which routes radiate from a central hub airport to a number of outlying spoke airports, is the effect they have in multiplying by permutation the number of city pairs an airline can serve. It makes it possible for the airline to carry on a single spoke passengers with the same origin but different destinations or passengers with different origins but the same destination. When airports are linked via a hub, the number of available city pairs is much greater than when they are linked directly, as shown in Figure 5.2.

Figure 5.2 Linear Routes Versus Routes Via a Hub



Source: Hanlon 1996

If, for example, five direct services, each linking a single city pair, are replaced by connecting services from the same group of cities via a hub, there is an elevenfold increase in the number of linked city pairs from a mere doubling in the number of sectors operated. One additional spoke would raise the number of possible linkages by a further eleven city pairs. Mathematically, if there are *n* spokes, an airline can provide through connecting services for up to a theoretical maximum of $n(n-1)/2$ city pairs. When these are added to the *n* city pairs to/from the hub itself, the total possible city pair markets is $n(n+1)/2$ and the way in which total city pairs rise with the number of spokes is illustrated in Table 5.1. (Hanlon 1996)

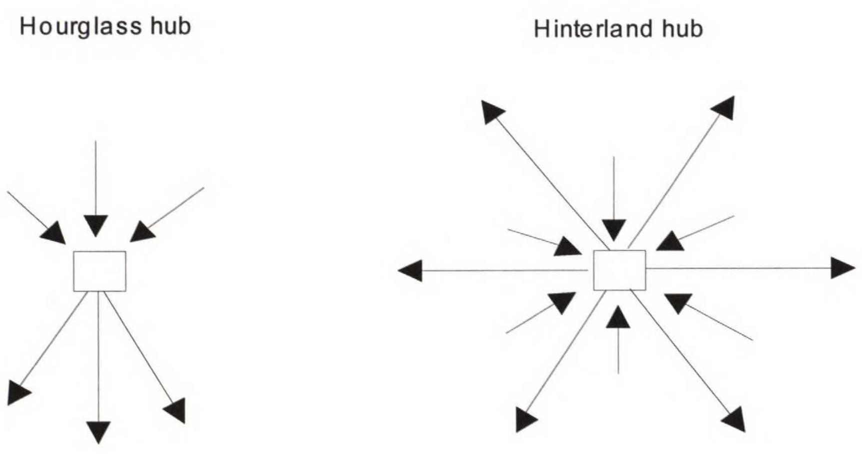
Table 5.1 Markets in a Hub and Spoke System

No. of spokes	Max no. of connecting markets	No. of local markets	Max no. of city pair markets
n	n(n-1) / 2	n	n(n+1) / 2
5	10	5	15
10	45	10	55
25	300	25	325
50	1225	50	1275
100	4950	100	5050

Source: Hanlon 1996

Figure 5.3 illustrates two main kinds of hub; the "hourglass" hub and the " hinterland" hub. Through a hourglass hub flights operate from one region to points broadly in the opposite direction and through a hinterland hub short haul flights feed connecting traffic to the longer trunk routes. An hourglass hub usually only caters for connections in two directions, outbound and return, whereas a hinterland hub serves as a multi-directional distribution center for air travel to and from its surrounding catchment area. Flights through as hourglass hub are usually operated by the same aircraft, whereas connections through a hinterland hub often require a change of the plane, for example, from regional aircraft to long range jet. (Hanlon 1996)

Figure 5.3 Two Kinds of Hub

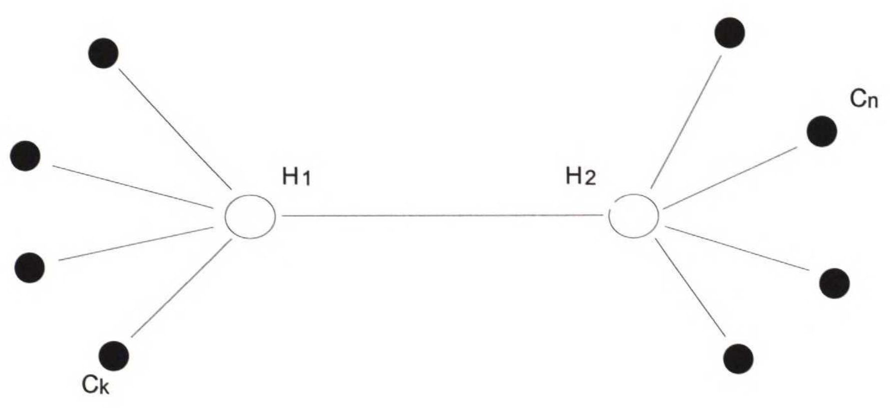


Source: Hanlon 1996

Rather than continue the earlier strategy of trying to connect smaller cities directly to each other, the alliances have also adopted the strategy of hub and spoke network in order to connect their code-sharing flights. In the case of the Northwest/KLM alliance hub and spoke networks connect 201 cities in the US and Canada through Northwest's US hubs and 107 European cities through KLM's Amsterdam hub. This strategy offers altogether 21 708 permutations for connecting flights between "beyond" i.e. spoke cities across the Atlantic. The overall scope of the alliance systems is staggering including all routes flown. The BA/AA-led alliance will serve 36 000 city-pairs throughout the world while the Lufthansa/United/SAS-led alliance will serve 55 212 city-pairs. (Staniland 1996)

The Figure 5.4 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 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. (Brueckner et al. 1997)

Figure 5.4 Two HS Networks Linked by an Airline Alliance



Source: Brueckner et al. 1997

5.2 Cost Savings for Airlines

Compared with direct flights, hubbing involves additional passenger handling, places greater peak-load pressure on the hub airport and may have the effect of reducing the average sector distance flow. Passengers routed via a hub are involved in two boardings and disembarkations and their baggage has to transferred from one aircraft to another. Passengers also have to travel farther on average under an HS network than under a point-to-point networks. The concentration of flight activity means that this has to be accomplished within a short interval of time which in turn means that extra staff and more sophisticated handling equipment are needed to cope with sharp surges in the flow of traffic. To a certain extent some of these costs are a burden, not just on the airline, but on the airport authority as well. But if hubbing reduces sector lengths, then the cost penalties from this fall on the airline alone, given that such a high proportion of its direct operating cost is incurred in take-off, landing, climb and descent. As long as the endpoint cities are relatively close to the hub the extra cost of this more-circuitous routing is dominated by the gains from economies of density, making the HS network cheaper to operate.

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.

One of the main determinants of unit cost is route traffic density. It can be measured as the ratio of traffic to network size, for example, passenger-miles divided by the number of cities served. As mentioned earlier in Chapter 3.2, there are some significant economies in route traffic density. These economies 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, because of the lower cost per passenger mile. 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. In addition, high traffic density permits greater flight frequency, which allows more intensive crew and aircraft operation, that is, more flight hours per day. Economies of density also arise from elements of an airline's costs 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 in the airline's network rises and hubbing has a major effect in increasing density. (Brueckner et al. 1997)

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. They 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 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 than in the high-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.

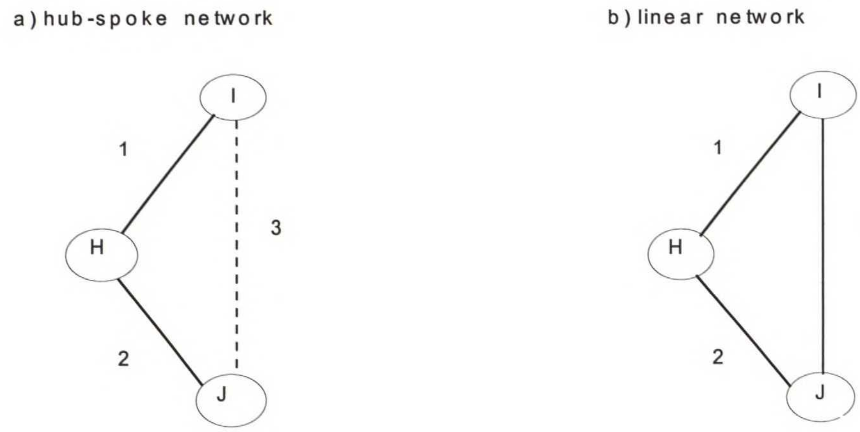
5.3 The Strategic Advantage of Hubbing

In this section the effects of the strategic interaction between deregulated airlines on their network choice are analyzed. Two route structures are considered; a linear system, under which city-pair markets are served via non-stop flights, and a hub-spoke system, under which passengers between cities on the spokes must take connecting flights at the hub. Oum et al. (1995) examined whether switching from a linear to a hub-spoke network confers a strategic advantage because it saves costs and improves service quality.

The significant point is that the firm that chooses a hub-spoke network may benefit strategically by altering the future terms of interfirm rivalry by modifying its own and its opponent's output decisions. Because network structures influence specification of the profit function and hence the output market equilibrium, carriers with foresight will have an incentive to choose a network structure to influence the output rivalry in their favor. Essentially, with the the network effect, hubbing allows the carrier to commit to a higher level of outputs since it lowers marginal cost and raises marginal revenue. This causes own outputs to rise and induces the rivals' outputs to fall. It is possible that even if hubbing raises total cost, it is still pursued by the airline either because hubbing is a dominant strategy in an oligopoly or because the choice of hubbing will be useful in deterring entry.

In the model there are three cities: H, I and J and three city-pair markets: IH, JH and IJ (labeled 1, 2 and 3 respectively) in which passengers originate in one city and terminate in the other (see Figure 5.5). It is assumed that only H can be developed as a hub. If a carrier serves all three markets and uses H as its hub, it will provide connecting flights between I and J trough H as a result its aircraft are flown only on the IH and JH routes. This route structure is referred to as a hub-spoke network. A carrier that serves all three markets may choose not to hub. In that case it would offer nonstop flights in the IJ market and its aircraft are flown on all three routes. This route structure is referred as a linear network.

Figure 5.5 A Simple Air Transport System



There are two air carriers (i = A,B) serving the transport system. The basic model is a two-stage networking game between the two carriers. In stage 1, firms simultaneously select their route structures, either a linear network or a hub-spoke network. If a firm chooses a hub-spoke network, it incurs sunk investment costs of hub development, denoted c^i_d. In stage 2, given the network decisions, firms simultaneously establish their output levels for city-pair markets. It is important to note that in this model the network decision is treated as strictly prior to the output decision and once the network structure has been chosen, it cannot easily be altered in a major way. The choice of airline route structure is a strategic decision, which can be regarded as given at the time that competing carriers establish quantities for particular city-pair markets.

Irrespective of its choice of network, each carrier in question can be viewed as a multiproduct (three-product) firm with a product corresponding to travel in a particular city-pair market. The nature of interaction among a carrier's products however depends on its network choice. This relationship can be shown by examing the interaction in both demands and costs. Consider costs first. A point to point airline incurs production cost $\Sigma^3{}_{k=1}\, c^i{}_k\, (x^i{}_k)$, where $x^i{}_k$ denotes i's output on the kth route and $c^i{}_k\, (x^i{}_k)$ gives the cost of carrying $x^i{}_k$ passengers on that route. A hub-spoke airline, on the other hand, incurs $\Sigma^2{}_{k=1}\, c^i{}_k\, (X^i{}_k) + c^i{}_h$, with $X^i{}_k \equiv x^i{}_k + x^i{}_3$ and $c^i{}_h \equiv c^i{}_d + c^i{}_a$, where $c^i{}_a$ denotes some additional costs incurred by routing flights between two spoke cities through the hub. It is noted that $X^i{}_1$ and $X^i{}_2$ include both local and connecting passengers and thus refer to the total passengers carried by the airline on the spoke routes.

To incorporate the effect of network structure on demands one may use the full price demand model. More specifically, the carriers' demands in the kth market may be written as

$$x^A{}_k = D^A{}_k(\rho^A{}_k, \rho^B{}_k) \qquad x^B{}_k = D^B{}_k\,(\rho^A{}_k, \rho^B{}_k) \qquad (1)$$

for $k = 1, 2, 3$, where $\rho^i{}_k$ is the full price of using carrier i's service. The full price is taken to be the sum of the sum of the ticket price, $p^i{}_k$ and the cost associated with the quality of i's service. By solving equations (1) for $\rho^A{}_k$ and $\rho^B{}_k$ we can obtain the corresbonding inverse demand functions as shown here below.

$$\rho^A{}_k = d^A{}_k\,(x^A{}_k, x^B{}_k) \qquad \rho^B{}_k = d^B{}_k\,(x^A{}_k, x^B{}_k) \qquad (2)$$

It is assumed that in each city-pair market the firms' products may but need not be perfect substitutes

$$\frac{\partial d^{\,i}_{\,k}}{\partial x^{\,j}_{\,k}} < 0\ , \qquad k = 1, 2, 3 \qquad (3)$$

An important aspect of service quality is the passenger's schedule delay time, that is the time between the passenger's desired departure and the actual departure time. Research has found that the schedule delay associated with a carrier depends largely on the carrier's flight frequency, which in turn depends on its traffic volume on the route. Thus, if Q represented the total passengers carried by i on route k, then the schedule delay cost may be written as $g^i_k(Q)$. The passenger delay costs of an airline will vary with the type of network the airline adopts. Under a linear network, the delay cost in each market is given by $g^i_k(x^i_k)$. If the airline adopts a hub-spoke network, the delay costs on the two spokes become $g^i_1(X^i_1)$ and $g^i_2(X^i_2)$, whereas the delay cost in the connecting markets is the sum of the delay costs on the two spokes, $g^i_1(X^i_1) + g^i_2(X^i_2)$, reflecting the fact that connecting passengers have to travel two connections to reach their final destination. Moreover, owing to the additional descent and ascent at the hub and to extra cruise time required for the circuitous routing, a connecting passenger may suffer an extra cost by flying with a hub-spoke airline compared with non-stop service. Using γ^i to denote this extra cost, the full prices thus can be written as:

$$\rho_k^{iL} = \rho_k^{iL} + g_k^i\left(x_k^i\right), \qquad k = 1, 2, 3 \tag{4}$$

under a linear network and

$$\rho_1^{iH} = \rho_1^{iH} + g_1^i\left(X_1^i\right), \quad \rho_2^{iH} = \rho_2^{iH} + g_2^i\left(X_2^i\right), \quad \rho_3^{iH} = \rho_3^{iH} + g_1^i\left(X_1^i\right) + g_2^i\left(X_2^i\right) + \gamma^i \tag{5}$$

under a hub-spoke network. According to the full prices specification, the willingness to pay of consumers is the same for the output of each firm and is reduced by the costs of delay and inconvenience.

Given these demand and cost specifications, these two network strategies will give rise to different relationships among products in a firm's profit function. If firm i chooses a linear network, its profit function can be written as, using (2) and (4),

$$\pi^{iL}\left(x^{A},x^{B}\right)=\sum_{k=1}^{3} d_k^i\left(x_k^A,x_k^B\right)x_k^i-\sum_{k=1}^{3}c_k^i\left(x_k^i\right)-\sum_{k=1}^{3}g_k^i\left(x_k^i\right)x_k^i \tag{6}$$

If i chooses a hub-spoke network, its profit function can be expressed as, using (2) and (5),

$$\pi^{iH}\left(x^{A},x^{B}\right)=\sum_{k=1}^{3} d_k^i\left(x_k^A,x_k^B\right)x_k^i-\sum_{k=1}^{2}c_k^i\left(X_k^i\right)-c_h^i-\sum_{k=1}^{2}g_k^i\left(X_k^i\right)X_k^i-\gamma^i x_3^i \tag{7}$$

After having examined the basic model, we can now explore the strategic issues involved in the choice of networks by examining the subgame perfect equilibrium of two-stage networking game specified above. In order to solve this duopoly equilibrium, we start with the second stage. In this stage, firms simultaneously choose their output vectors to maximize profits, taking the route structure of each firm (θ^A, θ^B) as given. The Cournot equilibrium is characterized by first-order conditions,

$\pi^i_i\,(x^A, x^B\,;\,\theta^i) = 0$

and second order conditions, that is the 3 x 3 Hessian matrices $\pi^i_{kl} \equiv (\partial^2\pi^i/\partial x^i_k\partial x^i_l)$ are negative define, i = A, B. Regularity conditions are imposed so that the equilibrium exists and is stable. The comparative static effects of the network variable θ^i on the equilibrium outputs, denoted $x^A\,(\theta^A, \theta^B)$ and $x^B(\theta^A, \theta^B)$, are derived in proposition 1.

Proposition 1. Switching from linear network to a hub-spoke network does not increase firm i's marginal cost in the connecting market. Then,

$$\frac{\partial x^i\left(\theta^A,\theta^B\right)}{\partial\theta^i}>0,\ \frac{\partial x^j\left(\theta^A,\theta^B\right)}{\partial\theta^i}<0 \tag{8}$$

Proposition 1 gives a strong result; switching from a linear to a hub-spoke network will increase the carrier's own outputs, while simultaneously decreasing its rival's outputs, in all three markets. The sufficient condition for this result, that the network switch does not increase the carrier's marginal cost in the connecting market, will hold if the traffic density effect of hubbing is sufficiently strong. The intuition associated with this result is as follows. With the network effect an infinitesimal hubbing raises marginal profitability of local outputs by lowering marginal cost of production and improving quality of service hence raising marginal revenue. This, together with the condition that the network switch does not lower marginal profitability of connecting output, allows the carrier to commit to greater outputs in all three markets. Since the firm's outputs are strategic substitutes in each market, such a commitment would induce a contraction in the rival's outputs.

Network structures influence the subsequent market share rivalry among firms, which in turn can affect their overall profitability. The strategic interaction among firms in selecting their network type takes place in the first stage. Taking the second-stage equilibrium outputs into account, firm i's profit denoted ϕ^i can be written as

$$\phi^i(\theta^A, \theta^B) = \pi^i(x^A(\theta^A, \theta^B), x^B(\theta^A, \theta^B); \theta^i). \tag{9}$$

The network equilibrium arises when each firm chooses its profit-maximizing network, taking the network of the other as given at the equilibrium value. The following result gives a sufficient condition for choosing a hub-spoke network in a duopoly.

Proposition 2. Switching from a linear network to a hub-spoke network does not increase the firm's total cost and its marginal cost in the connecting market. Then the firm will use a hub-spoke network rather than a linear network.

$$\frac{\partial \phi^i}{\partial \theta^i} = \sum_{k=1}^{3} \frac{\partial \pi^i}{\partial x_k^i}\frac{\partial x_k^i}{\partial \theta^i} + \sum_{k=1}^{3} \frac{\partial \pi^i}{\partial x_k^j}\frac{\partial x_k^j}{\partial \theta^i} + \frac{\partial \pi^i}{\partial \theta^i} \tag{10}$$

$$= \left[\sum_{k=1}^{3} \frac{\partial \pi^i}{\partial x_k^j}\frac{\partial x_k^j}{\partial \theta^i}\right] + \left[C^{iL} - C^{iH}\right]$$

If switching from a linear to a hub-spoke network does not increase i's total cost, then the second bracketed term in (9) is non-negative. Further, since $\partial\pi^i / \partial x^j_k = x^i_k \, (\partial d^i_k / \partial x^j_k)$ is negative by (3), the summation in (9) involving x^j is strictly positive by proposition1. This establishes that $\partial\phi^i/\partial\theta^i > 0$. This proposition shows that hubbing can be used as both an offensive and a defensive strategy in airline network rivalry. It improves a firm's profit, compared with linear routing, when the rival chooses a linear network and it defends the firm when the rival engages in hubbing. In effect, under the specified conditions, hubbing is the firm's dominant strategy.

Proposition 3. Switching from a linear network to a hub-spoke network does not increase the firm's marginal cost in the connecting market. Then switching from a linear to a hub-spoke network will reduce its rival's profit.

Proof.

$$\frac{\partial \phi^j}{\partial \theta^i} = \sum_{k=1}^{3} \frac{\partial \pi^j}{\partial x^i_k} \frac{\partial x^i_k}{\partial \theta^i} \tag{11}$$

Since $\partial\pi^j / \partial x^i_k$ is negative by (3), it follows using proposition 1, that $\partial\phi^j/\partial\theta^i < 0$.

This result has important implications for entry deterrence. Suppose that a firm A has an exogenously given opportunity to choose its network structure prior to the entry and network decision of a potential entrant, firm B, and that there exists a sunk cost associated with an entry into a city-pair market. Then proposition 3 suggests that for certain ranges of entry cost a possible entry by the rival will be pre-empted if the incumbent chooses hub-spoke routing. In other words, an incumbent firm can use hub-spoke networks as a device to deter potential entry and will do so if the incumbent is better off with hubbing and no entry than with hubbing and entry.

The foregoing analysis suggests that in today's highly competitive airline markets, a linear route system is vulnerable to attack from rival firms, whereas a hub-spoke network is more defensible against entry. Dominant carriers at their hubs can channel traffic from a large number of cities onto a particular spoke segment. An entrant to the segment would be unable to access this traffic and as a result would be confined to a small market share. The small market share could result in a failure for the entrant if its post-entry profit is less than the sunk entry cost; in these cases such entry would be unprofitable ex ante. Hendricks et al. (1997) offer an explanation for why regional carriers may not survive in hub-spoke networks. According to their study it is the complementarities associated with a hub-spoke network that can deter regional carriers from entering. The reason is that the hub operator can credibly threaten to maintain its presence in a spoke market even when it suffers losses in that market due to competition. As a result, regional carriers that do not have a cost advantage are forced to exit and entry is deterred.

5.4 Dominated Airports and Market Power Considerations

In order to raise traffic densities, an airline has an incentive to create a large HS network serving many endpoints cities. In doing so, the carrier may end up controlling most of the traffic at the hub airport, leading to a dominated hub.

Table 5.2 Dominated Hub Airports

Hub	Hub Carriers (seat share)	Passengers (total) (million)
Chicago	United (47%), American (38%)	70,3
Houston	Continental (80%)	28,7
Dallas	American (70%), Delta (20%)	56,9
Atlanta	Delta (80%)	67,8
Denver	United (71%)	35

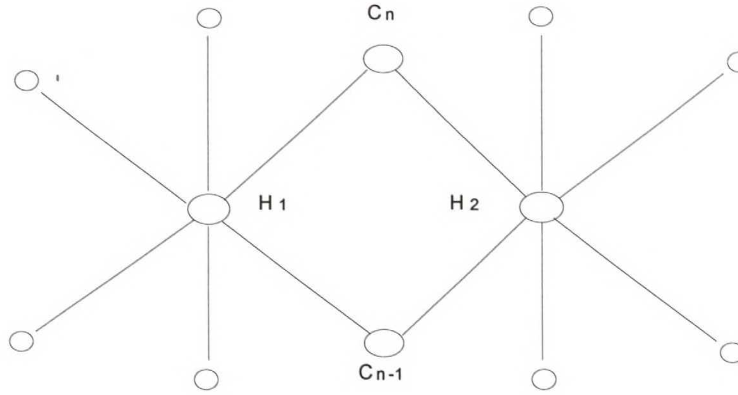
Source: Levere 1998

Deregulation in USA has led to the emergence of a number of dominated hubs, as shown in Table 5.2. It is interesting to note that in the cases of Houston and Atlanta, the dominant carriers control even 80 per cent of the airport's traffic.

Although in Europe there have not been yet any significant studies concerning dominated hubs, Berechman & Wit (1996) have studied which major European airport is most likely to attract additional service and thereby to become the main gateway hub. Principal results from the analysis show that, given air travel demand patterns, airline cost and production structure, aircraft type and airport charges and capacity, London Heathrow stands the best change of becoming the dominant European gateway hub, followed by Brussels.

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 5.6, which shows that the dominant carrier at hub H1 must compete for traffic between cities Cn and Cn-1 with another carrier operating its own HS network out of hub H2. This interhub competition keeps connecting fares low despite the dominant carrier's market power over local traffic at the hub.

Figure 5.6 Interhub Competition



The emergency 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 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 the same 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. (Brueckner et al. 1997)

5.5 The Effect of Hub Dominance on Fares

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 traveling 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. 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.

In economic theory price discrimination is held to be taking place when a producer charges different prices for different units of the same commodity, for reasons not to be associated with differences in the costs of supply. Discrimination is being exercised whenever prices differ more than costs. When price-cost margins vary some customers are being discriminated against. In most cases of discrimination the greater influence is exerted, not by cost differentials, but by differences in demand elasticity. On the inverse elasticity rule, optimal pricing requires the firm to charge more where elasticity is low and less where it is high. A firm that is seeking to maximize profits sets price (P) at the point at which the marginal revenue (MR) earned from the last unit sold is equal to the marginal cost (MC) incurred in producing that unit. It is further shown that MR is a function of price-elasticity of demand (E_p) via the relation:

$MR = P\ (1+1/E_p)$ when,

$E_p = dQ/dP \times P/Q < 0$ where Q denotes the number of units sold.

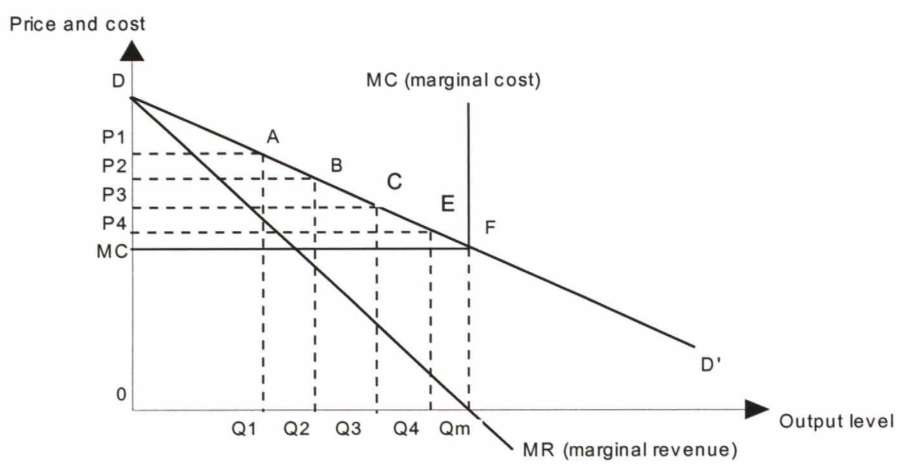
Thus maximum profit requires that:

$MC = P + P/E_p$ or $(P\text{-}MC)/P = -1/E_p$

The expression on the left-hand side is the proportionate price-cost margin, and profit maximization requires this margin to be higher where demand is inelastic and lower where it is elastic. The price-inelastic passengers are often called business travelers whereas the price-elastic passengers are called tourist travelers. The price-inelastic i.e. business travelers tend not to be able to book their flight very far in advance, need fast and ready access to a seat on the flight of their choice, want the flexibility to alter reservations at short notice, are generally subject to strict limitations on the time they can stay away at their destinations and in some cases place a high value on the status afforded by traveling in relative luxury. The price-elastic i.e. pleasure travelers on the contrary are prepared to subordinate any preferences they might have so far as booking, seat access, reservations, length of stay and status are concerned to the benefit of being able to travel at lower fares. Differences between elastic and inelastic travelers in these respects are often rather wide and present airlines with good opportunities to segment the overall market by reason for travel and to use this as the basis for price discrimination.

The main cause of variation in the fare structure is discrimination based in differences in willingness to pay which varies between passengers because of differences in 'consumer surplus'. Consumer surplus refers to the difference between what a passenger is prepared to pay for the service and what he or she actually does pay when the fares is set by the airline. In a conventional price-and-cost against output diagram (see Figure 5.7), points along the demand curve show what passengers are prepared to pay and their consumer surplus is represented by the area between the demand schedule DD' and the appropriate price line. The airline may set its fully flexible fare for economy class to maximize profits at P_1, where MC = MR. At this price the number of seats sold is Q_1 leaving Q_m - Q_1 seats unsold. If the MC of an extra passenger is constant up to the full capacity of the flight Q_m then the airline may seek to sell the remaining seats and increase its load factor by reducing fares selectively, selling some at P_2, some at P_3 and so on.

Figure 5.7 Price Discrimination and Consumer Surplus



Source: Hanlon 1996

Different passengers enter the market at different fare levels. Those who are able to book a long way in advance, but have relatively low willingness to pay may be charged P_4 and if the airline has any seats remaining on the day of departure it may sell these off as standby tickets at MC. By discriminating between passengers the objective of the airline is to expropriate as much as possible of what would otherwise be passenger consumer surplus if all seats were sold at MC.

While many studies find that airport dominance raises fares, supporting this idea, Berry et al. (1996) provide more detailed evidence by showing that business passengers value access to a large network more highly than leisure travelers. As a result, formation of a large network allows the airline to raise its business fares substantially at hub city. Since these fares are high to start with, a given percentage increase provides a substantial boost to profit. Focusing on data from 1985-1993, the model of Berry et al. shows travelers choosing from among 230 000 combinations of itinerary, fare and carrier in as many as 17 000 markets. Each fare represents a different market, a route connecting two cities and departure time.

The model captures this labyrinthine system and the buying behavior it breeds. It sorts customers into two groups; business and tourist, comparing the purchasing behavior of both in choosing myriad products within the same market. The estimates of the study show that a hubbing airline's ability to raise prices at its hub is not universal, but rather is focused on tickets that appeal to relatively price-inelastic consumers, i.e. business travelers. Berry et al. find that hub airlines do not find it profitable to raise prices much to non-business travelers. Thus, business travelers' higher willingness to pay for flying a hub-airline coupled with their price inelastic demands, provides hub airlines with the ability to offer higher priced products to which business travelers will self-select. Tourists using a dominant hub carrier paid anywhere from 1-5 percent above passengers whose flights were booked with non-hub carriers. Business travelers flying hub carriers, however, paid nearly 20 percent more than their counterparts using non-hub carriers. The problem with previous studies, according to study by Berry et al., is that they implied that all travelers who use a hub carrier are paying considerably higher prices and what they found was that only the business travelers are paying premiums.

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 alliance. It is possible to collect flight miles when flying with any of the carriers in the same alliance. Because of the greater value of their free-travel benefits the dominant airline can charge higher prices to the travelers of a hub airport 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, usually operated with other carriers in the same alliance. (Bruekcner et al. 1997)

6 INCREASING CONCENTRATION

The phenomenon that has occurred since deregulation in the U.S. airline industry is the market concentration and alliances are the expression of that development. Although the purpose of deregulation was to increase competition and to remove restrictions on routes and fares. The evolution in concentration in the U.S. has been studied extensively. Instead in Europe the impacts of the deregulation on market concentration has not yet been studied because of the short time that has been elapsed since the major reforms were introduced.

6.1 Market Concentration Measures

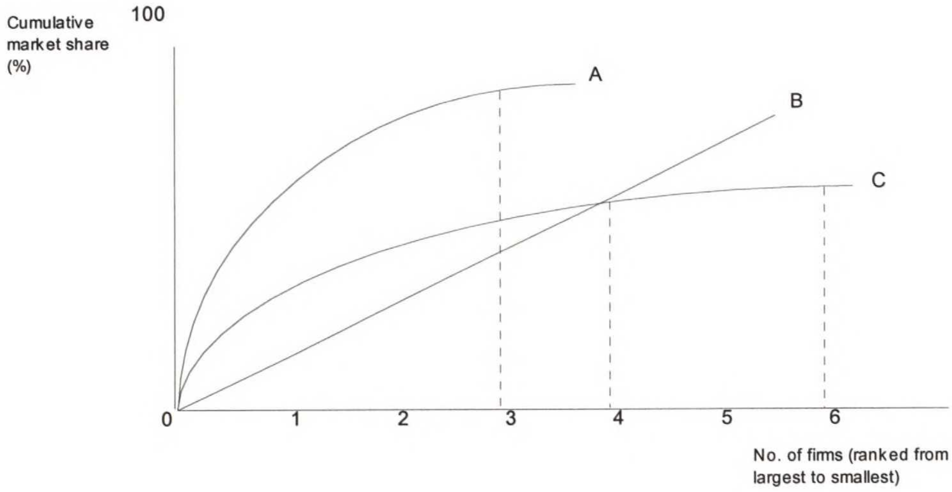
Market concentration means the extent to which the individual market is dominated by its largest sellers. It can be measured in a number of different ways. Two principal measures are the *n*-firm concentration ratio (Cr_n) and the Hirschman-Herfindahl Index (HHI). We can start by examining the concentration ratio first. The CR_n is calculated as the sum of the market shares of the n largest firms, where *n* is chosen fairly arbitrarily. For example, in the diagram 6.1 below. Reading off the vertical axis on which market shares are cumulated. The CR_n is a popular measure because of its limited data requirements, all it needs being the total market sales and sales made by the *n* largest firms. The drawbacks are, that it does only consider the largest firms and takes no account of disparities in firm sizes. The greater the number of firms and the more uniform they are in size, the greater the degree of competition likely to be present. There may be many firms, but the largest two firms may have 90 per cent of the market's sales. This market power makes these two firms more like oligopolists. Thus even though a large number of firms may make the market seem highly competitive, this could be deceiving.

$CR_3 = 90\%$ in market A

$CR_4 = 60\%$ in market B

$CR_5 = 70\%$ in market C

Figure 6.1 Concentration Ratio



$$CR_n = \sum_{i=i}^{n} S_i$$

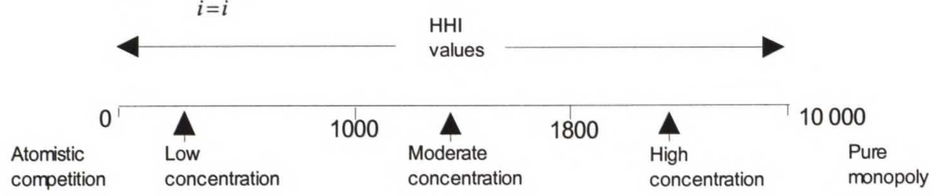
$$where\ S_i = \%\ market\ share\ of\ i^{th}\ firm$$

Source: Hanlon 1996

A measure of market concentration should ideally capture both these elements, the total number of firms and their size distribution. These are the advantages of the HHI measure, which equals the sum of the squared market shares of each firm in the industry. The process of squaring gives greater weight to the larger firms, and the more unequal the size distribution of firms, the higher the value of the HHI. The HHI is zero when there is a very large number of equal-sized firms and it reaches its maximum value of 10 000 under pure monopoly as shown in Figure 6.2.

Figure 6.2 Hirschman-Herfindahl Index

$$HHI = \sum_{i=i}^{n} S_i^2$$



Source: Hanlon 1996

Brueckner & Spiller (1994) have studied the major changes in the structure of the U.S. airline industry after deregulation. They find that deregulation has changed the extent of concentration within the industry, both at the national level and the route level. After an initial decline, industry concentration has increased at the national level over the postderegulation period. Second, despite the rising national concentration of the industry, competition in the average city-pair market has grown over the period. Table 6.1 shows the percentage of the national market controlled by the four largest firms as well as the "effective number of competitors".

Table 6.1 Concentration at the National Level

	1978	1984	1988
Four-firm concentration ratio	0,591	0,536	0,591
Effective number of competitors *	8,85	11,13	8,03

* Equal to the inverse of the Herfindahl index

Source: Brueckner & Spiller 1994

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. (Brueckner et al. 1997) To see the connection between network growth and rising concentration, observe that firms with large, heavily traveled networks are able to achieve low costs per passenger. The results of study by Brueckner & Spiller (1994) show that in 1985, the marginal cost of carrying an extra passenger in a high-density network was 13-25 per cent below the cost in a medium- or-low-density network, giving the high-density carrier a distinct competitive advantage. Thus, these empirical results provide a cost-based rationale for the industry consolidation that has occurred since 1985. Also Leahy (1994) has examined changes in concentration in the airline industry. The results of his study suggest that economies of density has been important determinant of changes in concentration since deregulation. Addition to that, Leahy found that length of individual flights and the beginning value of the HHI are also relevant determinants when observing changes in concentration.

On the contrary to the decreasing competition at the national level, competition at the level of individual city-pair markets has risen since deregulation. This means, that even though the industry contains fewer firms at the national level, the number of carriers competing in individual markets grew.

Table 6.2 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	2,3

* Equal to the inverse of the Herfindahl index
** Markets ranked by 1988 origin and destination traffic

Source: Brueckner & Spiller 1994

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 6.2 above. 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. (Brueckner et al. 1997)

When airlines are given greater freedom, both to fly where and when they want and to determine the levels and structure of their fares, competition has in many places become more intense. At the same time there is a market tendency for the industry to become more highly concentrated in the hands of just a few large airlines or consortia of airlines bound together by alliances. It is explained that the trend towards increased concentration can have both positive and negative effects. On the positive side efficiency may be enhanced when large airlines are able to reap certain economies not available to the same extent to smaller carriers; but on the negative side, there is the fear of large carriers becoming so dominant that they can exert considerable market power. For example, in the United States the six major airlines are planning of cooperation, which would be sort of culmination of alliance development. If this process is going to work out, it means that 80 per cent of world's biggest airtraffic markets would be divided between only three big alliances. This kind of development is alarming and it has started to raise questions about the need of reregulation.

REFERENCES

Balfour, John & Bischoff Frere Cholmeley 1997. *EC/US Airline Alliances - Who Regulates?* Meeting paper, 6.2.-7.2.1997, European Air Transport Services and Airports, London.

Berechman, Joseph & de Wit, Jaap 1996. An Analysis of the Effects of European Aviation Deregulation on an Airline's Network Structure and Choice of a Primary West European Hub Airport. *Journal of Transport Economics and Policy.* Vol. 30, No. 3, pp. 251-274.

Berry, Steven & Carnall, Michael & Spiller, Pablo 1996. *Airline Hubs: Costs, Markups and the Implications of Customer Heterogeneity.* Working Paper 5561, National Bureau of Economic Research, Cambridge.

Brueckner, Jan K. & Goebel, Anton & Niskanen, Esko 1997. *Airline Deregulation: The American Experience and Prospects for Europe.* VATT - Discussion Papers No. 149 . Government Institute for Economic Research, Helsinki.

Brueckner, Jan K. & Spiller, Pablo T. 1994. Economies of Traffic Density in the Deregulated Airline Industry. *The Journal of Law and Economics.* Vol. XXXVII, No. 2, pp. 379-415.

BusinessWorld. *Convergence of Competition law and policy in the field of Air Transport with Special Reference to the EU-US Context.* International Chamber of Commerce, Commission on Air Transport 1997. Document No.310/468 Rev.2. [http://www.iccwbo.org/cust/html/310468e.htm] 9.2.1998

Carlton, Dennis W. & Perloff, Jeffrey M. 1994. *Modern Industrial Organization*. Second Edition. Harper Collins College Publishers, New York.

Caves, Douglas W. & Christensen, Laurits R. & Tretheway, Michael W. 1984. Economies of Density Versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ. *The Rand Journal of Economics.* Vol.15, No. 4, pp.471-489.

The Comité des Sages, European Commission 1994. *Expanding Horizons.* European Commission Directorate-General of Transport, Brussels.

Doganis, Rigas 1991. *Flying off Course.* Second edition. Routledge, New York.

The Economist 1997. Let the Market Take Off . *The Economist.* January 18th, pp. 82.

European Commission 1996, European Community. *XXVIth Report on competition policy.* EU, Brussels.

Gallacher, J. 1997. Partners for now. *Airline Business*, vol.13, no.6, pp. 26-27.

GAO (United States General Accounting Office) 1995. *International Aviation: Airline Alliances Produce Benefits, but Effect on Competition is Uncertain.* GAO, Washington, D.C.

GRA, Incorporated (Gellman Research Associates,Inc.) 1994. *A Study of International Airline Code Sharing.* Gellman Research Associates Inc., Jenkintown, Philadelphia.

Hanlon, Pat 1996. *Global Airlines: Competition in a Transnational Industry.* Butterworth-Heinemann Ltd, Oxford.

Hendricks, Ken & Piccione, Michele & Tan, Guofu 1997. Entry and Exit in Hub-Spoke Networks. *RAND Journal of Economics*. Vol. 28, No. 2, pp. 291-303.

IATA (International Air Transport Association) 1994. *The Economic Benefits Of Air Transport - 1994 data*. IATA, Geneva.

IATA (International Air Transport Association) 1994. *North American Traffic Forecasts 1980-2010*. IATA Concultancy Services, Geneva.

IATA (International Air Transport Association) 1996. *European Traffic Forecasts 1980-2010*. 1996 edition. IATA Concultancy Services, Geneva.

IATA (International Air Transport Association) 1997. *Annual Report 1997*. IATA Public Relations Dept., Geneva.

The Industry Commission 1997. *The Economic Impact of International Airline Alliances*. Australian Government Publishing Service, Canberra. [http://www.indcom.gov.au/mediarel/aircraft.html] 30.11.1997

Keeler, J.P. & Formby, J.P. 1994. Cost Economies and Consolidation in the U.S. Airline Industry. *International Journal of Transport Economics*. Vol. XXI, No. 1, pp. 21-45.

Leahy, A.S 1994. Concentration in the U.S. Airline Industry. *International Journal of Transport Economics*. Vol. XXI, No. 2, pp. 209-215.

Levere, Jane 1998. Hub Wars. *Airline Business*. October, pp. 53-57.

Lindquist, J. 1996. Marriages made in heaven? *The Avmark Aviation Economist*, January/February 1996.

Lynch Robert Porter 1993. *Business Alliances Guide: The hidden competitive weapon.* John Wiley & Sons, Inc. New York.

Morrison, S.A. & Winston, C. 1986. *The Economic Effects of Airline Deregulation.* Brookings, Washington D.C.

Oum, Tae Hoon & Park, Jong-Hun & Zhang, Anming 1996. The Effects of Airline Codesharing Agreements on Firm Conduct and International Air Fares. *Journal of Transport Economics and Policy.* Vol. 30, No. 2, pp. 187-202.

Oum, Tae Hoon & Zhang, Anming & Zhang, Yimin 1995. Airline Network Rivalry. *Canadian Journal of Economics.* Vol. XXVIII, No. 4a, pp. 836-857.

Raivio, J. 1998. Lentoliikenteen kilpailu siirtyy muutaman jättimäisen allianssin käsiin. *Helsingin Sanomat*, 25. January, pp. E4.

Skapinker, Michael 1998. Flights in Formation. *Financial Times.* January 10th.

Small, K & Rosen, H. 1981. Applied Welfare Economics With Discrete Choice Models. *Econometrica.* 49(1981), pp. 105-1390.

Sparaco, Pierre 1997. New Carrier Relationships Create Legal Complexities in Europe. *Aviation Week & Space Technology*, November 17, pp. 54-91.

Staniland, Martin 1996. *Open Skies - Fewer Planes? Public Policy and Corporate Strategy in EU-US Aviation Relations.* European Policy Paper Series. University of Pittsburgh, Center For West European Studies.
[http://www.pitt.edu/~wesnews/epp/planems.htm] 21.1.1998

Stockman, Ian 1996. Ramping up the Price. *Airline Business.* November, pp. 53-58.

Yossef, W. & Hansen, M. 1994. *Consequences of Strategic Alliances Between International Airlines: The Case of Swissair and SAS.* Transportation Research 28A, pp. 415-431.

INTERVIEWS

Hurtola Pekka, vanhempi hallitus sihteeri. Liikenneministeriö, Helsinki 23.1.1998

Koponen Outi, suunnittelupäällikkö. Finnair Oyj, Helsinki 03.2.1998

Passi Leena, tutkija. Kilpailuvirasto, Helsinki 12.1.1998

Although the names of the interviewees do not appear in the text, their assistance have been of great importance to the study.