THE UNO AVIATION MONOGRAPH SERIES

UNOAI Report 98-8

The Conference Proceedings of the 1998 Air Transport Research Group (ATRG) of the WCTR Society

Volume 3

Editors
Tae H. Oum
Brent D. Bowen

December 1998

UNO
Aviation Institute
University of Nebraska at Omaha
Omaha, NE 68182-0508

Topic Area: A4.

8th World Conference on Transport Research
Anthwerp, Belgium
12-17 July 1998

51-03
C42
385468
p.20

IMPLICATIONS OF COMPETITION IN THE EUROPEAN AIRLINE MARKET

Juan Carlos Martín
Gustavo Nombela
Manuel Romero

Department of Applied Economical Analysis
University of Las Palmas de Gran Canaria
Spain

This paper presents some preliminary results of Strategic Organisation and Regulation in Transport (SORT-IT), project no. ST-95-SC-402 funded by the European Commission. We wish to thank Kenneth Button for some helpful suggestions.

1. INTRODUCTION

Market performance is not only a function of demand structure and cost configuration of the companies which serve a transport service. It also depends on the existence of different types of barriers obstructing free competence between operators. Some of them come directly from the regulation conditions imposed by the governments but others do not depend of this, although can have been generated as a consequence of past regulation policies and that remain even after deregulated process. So, for example, one company can have a dominant position in a deregulated coach market if it keeps the monopoly access to an important coach station. The existence of this type of barriers can be affecting the generalised cost carried by the users, and therefore the level of welfare they obtained.

Among the different state member we can find barriers which obstruct the free competence in the transport sector. In the rail market we can find many different types of barriers. In this line, one of main which is common in many state members is the existence of a regulation which obstruct the free entry of new operators in the market. Other barriers are different electric system or track gauge system. In the air sector again the regulation obstruct in some countries the free entry of new operators. Another important barrier is the limited capacity of airports, this affects directly to the slot distribution, which can determine even the presence of one carrier in some airports.

The regulatory intervention has been a common place in the transport policies, but the situation has changed in the last years. Kay and Thompson (1991) identify three groups of circumstances under which market failures and inappropriate regulatory regimes can be categorised:

Competitive solutions may not exist in circumstances where there is natural monopoly and high-sunk costs of market entry.

Competitive solutions may exist but may not be achieved because incumbent firms may be able to successfully deter market entry, encourage the exit, merger or acquiescence of competitors and establish a dominant position.

Competitive solutions may exist and be achieved but their outcome may not be considered desirable: this outcome is particularly true when externalities exist (environmental problems), where information asymmetries between market participants are important, where social concerns are considered relevant, or where a more efficient arrangement of production cannot be sustained in the face of market entry.

It is important to appreciate the difference between unavoidable failures that follow directly from the economic characteristics of the sector being regulated and escapable failures, which follow from the adoption of inappropriate methods of regulation. Salop (1979) distinguish between 'innocent' barriers to entry, those that arise when incumbent pursue policies that maximise short-run profits and the 'strategic' barriers, those activities that subtract from short-run profitability but that are undertaken in the belief that they will deter entrants and add to profitability in the longer term.

Market liberalisation and the withdrawal of the state have features of virtually every transport market over the past fifteen years (Button and Keeler, 1993).The various effects of these changes on transport has been much studied. Nevertheless, the understanding of the nature of what are often termed "deregulation" - with no or very little regulation of fares, entry and exit - is still remarkably limited despite the considerable experience we have. The deregulation of express coaching in 1980 (UK) and the deregulation of aviation in the United States in 1978 initially resulted in substantial fare reductions associated with new market entry. However, these initial effects of deregulation in reducing prices have been followed by increasing concentration in the industry and prices have risen steadily in real terms and are now substantially above the levels to which they fell in the inmediate aftermath of deregulation.

Does this mean that deregulation has failed? We are sure this is not the case. However, we can argue that some competing hypothesis are not really fulfilled (Jaffer and Thompson, 1986), imperfect forms of competition and contestability (for example, Morrison and Winston, 1987), oligopolistic structures (Kahn, 1988) or the existence of an empty core problem (Button, 1996). It is interesting to remark that the intellectual position is not stable and some of the leading figures who initially suggested that aviation may naturally be contestable have subsequently changed their minds. "We now believe that transportation by trucks, barges and even buses may be more highly contestable than passenger air transport" (Baumol and Willig, 1986).

The concepts of competition and contestability are fundamental in the study of the debate of the regulatory reform in transport policy. Baumol (1982) argued that contestability is a generalisation of the concept of perfect competition. Perfect contestability is not a description of reality but a benchmark for desirable industrial organisation.

Barret (1992) describes two general types of barriers that we can find in a deregulated air market obstructing the free competence between operators: structural and strategic barriers:

> As structural barriers: Hub airport dominance: this means the control of major airports by incumbent carriers and restricting the access for new entrants, ground handling monopolies, the control on computer reservations systems
>
> As strategic barriers: Airlines with large networks can offer selectively lower fares in response to new market entry on contested routes and raise fares on uncontested. Also incumbent airlines can response to new entrants with collusive policies in prices and/or capacity.

2. THE DEREGULATION POLICY IN THE US AND EUROPE

The regulation of civil aviation in many countries sought to control entry and exit of carriers on routes and to set the prices, frequencies and capacity offered by the carriers. This system became to be highly criticised as inflexible and incredible protective of those they were supposed to control. This was the cause that the regulation came under scrutiny among airlines and authorities. The changing of the system was possible depending on the market to be reformed. In Europe the difficulties were harder because of the subsidiary principle, by which the need of agreement between the different governments of the State Members is obliged.

The pressure for deregulation was very high in the seventies, and the Aviation Deregulation Act became law in 1978. The law suppressed the majority of the controls that Civil Aviation Board had, as well it prepared for the abolition of the CAB in 1985.

Restriction on route access was relaxed. It had a dramatic increase on the number of carriers providing scheduled services. The overall concentration fell, but the concentration index was not too different to the previous period because the new entrant were small operators. Some new operators were existing intrastate operators, but often the entrants were new in the industry.

The availability of discount fares was permitted. In this case the benefits of deregulation to consumers consisted not just in a reduction of fares to existing travellers, but the promotion of a big increase in traffic figures. Traffic rose dramatically and in 1985 the increase was about 50 per cent respect to 1978, in spite of the existence of a stable period in the recession time. Due to the increased availability of discount fares, more than 80% of passengers in 1984 were travelling on discount tickets.

Many of the favourable outcomes of deregulation predicted by observers of the airline industry have in fact been realised, and there exists a consensus to agree that the benefits of deregulation have overweighed the costs. Although the designers of deregulation and economists in general appeared to have predicted accurately the direction of welfare change, they did not predict accurately the present structure of the airline industry. Deregulation has enabled airlines to reduce operating costs, increase load factors, increase the availability of discount tickets, and increase the number of flights, all without a serious decline in service to small communities or safety. However, the hub-and-spoke method of delivery, complex pricing strategies, the dominance of many airports by single carriers, the control of computer reservation systems, and the growth of devices that induce loyalty in the agents, such as frequent flyer programs and travel agent commission overrides, did not exist in the regulated airline industry and were not predicted in advance. This fact demonstrates that the regulation tapered the possible behaviour of the industry.

The deregulation of civil aviation in the US since 1978 was taken place in different circumstances from those of Europe, but some remarkable lessons can be learnt about the potential gains of a single market, as well as some of the costs incurred in the absence of the former regulation. Anyway it is well known that some lessons of American deregulation are quite far away from European case. Same country, same market confers a relative superior position to the potential gains in the American case in terms of revenue passengers. A great quantity of US domestic traffic falls into the category "visiting friends and relatives". This evidence can be seen as part of cultural barriers that limit the progress of the development of the single market inside EU. Average journeys lengths are shorter, which means that take-off and landing costs represent a larger proportion of total costs and competition from other modes (such as high speed trains) is much greater than in the American market.

The pre-deregulation situation in Europe was a result of international bilateral agreements between some Member States within EU and even with countries outside EU, specially with US. These agreements determined both the procedures for setting fares and the maximum share of capacity that can be offered by airlines of each country. Bilateral agreements permitted carriers to prepare a joint schedule and to pool revenue. In the majority of occasions, agreements prevent route entry by any company except flag carriers. The need for both governments to agree any change in the accord has reduced possible global reforms inside Europe. Proposals for reform of the industry were being made in a situation similar to the American deregulation, but this approach was firstly opposed by most European governments with self-interests in their own flag carriers. So it was necessary to introduce more flexibility and competition into the existing system without ruining it.

The following liberalisation agreements (see Button and Swann, 1991) were set out in the market before its complete deregulation. These have been like trials preceding to the full deregulation and some airlines have used these experiences to operate in freer conditions. In the sample that we have extracted it is observed that UK comprise the major agreements achieved.

Table 1. Bilateral agreements. Pre-deregulation era in the aviation market in Europe

Countries	Year	Terms of agreement
UK and Netherlands	1984	permitting free, route access and capacity.
UK and Netherlands	1985	airlines were left to set their own fare.
UK and FR of Germany	1984	Permitting free route access, fares and capacity.
UK and Luxembourg	1985	permitting free, route access, fares and capacity.
UK and Belgium	1985	permitting free, route access, fares and capacity.
UK and Switzerland	1985	permitting free, route access and capacity
UK and Italy	1986	permitting free, route access and capacity
France and Germany.	1986	permitting free, route access and capacity

The European liberalisation process has been divided in three packages. It permitted to achieve carriers to set freely fares and to operate in any European country since April of 1997. The Commission proceeded carefully because of the opposition of national governments that took actions protecting their national flag carriers in spite of the observed differences in their performance. Most countries do not allow competition with the flag carrier on domestic trunk or international routes. In effect, except in the UK, the Netherlands and the Republic of Ireland, no flag carrier had in the past faced competition on any route.

The first package adopted on December of 1987 came into force on 1 January 1988. It included some measures to introduce some kind of flexibility in the aviation sector and established the basis to obtain a gradual liberalisation. Airlines may offer fares with discounts between 65 and 90 percent of economy class for tickets with certain conditions and another type of discounted fares between 45 and 65% of economy class (Council Decision 601/87). A second Council Decision 602/87 which permitted a capacity share for one airline until 60% in 1990 between two countries leaving the equitable market share. Also a second operator can enter into the market under certain limits of traffic. As a consequence of this package some smaller airlines enter some important intra-Community routes (CAA 1993). This reform also pointed to focus on ownership. Some countries introduced or increased the share of private capital in their flag carriers.

The second package came into force on June 1990, included measures on market access on intra-community scheduled routes and capacity share. Third and fourth freedoms rights are applied all around European Community and fifth freedom with a maximum of 50% of the capacity of the plane and for flights with origin or destination in the country of the company. The package incorporated some important promises for the future. Member States have legally bound themselves to full liberalisation by January 1st 1993. One of the principal measures to ensure was the ending of capacity-sharing arrangements between governments, which hitherto guaranteed some share of traffic on particular routes independently of the efficiency of the companies. On fares, the package includes more flexible conditions allowing to decrease the deep discount fares without the requirement of government approval. The lower limit was reduced to 30 per cent of the reference economy fare, coming from the 45 per cent established in the first package.

Finally the third package entered into force in January 1st 1993. It is formed by three acts which constituted the completion of the deregulation in the aviation European market. Airlines are free to set fares and stated conditions in which are going to be used. Until April 1st 1997 carriers could make cabotage into one state member up to 50% of capacity, unrestricted from that date. The intention of this measure is to open the national markets, allowing EU airlines to compete freely in a single market.

Perhaps the main barriers that exist yet to competition in the European market come from the lack of slots at airports and which obstructs the enter of new competitors in same conditions of the incumbents that hold them. This affects also to airports where is possible to achieve slots in off-peak demand periods. The Commission therefore felt that rules are needed on the allocation of slots to ensure that liberalisation is not undermined by barriers against new entrants at congested airports. The actual regulation based on a Council Regulation CEEC no 95/93 permit the existence of 'grand father rights' which is the method that dominate in the European airports establishes also the principle 'use it or lose it'.

So the slot control in the airports is now a way to limit competition and to establish a stronger position of incumbents in the market. The effectiveness of the deregulation policy depend on the measures that the Commission could design in order to regulate this airport service. It is absolutely necessary that these kind of facilities which are limited would be allocated in the way most conducive to competition.

Increasing capacity airports to solve this problem does not seem to be the correct way, because this requires heavy financial investment with environmental consequences too, and other problem can arise as traffic control. Land is a scarce commodity that imposes very restringent limitations. The slot provision presents the problem of peak demand. The airport landing charges do not contribute to efficiency since they do not reflect the costs of delays to other aircraft (costs of congestion). It has been estimated by the International Air Transport Association (IATA) that the delays for more than 15 minutes due to congestion are going to increase in figures well above the 25 per cent of the total flights in the next years.

In Europe, the Civil Aviation Authority in UK proposed a mechanism such that incumbent airlines with a set of slots above a threshold would be required to surrender a proportion to the scheduling committee which would permit the entry of new carriers to operate in the market (see, European Commission, 1997). In the United States the Federal Aviation Administration suggested as alternative to create a market based on the willingness to pay of the carriers to acquire the slot. These systems include differential pricing and auctioning of slots rather than the present system of allocating them.

As consequence of the liberalisation process, the European companies have adopted different strategies in order to achieve a good position in the market.

One of these has been alliances and mergers. Fundamentally seeking increase the network operated exploiting so the economies of density derived. With this strategy also cost reductions are produced because of joint services. Also, this is the way to entry in markets where the slot allocation made no possible to enter in the market.

So as example, British Airways acquired 49,9% of TAT, 10% of DAN Air and 100% of British Caledonian in 19[illegible]. Air France acquired 100% of Inter, UTA or Swissair that acquired 49,5% of SABENA in 1995. Or the agreements between Lufthansa and SAS on route network, schedules, ticketing frequent flyer program and cargo services.

The pricing strategies has been very important in this process, implementing a wider range of discount fares to try to share the demand as much as possible fixing higher discounts for more elastic segments. This may have could been used as an instrument of competition between different operators in one market.

Finally this process has required that companies adjusted their cost structures overall flag carriers trying to increase in efficiency in order to compete with potential or existing in fact new entrants in the market. In fact, it has been observed important labour reduction in many carriers during this period.

3. DATA DESCRIPTION.

Given the present deregulation of the airline industry, in which an ample pace of reform has been introduced, a logical question to answer is how this reform has affected the overall performance of the industry. In order to do this, we are going to focus our attention in how global demand and prices have responded to this new state, trying to discuss how competition, airport dominance, existence of alternative flights and other variables affect prices and demand.

This section describes the selection of the sample to analyse the effects of the airline deregulation process inside the European Union. In the existing literature the observation that is commonly employed is the route. Average fares, or percentile yields are employed whenever is possible, global demand, geo-economic variables representing the characteristics of the origin and end-point cities of the route are among the most common variables appearing in models. The principal inconvenient of this kind of studies is that they do not take into account the big heterogeneity that can exist in the firms characteristics, such as size of companies, airport control in cities of the routes, costs of airlines, among others. For this reason, in addition to the route level unit of observation, observations to route-airline level are considered in this paper.

We have employed a cross section of the year 1994. This year was the last one, for which we could obtain the principal variables which our model incorporate. We pretend to maintain the sample as a basis for future studies that can be fulfilled using multiple years of data conforming a panel.

In the selection of the sample, a three stage method was carried out. The criterion employed in the first stage was used to decide which airports (origins and end-points of the routes) are going to be selected. The sample includes 33 European cities (more airports are involved, because some cities like London, Paris or Milan have more than one airport). The selection of the cities was done by the importance of the airports, selecting airports of all the countries of the European Union and Switzerland. Once the cities were selected, the second stage focused the attention in the selection of the routes. With 33 cities 528 pairs can be formed, but for some pairs a direct flight did not exist in the year 1994. We selected the largest routes for each city, and once a pair was selected, the symmetric pair was automatically is included. Some routes were also included at random and in this way we formed a sample of 414 routes. Finally in the third stage we selected the airlines that at least had a flight per week in the route, forming a sample of 919 route-airline observations. Basically, two cross sections can be used in the modelling work, one at route level and other at route-airline level.

The differences between the two groups of observations are that in the route level we use variables representing global concepts, like demand, average business class fare, average high discounted fare and average tourist class fare. In the observations at route-airline level, the individual demand of each firm and the differentiated fares if exist are used. To capture the effects of actual competition, we include a dummy variable if the concentration of the two firms is below a threshold figure. A more detailed of the description of the variables can be observed in the models.

The variables were obtained from different sources. The principal sources that we used are: Traffic by Flight Stage (1994) (publication from International Civil Aviation Organisation) and OAG World Airline Guide (March, 1994) (a monthly publication with detailed information on prices and timetable). Data as distance, number of operators, were obtained from the ICAO publication Traffic by Flight Stage. Flight frequency, and the number of indirect alternatives to any route and the fare in this case was obtained from the ABC publications.

4. EMPIRICAL FINDINGS ON DEMAND AND PRICE RESPONSES.

In this section we present and discuss the results of our analysis of the effects of concentration of the market, airport concentration and other factors on demand and air fares.

On the demand side, the study requires a number of input assumptions. In some sense, we can separate these assumptions in two different groups: external issues like population, income, transport substitutes, etceteras; and internal issues like price, travel time, waiting time, size of the plane, etceteras. Both components, of course, are important in the estimation of the demand. It is usual to distinguish travel by the purpose for which it is made.

There are two principal reasons to do that, first of both, there are some situations in which institutions play an important role of certain kind of trips. To begin with this, think of the business market segment. Business fares are mostly paid, not by the travellers themselves, but by their companies, for whom expenditure on air travel is a pre-tax price, meanwhile excursion fares are usually paid personally by holiday travellers out of post-tax incomes. This was one of the reasons why airlines originally takes businessmen as a market segment being in some kind indifferent to pay higher fares. Secondly, the sensitivity to changes in prices and time varies according to the purpose of the trip. Some kind of travel are more mandatory, for example travel by work, than others that can be more discretionary, travelling for holidays. For the same person, the time and space alternative sets are quite different.

Air industry is almost an ideal place to study concentration and prices. There are many works touching the topic of concentration and prices relationship with respect to the air industry. Keeler (1990) was one of the pioneers. Our contribution to the subject follows many patterns of the preceding papers. We try to explain how the concentration measures raise prices and competition lower them. Our work supports these conclusions as other studies that have been reviewed, but we focus our attention in the different contribution of the concentration of the route, concentration of the airport and possible competition of the indirect routes. This last item is very important because we firmly believe that there is likely to be an increasing interest on hubbing as European airlines must adopt strategic policies to compete effectively in the Single European Market.

Hubbing offers an airline a great number of competitive advantages in the new situation of the transport industry in Europe. The most obvious one is the dramatic increasing of the new markets that can be served for a fixed volume of output. Doganis and Dennis (1989) present the following result: an airline with a network based on hubbing with one hundred spokes can offer service in over five thousand city-pair markets.

Factors influencing demand are divided into geo-economic and service-related, the former belong to the group of external variables, although airlines may be still able to control them by selecting alternative markets to serve, the latter are internal to a given market.

The most common geo-economic variables used in the studies of demand are population, income and distance. It can be seen in the literature review that there is no a uniform result relating to the population effect. In some cases, as in Fridström and Thune-Larsen (1989) and Fleming and Ghobrial (1994), population elasticities are above one. In others, as in Rendaraju and Thamizh-Arasan (1992) population elasticity is under one. Anyway, this is not a surprising result because many different characteristics of the demand and population can exist in the studies analysed. Some differences can also exist in the specifications of the equations to estimate these results.

Something similar occurs when income elasticities are observed but in this case as Jorge-Calderon (1995) suggested there exist some differences on income sensitiveness across the different type of travellers. Business travellers tend to be less income sensitive than holidays travellers, reflecting also their different price elasticities.

The distance is a variable that has a large influence in the determination of the demand. As Russon and Hollingshead (1989) pointed out, the distance has two important effects with different signs. If the distance increases the air travel begins to be more convenient, due to the higher speed, comfort and safety, but at the same time absolute figures for traffic decreases as more distant cities have a lower degree of social and economic interaction due among other things to the increased transport costs. It appears a well known problem of circularity. Hypothetically there will exist a limit figure d, for which shorter distances, the convenience effect will outweigh the distance decay, making traffic increase; and for longer distances the whole argument will be reversed. Taking these two effects into account, Russon (1990) found that the traffic maximising distance for non-stop air trips made by jets was about 360 miles.

The need to cross sea water has a critical influence about the competitiveness of other modes of transport in terms of travel times and the possibilities of the service establishment. A current and major example of how new developments can overcome some geographical constraints and alter the modal split of the traffic between two cities is the opening of the Channel Tunnel. The introduction of high speed rail services through the tunnel has affected seriously the modal balance in London-Paris and London-Brussels routes.

The service-related factors include some quality attributes of the service and the price. You can use a large number of variables to measure the quality of the utility, as frequency, size of the aircraft, travel of time, number of stops, connecting time, etceteras. Note that except for some constraints as a limited fleet size, indivisibilities in aircraft size, congestion of some airports, political interference in the objectives function of the firms, the airlines would set these attributes where the marginal cost of each equals the corresponding marginal revenue.

The frequency is perhaps the most important factor determining the service quality in air travel. A higher number of flights allows the company to be near the average passenger desires of travel departures. The frequency has been used as a predatory device. Incumbent airlines have been sometimes accused of responding to the entry of a rival company by starting frequency wars, flooding the route with such extra capacity that the new entrant find too difficult maintaining this new route profitable. Incumbents try to undermine a competitor's service by the bracketing scheduling departures' practice. It consists on the scheduling departures to take off just before and just after the rival's flights, Hanlon (1994).

Some recent studies have used aircraft size as a quality of service variable, the common hypothesis being that larger aircraft are preferred to smaller ones. It could be expected a priori that the sensitivity to aircraft size varies with the distance, for as the time spent on the plane increases the size can be used as a proxy of the comfort utility enjoyed by the passenger. The results obtained by the works of Ghobrial (1993) and Pickrell (1984) confirm the hypothesis. Both authors present significant and positive effects of the size of the plane on demand.

Travel time can be split in three different components. The first of the three is the time spent getting to the airport and from the destination airport to the final destination. This one is known as the service access time. The time in the airport, checking in and waiting to board, and the time in the destination airport to pick up the luggage is considered as the handling time. And finally the time in the plane that it is measured as the time that elapses from boarding the plane to disembarking in the final destination. The service access time varies with the airport location and airport facilities relative to the initial origin-destination cities. This time is linked with the concept of intermodality in the airports because it is highly affected for the mode of transport affordable to go to/from the airports. In the case of the airports connected by railways, the access time is inferior because of the level of congestion of the roads in the majority of the cities of the more developed countries. The handling time depends on the service levels of the airports and this is usually out of the control of the companies. The on-board time is a function of the speed of the plane. Nowadays most of the jet planes travel at similar speeds and these are used uniformly across the different routes. There are some exceptions with the supersonic planes, but these are more appropriate for long-haul routes where the advantages of their superior speed compensate their higher average cost of the service.

Fare is the most important variable in determining the total cost of a trip. Just as other variables studied, the sensitivity of demand to fare changes will vary across passenger types. Price elasticity will depend on the income level of the passenger as well as on the journey purpose. Higher income passengers and those travelling on business who normally obtain their tickets paid for, will generally conform the segment of the market more inelastic.

Airlines have responded to these different needs through marketing different fare-types. Anyone who has bought an airline ticket will know it is possible to pay any one of a large number of prices to fly a given route. Fares vary with time of travel, whether peak or off-peak; with class of travel reflecting different on-board services, whether first, business or economy; with the length of stay at the destination reflecting in some cases the flexibility of the fare, whether it exceeds a certain number of days or weeks, or whether it includes a Saturday night; and with a whole host of other factors such as size of the travelling group and the ages of any children involved.

Limits on reservation procedures are also very common, including requests to make full payment at time of reservation, and establishing a minimum period for purchase prior to the departure known as advanced purchase restrictions. There are also common penalties when you want to alter the departure time or the date after the purchase. Further, more focused restrictions can be imposed through the possible candidates to purchase a determined fare, the eligibility conditions. These can vary from ranging in the age, the social status, the peripheral regions. You can include in this group, special fares for children, or for people below/above a given age, or for students, or retired people, or citizens of a determined peripheral region.

The multiplicity of fare categories is often so great that for scheduled service by a particular airline on a particular route there can be more than 50 separate fares published in airline tariff manuals. The variation between fares can be such that it is possible for two passengers sitting next to each other on the same flight, and enjoying exactly the same quality of in-flight service, to find that one is paying very much more than the other, in some extremes cases even more than double.

Fare elasticities can also be expected to vary with the distance. In this respect, there is an obvious phenomena that has been cited many times, at shorter distances air transport experience tougher competition from other modes of transport, so that as distance increase fare elasticities could be expected to decrease. But even in comparisons of routes of the same or similar length, some considerable differences exist. Within Europe, when comparisons are drawn between cities in terms of the lowest available levels of business or standard economy fares, a clear distinction emerges between certain 'high fare' and some 'low fare' cities. Frankfurt, Brussels, Paris and Amsterdam belong to the first group. Levels on routes to other cities in Europe can be as much as 50 to 75 % above the levels from low fare cities like Athens, London, Lisbon and Dublin, Hanlon (1994). Some quite dramatic comparisons can be drawn when the variation in fares for individual routes is combined with the variation in fares across routes. This is specially true when you compare European fare level with the comparable ones in North America. We can see in the work of Guasch and Spiller (1996), the following table that contain the data for explaining the anterior argument.

Table 2. Fare comparison of similar US and European routes in 1995

Miles	Route	Fare ($)
187	Boston-New York	106
216	Washington-New York	157
211	London-Paris	214
302	Houston-New Orleans	89
311	Copenhagen-Oslo	296
853	Dallas-Minneapolis	425
887	Frankfurt-Madrid	727

4.1 Specification of the demand and price equation.

In the demand equations we are going to analyse the effects of market concentration, concentration of the airports, distance, income, fare, existence of sea in the route, the competition of the indirect routes and the frequency on the existing demand in the air traffic of the European Union. They are based in a cross-section estimation of the carriers' performance in the year 1994. In some aspects this study is very similar to those described in the previous section, except that we include the effects of competition and in some sense airport hub domination.

We would like to use similar previous fare variables used in Borenstein (1989). He employed the 20^{th} percentile, the 50^{th} percentile (median), and the 80^{th} percentile fare paid to the observed carrier on the observed route, but till this moment the state of the art in Europe is completely different and we do not know which are the prices that user really pay. For this reason we use the prices quite similar to those employed for him, but of course we limit our attention at the published fares. The interpretation of the coefficients of many variables is quite complicated, as it was seen in the previous section. We know that a single variable can have influence in more than one of the variables that are being used in the models. In these cases we know that some of the hypothesis of the linear model are not fulfilled, the independence of the error and the dependent variables, producing biased estimations. The unit of observation is an airline route pair in the year 1994.

In the price equation we are going to analyse how the European deregulation process have affected to market efficiency.

The data set includes observation of the companies that had more than one flight per week. The variables describing market structure are the observed airline's share of the passengers transported in the market and the CR2 index, constructed from the shares of all carriers in the market. The structure of the market at the origin-point airports is studied by the airline's shares of passenger enplanements and the Herfindahl index of these shares. The structure of the possible competition of the indirect routes is measured by the number of flights that exist in each route that have one stop.

In the equation estimated coefficents are measured in logarithmic form and for this reason can be interpreted as an elasticity.

We define here the variables and the expected effects are discussed:

- Paxperf is the number of passengers carried by the company in the route. This variable is expected to have a negative sign when it was used as endogenous in the price equation.
- Distance is the non-stop kilometres from one endpoint of the route to the other. One would expect distance to have a positive effect in the demand, but this effect is not clear. Also in the price equation this variable is expected with a positive sign.
- Gdp is the gross domestic product of the origin city measured in ratios expressing the relative position respect to the average of the European Union. The basic source for this variable is Eurostat's 1994 "Yearbook of Regional Statistics". The per capita income

measure chosen is the average for the region in which the airport is located. The expected sign is positive both for the demand and price equation.

- Compet is the dummy variable that reflects the existing competition. It is one if the share of the two main operators is less than 0.98. The expected sign for the demand equation is positive because we can assume that the demand is higher when there exist more competitive forces in the market. In the price equation the expected sign is the opposite expecteing that a higher level of competition in a route may cut fares an increase efficiency.

- Herfae is the Herfindahl index of the market shares of the emplanements of the start-point airport. The expected sign is negative in the demand equation and positive in the price equation, because of the possible monopoly abuse of the companies that control an airport, limiting the competition of the possible entrants in the market.

- Fare is measured by two different variables that yield two different estimations in the price model, the highest discounted fare in the route and the economic fare in the route. In the demand equation it has been used the tourist class as a return fare. The expected signs in the demand equations are negative because they measure the price elasticities.

- Fc is the number of flights with one stop that exist in the observed route. We can expect a negative sign because this is a substitute alternative to fly between two cities.

- Sea is a dummy variable taking the value of one whenever the route over-flies the sea. We can expect a positive sign because the existence of sea limits the alternative modes to be competitive.

- Freq is the number of direct flights that exist in the observed route for each of the companies. We can expect a positive sign.

4.2 Demand equation.

The demand equation estimated with the entire sample of individual observations is the following:

$$\log paxperf = \underset{18.5}{7.018} + \underset{9.70}{0.664}\log dist + \underset{1.06}{0.058}\log gpd + \underset{6.68}{0.212}\log compet$$
$$- \underset{-2.02}{0.0091}\log Herfae - \underset{-5.503}{0.576}\log fare + \underset{-3.41}{0.002}Fc + \underset{0.51}{0.016}Sea + \underset{77.9}{1.028}Freq$$

The explained variation is well above of 85% in the estimation. The income variable and the existence of sea have not a significant impact and sometimes do not present the expected signs. This result is not too rare because we are using in this estimation the sample of individual firms.

The result of distance indicates that the positive impact in terms of travel time differentials with other modes of transportation outweighs the negative impact of a lessen interaction between the cities. The impacts of the variables measuring competition and the dominance of the airport present the expected signs and they indicate quite clearly that concentration of the routes and the airport's dominance imply less possibilities to new entrants to capture some market share. These results confirm the hypothesis of the existence of barriers to entry in the European market. How this issues must be tackled on ought to be a principal task of the officials of the EU transport agency.

The number of flights with one stop present the expected sign and is quite significant. This result confirms the idea that once an increasing emphasis on hubbing in the air market in Europe will be developed for some companies, these emerging indirect routes could effectively compete with the direct-route market. So, in spite the net effect is not too big, we anticipate that this result can be considered as the starting point to observe a dramatic change in the network of the companies. It is time to re-route the point-to-point services through a centrally located hub in the nowadays-European network.

The fare estimated parameters (price elasticities) are too consistent with the expectations. We have obtained a range for price elasticity of –0.23,-0.57. The elasticity of the individual demand obtained for each firm over the week frequency is positive and quite uniform around one in the three estimations. The figure is the highest elasticity in absolute values and it is in the line of the previous estimations of Jorge-Calderon (1995), Agarwall and Talley (1985), Talley and Schwarz-Miller (1988) and Ippolito (1981). They obtained frequency elasticities of 0.94, 1, 0.98 and 0.86, respectively.

In fact, demand seems to present unitary frequency elasticity because of the results that we have obtained from the Wald test for each of the three models. In the specification of this parameter we cannot conclude that this was different from one with the 95% confidence level. This result is concordant with the hypothesis presented in the work of Agarwall and Talley.

Now we can understand better the strategic behaviour that some companies seem to perform in order to reduce the danger of potential entrants. We have mentioned before the bracketing strategy of the departure's timetable. It is certainly true that this result can be interpreted in other direction, which consists in giving more importance to the market characteristics of the sample with high income travellers being served with more frequent flights.

The following equation presents the results of the same structural equation using the route as the unit of observation. In this case, we concentrate our attention with a different approach. We are not interested in knowing the individual effects to the level of the behaviour of the company, but the overall performance of the demand in the air industry in the European market.

$$\log paxperf = \underset{1.6.33}{6.603} + \underset{9.01}{0.689}\log dist + \underset{0.16}{0.009}\log gpd + \underset{2.487}{0.094}\log compet$$
$$- \underset{-1.43}{0.069}\log Herfae - \underset{-4.46}{0.544}\log fare + \underset{-0.046}{0.000}Fc + \underset{0.277}{0.009}Sea + \underset{63.8}{1.116}Freq$$

We lose the significant impact of the dominance of the airport and the non-direct routes. These effects are lost in the overall demand of the route because it can be seen as a strategic behaviour of the companies. However, the rest of the effects are very similar to those ones described in the beforehand models. Some clear patterns have been obtained: the unitary frequency elasticity; the positive effect of competition on demand; sea crossing do not generate demand; demand is price inelastic with respect to every fares, this provides further support for the hypothesis of relatively high business or high composition of traffic; the most discounted fares present values of price elasticity in absolute values lesser than the economic class.

Frequency is an important attribute of the service quality and product differentiation. When planning the service on a given market, Pollack (1982) determined that the airlines face a trade-off between frequency and plane size. Pickrell (1984) and Ghobrial (1993) have reported that the demand is more elastic with respect to frequency than to plane size. Moreover, they coincide in that frequency share is associated with more than a linear relation with the market share. For this reason airlines want to move for obtaining a competitive advantage through high frequency service, this strategy is very suitable in particular with the high yield segment, composed of passengers with a high value of time. This variable would acquire more importance in the developing of the hubbing operations.

The net effect of hubbing on demand will depend on the extent to which greater travelling times and the inconvenience of having to wait in a connected intermediate airport are outweighed by the increase in flight frequency. Anyway, in the deregulation of the U.S. market Fleming (1991), Ivy (1993) and Philips (1987) show that the increase hubbing cause a dramatic increase of concentration at the larger airports. Empirically, other authors as Berry (1990), Borenstein (1991) and Ghobrial and Soliman (1992) detect a significant effect of hub dominance on the relative market share in the routes touching that airport. Borenstein (1991) showed that the travellers will prefer to use an airline which they have used before. For this reason, airlines awareness in the region is a factor to take into account, specially in the Europe's air industry, where some national barriers have been identified.

There is a mixed effect when we speak about the hub dominance. For one side, Morrison and Winston (1990) have showed that hub airlines present a higher propensity to enter in new markets. Following this argument one can suggest that strong presence provides the airlines with a good base form which to enter in new markets. However, this can be seen from the incumbent's perspective, as Strassman (1990) found that both the number of endpoints cities at both ends of the route and the number of incumbents with a hub at one or both endpoints limit in a significant way the prospects of new entrants. So, it seems that hubbing, through product differentiation and probably sunk costs, is a good defence against entry.

4.3 Price equation

In this section we analyse how deregulation process in the European air market has affected to market efficiency. With this objective we have estimated a price function using as endogenous variable the fare. We have estimated two models for tourist fare and a model where the endogenous variable is the higher discount offered in the route. As exogenous variable we have included in the functional form the variable distance, gross domestic product of the origin city, the Herfindal index in the route, the dummy variable compet and the variable Fc used in the former model of demand. The results of the estimation for each fare are the following:

$$\log y = \underset{0.11}{1.678} + \underset{0.01}{0.583}\log dist + \underset{0.01}{0.307}\log gpd - \underset{0.009}{0.048}\log compet +$$
$$\underset{0.013}{0.101}\log Herfae - \underset{0.003}{0.024}\log paxperf - \underset{0.0001}{0.0006}\,Fc$$

$$\log desc = \underset{0.23}{2.29} + \underset{0.02}{0.461}\log dist + \underset{0.02}{0.173}\log gpd - \underset{0.01}{0.053}\log compet +$$
$$+\underset{0.02}{0.058}\log Herfae - \underset{0.008}{0.033}\log paxperf - \underset{0.0002}{0.0007}\,Fc - \underset{0.012}{0.032}\,ntarpax$$

As we could observe from data for a same route there were important differences in the fare level depending on the origin country. The positive sign of the variable *gpd* can be reflecting this effect. This can be combined with the effects of the negative sign for the variable *compet*, reflecting that the level of fare also depend on the level competence in the origin market.

The value of the coefficient for the variable *compet* in the second model permits to conclude that when competition is introduced in the air market the response of carriers cutting prices is more important in the high discount fare class, than in tourist or business class because the former correspond to more elastic market segment.

The variable *Herfae* presents a positive sign which is implying that airport control are affecting to the level of the fare in the route. So the slot control in the origin airport appears as a barrier that actually the liberalisation process has not eliminated.

Finally as we can observe by the sign of the variable *Fc* the existence of indirect routes substitute determine the level determine the level of the fare in the direct routes too.

Both the variable distance (*dist*) and demand (*paxperf*) presents the positive and negative sign respectively as was expected initially.

As was observed initially from data the level of fare could change for a same route depending on the origin country, so we can find that for a same pair origin-destine there is important diferences in prices depending on origin where you bought the ticket. This can be explained by two factors: on one hand by the level of income of the origin country in the way that countries with high gross domestic output can present higher level of fares. But also the level of competition in the origin market may be influencing this effect but with the contrary sign, so routes with a high level of competition in the origin market present lower levels of fare.

The level of concentration and consequently the level of deregulation in one route affect directly and significantly to fare paid by users. So an important barrier that actually remain in the European air market is the slot possession by incumbent carriers. This permit in many cases to have a dominant position in the market even that represent a real barrier for new entrants in the market. This can be limiting the complete development of the measures carried on by the Commission to liberalise the market.

Market deregulation has greater effect on the fare of more elastic segments of demand. So the deregulation measures has developed that carriers offers a high range of discount fare in order to obtain a greater consumer surplus of the demand but that indirectly generate more efficient situation in the market.

5. CONCLUSIONS

As a consequence of limiting the possibility of new entrants in the market because of the privileges that flag incumbent airlines enjoy in their airports of their influence, there is only a 6% of the continental routes that can be considered as competitive according to our own definition of competition in the estimation of the models, and this one it is not too stringent. In this case we have shown that the demand is below the levels it could be achieved by the likely monopoly power that it is exerted by the pairs of national flag carriers. In particular, it is necessary to develop a transparent policy trying to establish the common-user access rights to the principal airport of the E.U.

The analysis shows that we have more goals to get by introducing initiatives to obtain more competition in the routes and at the same time it is clear that competition is possible and desirable to some extent. The airport at Brussels has the same landing capacity as London's Heathrow, but only half of the traffic. Its refusal to create new landing slots, on ground that there is not enough room, it is a serious barrier to entry that can be exploited by Sabena, Belgium's national airline. In addition, some new entrants airlines complain that in many cases the handling labour of the airports favour the national carrier. An E.U. directive 96/67/CE form 1996 intended to prevent monopolies in airport services, but this directive in some experts' opinions has been watered down by the member states to the point where it will achieve virtually nothing. Swifter justice and a stronger directive on airport services would do much to help new entrants. To give newcomers a chance to break into new routes, the Commission needs to create a proper market in slots.

In spite of the previous paragraphs we cannot minimise the real advantages and benefits that European citizens enjoy in these years after deregulation, and that the real change is going to be observed in the future after this year 1997, when we can say that the complete market deregulation is fulfilled. The paper that can be played by the companies that till now have developed their strategic movements to the competitive segment of regional and charter services can be higher that the expectations that have been said by some analysts. Cross entry and the signature of contracts with some companies can change the nowadays' network, and some low-priced services can emerge from this new situation.

6. References.

Agarwall, V and Talley, W.K. (1985). "T: ; demand for international ai: passenger service provided by U.S. carriers". International J: urnal of Transport Economic :. 12(1). 63-70

Berry, S.T. (1990). "Airport presence a: product differentiation" American Economic Review. 80(2). 394-399.

Borenstein, S (1989). "Hubs and high fares: dominance and market power in the U.S. airline industry". Rand Journal of Economics. 20(3). 344-365.

Borenstein, S. (1991). "The dominant fi :m advantage in multiprodu:t industries: evidence from the U.S. airlines". Quarterly Journa: of Economics. 106. 1237-1266.

Directiva 96/67/CE del Consejo de 15 de octubre de 1996. Acceso :. mercado de asistencia en tierra en los aeropuertos de la comunidad.

Doganis, R and Dennis, N (1989). "Lessons in hubbing". Airline B :siness. March. 42-47.

Fleming, D. K. (1991). "Competitio.a in the U.S. airline industry". Transportation Quarterly. 45(2). 181-210

Fleming, D.K. and Ghobrial, A (1994)."An analysis of the determinants of regional air travel demand". Transportation plannin ; and technology. 18(1). 37-44.

Fridstrom, L and Thune-Larsen, H (1989). "An econometric :r travel demand model for the entire conventional network: the case of Norway". Trar sportation Research. 23(B). (3).231-233.

Ghobrial, A (1993). " A model to estimate the demanc between U.S. and foreign gateways". International Journal of Tr nsport Economics. 20 3). 271-283.

Ghobrial, A. and Soliman, S.Y. (19 2). "An assessment c: some factors influencing the competitive strategies of airlines in .omestic markets". International Journal of Transport Economics. 19(3). 247-258.

Guasch, J.L. and Spiller, P.T. (199:). Managing the regu:atory process: design, concepts, issues and The Latin America and C:ribbean story. The World Bank

Hanlon, P (1994). Pricing policie: in International Ai: Transport: The implications of discriminatory and predatory be:aviour for airline competition. The University of Birmingham.

Ippolito, R.A. (1981). "Estimati: g airline demand with quality of service variables". Journal of Transport Economics a: : Policy. 15(1). 7-1:.

Ivy, R.L. (1993). "Variations in hub service in the U.S. domestic air transport industry". Journal of Transport Geography. :(4). 211-218.

Jorge-Calderon, J.D. (1995). Prospects for entry and competition in the deregulated E.U. Airline Industry. Leeds. (unpublished PHD thesis)

Keeler, T. (1980). "the revolution in Airline Regulation". In L.W. Weiss and M. Klass (eds). Case Studies in Regulation. Boston

Morrison, S.A. and Winston, C. (1990). "The dynamics of airline pricing and competition". American Economic Review. 80(2). 389-393.

Philips, L.T. (1987). "Air carrier activity at major hub airports and changing interline practices in the United States' airline industry". Transportation Research. 21A(3). 215-221

Pickrell, D.H. (1984). The demand for short-haul air service. In Meyer, J.R. and Oster, Jr, C.V. (eds) Deregulation and the New Airline Entrepreneurs. MIT Press. Cambridge, Massachusetts. 22-49

Pollack, M (1982). "Airline route-frequency planning: some design trade-offs". Transportation Research. 16A(2). 149-159.

Rendaraju, V.R. and Thamizh-Arasan, V (1992). "Modelling for air travel demand". Journal of Transportation Engineering. 118(3). 371-380.

Russon, M.G. (1990). "Iterative nonlinear estimation of air passsengers flow sensitivity to political boundaries and a complex function of distance". Logistics and Transportation Review. 26 (4). 323-337.

Russon, M.G. and Hollingshead, C.A. (1989). "Aircraft size as a quality of service variable in a short-haul market". International Journal of Transport Economics. 16(3). 297-311

Strassman, D.L. (1990). "Potential competition in the deregulated airlines". Review of Economics and Statistics. 72(4). 696-702

Talley, W.K. and Schwarz-Miller, A (1988). "The demand for air services provided by air passenger-cargo carriers in a deregulated environment". International Journal of Transport Economics. 15(2). 159-168.

"A4" Airports and Aviation (SIG)

52-03
385669

PRIORITIES AND STRATEGY FOR LIBERALISATION IN THE EUROPEAN AIRLINES.

Sophie Briand, Diplome d'etudes specialisees en transport international, Sorbonne University, Paris, France, and

Dr Alex Kelvin, Scheme Tutor for International MBA and MA in International Business, Department of Management and Business Information Systems, Business School, University of Hertfordshire, Hertford SG138QF, United Kingdom.

1 INTRODUCTION.

This paper assesses how successfully liberalisation increases contestablity in the European air transportation. Impacts on the customers and the airlines are examined. Examination is based on the theories of contestability, strategic partnerships and networks, and personal research. Liberalisation is the removal of statutory barriers and opening up of the sector for competition. In the course of the 1980s-1990s, over 80 countries were involved in deregulation. The wider aspects of macroeconomic reforms such as liberalisation of trade and prices and demand management are beyond the framework of this paper.

Today the national public companies still provide an important share of air transport service in Europe. A number of them continue to get subsidies. For the last ten years or so, liberalisation pressures have been increasing in air transport. Several arguments are commonly used in favour of regulation. The natural monopoly can be presented as most beneficial. For this reason, in many western countries quasi-monopolies are common in utilities. Theoretically, regulation aims at accommodating the public interest by reducing social costs of provision and upgrading benefits from externalities. Protective regulation still manifests itself in pricing, restrictions on entry/exit, capacity, public investment, access to funding and taxes. But contestable pressures encourage cost-benefit considerations and improve the match between the volume and the scope of demand and supply. The administration becomes leaner, simpler and more flexible. Besides, the inflationary pressures were attributed to the rigid framework of regulation. Well, what are the best ways to liberalise air transport in Europe?

Out of 1,012 airports which are accessible to the international traffic, Europe has 380, i.e. 37.5%. Ten busiest routes in the world include Paris-London in the first place and Amsterdam-London in the fifth place. The London-New York route ranks second in the world. Six states are most active in the EEC: the United Kingdom, France, Germany, Netherlands, Italy and Spain. They account for about 25% of the world total passenger traffic against approximately 31% in 1978. The United Kingdom, with 10.2%, holds the second place closely following the United States (10.3%). Japan accounts for 6%. Between 1978 and 1988, the passenger traffic increased by 4.8% per year in Europe, while it grew by 7% in the world. In North America it grew by 8.4%, and in the Asian-Pacific area it grew by 10.4%.

In 1993, in terms of freight traffic, Germany, France, the United Kingdom, Netherlands, Italy, Belgium and Spain accounted for one third of the world turnover compared to 37.5% in 1978. On the basis of total turnover, i.e. passengers and traffic, three European airlines are among ten largest in the world, i.e. Lufthansa, British Airways and Air France. But only British Airways and Swissair appear reasonably profitable. In 1991 at the bottom of the recession, there were almost no openings of new routes in Europe, while about fifty new routes were considered common in the previous years. At the same time, many secondary routes were closed, and orders in new planes fell by 43%.

By the year 2,000 the number of annual flights in Europe will increase from 3.6 million to seven million. The express courier service is expanding by 15% per year. Certain

European cities are becoming hubs for multinationals, e.g. Brussels for DHL, Cologne for TNT and UPS. But the annual losses associated with congestion were estimated at £34 million per year for British Airways, DEM200 million for Lufthansa, and FFR200 million for Air France. For the mid-1990s, the annual cost of congestion in Europe was estimated at approximately $5 billion. It appears that this can double by the year 2,000. The majority of flights in Europe use the space of at least three states. For example, the Amsterdam-Nice flight uses the national spaces of Netherlands, Belgium, Luxembourg, France and Switzerland. Noise reduction lengthen the routings to avoid flying over the towns at low altitudes. Price competition is tough between 40 competing carriers in North Atlantic which represents about one third of the turnover for the European airlines. The American airlines benefit from air deregulation in the USA and service about 70% of traffic with France.

Concentration and globalisation are on the way. The European carriers have to compete with the American giants and the aggressive Asian companies. The Asian fleet is most modern, and staff is two or three times cheaper. Co-operation agreements are popular in order to limit expenses. Atlas Group in 1968 and KSSU Group in 1969 were among the first to develop strategic partnerships. Later British Airways, Alitalia, KLM, Sabena and Swissair collectively created the electronic booking system Galileo. In 1987 Air France, Lufthansa, Iberia and SAS established the Amadeus system. The European companies make joint purchases, exchange aircraft or jet engines, co-ordinate pilot training and exchange managers. The European companies need partnerships because they cannot develop global airline systems on their own.

The European Commission of Civil Aviation decided that a single centre of air traffic control would be installed in Brussels. A better radar cover and harmonisation between 42 control centres would result. The USA covers the territory twice as large as Europe using only 20 control centres. In 1993, several relevant programmes were launched. One of them was ARTAS (ATC radar tracker and server) for which Thomson-CFS had to design a single radar system in order to replace about 30 existing systems. IBM and IDE (Interactive Development Environments) had to provide a software platform common to all European air control systems. There was a project of the European compulsory incidents analysis system, similar to the American Aviation Safety Reporting System.

Official goals can be imposed on the public airlines from outside. However the unofficial objective of corporate survival tends to remain dominant. Many of the airlines survive due to preferential access to capital funding, tax exemptions, restrictive national regulations or bilateral agreements. For a long time, the European public airlines have resisted the advent of effective competition using their influence on political and legislative decision making. The European customers do not seem to care if they are transported by foreign companies, provided the prices and the quality of service improve.

2 METHOD.

The aim of liberalisation is to leave the market find the prices and configuration of services, by removing controls. Several objectives are pursued:

1 to use contestability to determine costs, outputs, prices and the market structure;
2 to replicate contestability when it is insufficient;
3 to establish a set of guidelines for the European and national regulations; and
4 to assess the impact on the industry.

The analytical method is based on the theories of contestability and strategic partnerships and networks. The following working assumptions are made:

1 Competition can be promoted or contestable conditions can be created.
2 Barriers to entry and exit can be minimized.
3 Quasi-monopolies can be ended, resulting in better allocation of resources.
4 Contestability creates opportunities for innovations and dynamic efficiency.

Consumer surplus in the European air transport is lower than it could be, and consumers' wants cannot effectively guide the allocation of resources and future supply. Consequently, there is a scope for improving the range of services so that they better reflect the evolving demand. Biased pricing results in poorer services and enhanced costs. Tariffs did not appear to encourage the best use of the air transport facilities. The rates of growth in the European airports have been lower than in the of the world. Moreover, the tariffs provided suboptimal guidance for corporate investment/divestment decisions. The institutional and motivational constraints checked the diffusion of benefits from new investments. In a more contestable environment, the demand would become more elastic, and the customers could reap higher benefits. The highest mark-up is attained under quasi-monopoly. But under growing contestability, new entries are encouraged. Capacity and provision of services expand beyond the level which assures the highest unit mark-up. This is advantageous to the customers. Liberalisation increases capacity supply and diversify the range of services.

The theory of contestability provided basis for the endogenous determination of cost functions, and market structures. The market structure is considered sustainable if at the existent prices costs are covered and there exists no output-price combination for potential entrants that can yield economic profits. Entry costs represent the critical mass of minimum investment which a firm must make before it can assume operations (Ansoff, 1987).

The Sherman Act (1890) enacted anti-trust legislation. Big firms' efficiency had been rationalised by economies of scale. The role of regulation was seen as setting legal constraints on natural monopolies. The adverse effects of rivalry were emphasized in the context of predatory competition. However the perfectly competitive model is not applicable to the air transport because the important economies of scope originate from indivisible transport infrastructures which provide multiple services simultaneously. It is essential is to make entry and exit as free as possible. In diversifying the range of services, emphasis from large scale for one service shifts to multi-service partnerships and networks. Rapid advances in information technology and telecommunications help to widen choices for the customers.

The behaviour of existing firms and likely entrants is treated asymmetrically. The present firms try to meet the total demand at the existing price. The latent entrants can cover only a fraction of demand at the price. It is assumed that the existing firms do not react immediately to the new entrants offering a lower price. The shorter the reaction of the available firms, the less the opportunity of a profitable entry to succeed. Success of potential entries depends on the price after the entry.

The original dissertation (Briand 1995) covers the assumptions and mathematical formulation of identical cost functions, representative firm, static and dynamic framework of ultra-free entry, and the primacy of potential competition. It has been shown that the contestable assumptions are either too restrictive such as the absence of entry and exit barriers, or logically incoherent e.g. the non-reaction of existing firms to new entrants. Despite its imperfections, the theory plays an important role in the renewal of the market structures and provides guidelines for regulation. Contestable pressures are considered effective when the market requires little regulation.

The framework of strategic networks is complementary to contestability in finding new market configurations. The purpose of flexible strategic partnerships is to respond quickly to the accelerating change in customers' preferences, competition and technology. The concept of strategic partnerships focuses on positioning firms in the production chain so that value to the customers can become optimal (Webster, 1992).

The most significant feature of deregulated sectors is that the price differentiation increases for short distances but decreases for long distances. It seems that stronger price discrimination on short distance trips is conditioned by a finer segmentation of the customers. The important test of deregulation is whether the consumer surplus and other indicators of collective well-being improved.

3 DISCUSSION.

In October 1978 President Carter published his Airline Deregulation Act. The US experience was important for subsequent deregulation in other markets. In 1986 the European Court of Justice ruled that the Competition Articles of the Treaty of Rome should be applied to the EC air services. In December 1987 the European ministers agreed on a three-year programme of gradual liberalisation. Entry was made a little easier, with a number of airlines allowed to operate in the dense markets. A considerable freedom was granted for carriers to serve thinner routes with small aircraft. Capacity and pricing restrictions have to be eased. The airlines from one country would be able to hold up to 60% of the capacity in each city-pair market. The airlines with lower costs would be able to introduce lower fares and practice discount fares.

Finally, there have been significant moves towards competition through granting of the Fifth Freedom Opportunities. The classification of international traffic was set by the

Chicago Conference on International Civil Aviation in 1944. In five categories of traffic, the nationality of the airline counts, not the nationality of the passengers. The First Freedom grants the right to fly over another country without landing. The Second Freedom allows a technical stop in another country for refuelling or repairs. The Third Freedom gives the right to take passengers or cargo in the home country of the airline and carry them to a destination in a foreign country. The Fourth Freedom gives the right to bring passengers of a foreign origin to a destination in the home country. The Fifth Freedom means the right to collect passengers or cargo from other countries and take them to a destination that is not in the home country of the airline. Most countries grant the first two freedoms. But since the following three freedoms involve the establishment of scheduled airline services, these must be granted on the bilateral basis. The Bermuda agreement linked the Fifth Freedom to capacity. However the Fifth freedom is commonly not granted. This puts a limit on changing networks, and restricts displacing through competition.

For example, Virgin Airlines is unable to compete for Air France passengers if the United Kingdom is not part of the itinerary. The airlines should be in the position to choose hubs and experience fair competition on a route-by-route basis. The USA can permit a European carrier to conduct a service to New York via Montreal, but carriage of traffic only between Montreal and New York is not allowed. In the Second Bermuda Agreement the USA accepted a number of such services east of London. The new American approach is to remove from bilateral agreements regulation of the Fifth Freedom traffic, frequency and capacity. Airlines from one EC country were allowed to carry traffic between points in two other countries, providing not more than 30% of the up-lift consisted of locally originating traffic.

The United Kingdom, the Netherlands, Belgium and Ireland favour the open European sky. The domestic market from the Heathrow airport used to be the monopoly of British Airways. Now access to others is much easier and there are virtually no price controls. Since 1983, the UK signed a number of bilateral agreements for air services. These agreements allow open entry, intense price competition and they are almost completely free in capacity scheduling. But the Mediterranean countries prefer to carry their own and numerous foreign tourists without competition. Yet in June 1994 France was forced by Brussels to open its Orly airport to British Airways and its subsidiaries such as TAT. In addition, the most profitable Paris-Toulouse and Paris-Nice routes were given to competition. This change can have serious financial consequences since the generated surplus was used to cross-subsidize deficits on many routes with public service characteristics.

Operational costs of the European airlines are higher compared to their American and Asian rivals. The air links are considerably shorter in Europe. The number of highly profitable routes is limited. Social constraints are stronger in Europe. However in September 1992 the USA and Netherlands signed an open-sky agreement which allows their airlines to fly without restrictions in the air space of both countries. This agreement allows the USA to better control the transatlantic traffic flows. In 1994 Lufthansa signed a similar agreement and other agreements can follow. Bilateral agreements appear to be favourable to the American airlines. The American airlines have secured 19 rights over the coastal traffic in Europe. Therefore, Brussels would like to be able to negotiate by itself.

The following areas seem most important for regulation: predatory pricing, ticket conditions, financial transparency, safety, and allocation of airport slots. The predatory behaviour implies accepting a short-term loss leading to a monopolistic position. The attraction of such strategy is reduced by extending the period of loss. Besides routings and network configurations, slot allocation is critical. Airlines serving a particular route will not be competing fairly unless they have access to equivalent slots at each end of the link. The usual method of slot allocation at the European airports is based on 'grandfather rights', i.e. if an airline used a particular slot at the same time last year, it will get the slot the following year. Scheduling committees at the airports are made up of representatives of the major airlines, e.g. British Airways at Heathrow. This puts new entrants at a disadvantage. Since the slots are allocated to airlines rather than to routes, the big carriers have the flexibility to deal with competition on each specific route while the smaller airlines are unable to respond.

The airports will retain several monopoly characteristics. Baggage handling, ticketing, duty free sales, accommodation and catering are airport services. The passengers cannot leave the airport for a drink or a snack. The interests of the airport operators will not completely coincide with those of the customers or local inhabitants. Customers need to be directly represented in the decision making on running the airports. Since the airports have significant impacts on their environment, there is a need to take the inhabitants' views into account.

4 CONCLUSION.

The purpose of this paper was to outline priorities for liberalising European air transport. Although the empirical evidence from the US air industry has not fully supported all contestability assumptions, prices have fallen, networks have expanded, and the customers have benefited. More slots have been created and competition increased. Both price and quality of service appear to be better in America than in more regulated markets.

Similarly, the increased competition in the United Kingdom has improved services. Up to the 1990s, the liberalisation of air transport in Europe did not seem very effective. Protection of the incumbent public airlines appears to be detrimental to the customers and the taxpayers. But while competition is on the rise, some governments still continue subsidising their national carriers, e.g. Air France. The sheltered markets exist in quite a number of countries. They result in redistribution of consumer surplus to the providers of air services.

However, successful companies use market segmentation and positioning to match supply and demand. Under pressures of liberalisation, there is a definite move towards globalisation. With over 400 alliances worldwide, the industry is changing to meet the needs of global market. Priorities for liberalisation were outlined such as removal of restrictions on route access and capacity related to the carriers' nationality, ending national public monopolies over air transport. Private companies or partnerships appear to provide services at lower financial costs, transaction costs and social costs. The customers express preferences for widening the choice of competing companies.

In liberalised markets, the regulatory authorities need to prevent predatory pricing and price collusion, maintain high safety standards, make obligatory insurance arrangements to compensate the customers in case of airlines going bankrupt. Regulation would safeguard the fair allocation of slots. Mechanisms are needed to ensure that the customers' and environmentalists' views are adequately represented in decision-making. It is most encouraging that the customers are reaping rewards.

BIBLIOGRAPHY.

Ansoff I	1987	*Corporate Strategy*. Harmondsworth, Middlesex: Penguin Books.
Arndt J	1983	The Political Economy Paradigm: Foundation for Theory Building in Marketing. In *Journal of Marketing*, 47 (Fall), pp.44-54.
Bailey E et al	1982	Market Structures and Multiproduct Industries. *In Journal of Economic Literature,* Vol.20, September, pp.1024-1048.
Baumol W et al	1986	Contestability: Developments since the Book. In Morris D et al (eds) *Strategic Behaviour and Industrial Competition*. Oxford: Clarendon Press.
Bavoux J et al	1994	*Transports et Structuration de l'Espace dans l'Union Europeenne*. Paris: Masson.
Briand S	1995	*Assessment of Regulatory Reform in the European Airlines*. Dissertation BA in Applied Economics, Business School, University of Hertfordshire, Hertford.
Briand S and Kelvin A	1997	Strategic Alliances in Global Air Transport. Conference Paper, Annual Conference of *the British Academy of Management* London Business School, Queen Elizabeth II Conference Centre, 8-10 September, 1997.
Folliot M	1985	*Les Relations Aeriennes Inrenationales*. Editions A.Pedone.
Gialloreto L	1993	*Strategic Airline Management, the Global War Begins*. Pitman Publishing.
Gordon H	1954	The Economic Theory of a Common Property Resource: the Fishery. In *Journal of Political Economy*, 62, pp 124-142.
Hughes S	1996	*Globalisation with Reference to the Commercial Airline Industry*. Dissertation B.A. in Applied Economics, Business School, University of Herfordshire, Hertford.
Kelvin A	1995	Planning Framework of Analytical Approaches Applied to Transportation. In *Maritime Policy and Management*, Volume 22, No.2, pp. 135-153.
Kelvin A	1996	From State Monopolies towards Contestable and Sustainable Market Structures. The Case of Transport in Zaire. In *Tijdschrift Vervoerswetenschap* (Dutch Journal of Transport Science), No2, June, pp. 145-168.
Kelvin A	1997a	Impact Model of Socially Low Tariffs in River Transport. *In Annals of Public and Cooperative Economics*, 68:1,

pp. 107-128.

Kelvin A 1997b *Upgrading Private Contribution to Partnerships in View of Failure in the Public Provision.* Conference Paper, UK Academy of International Business 1997, 4-5 April, Centre of International Business, University of Leeds.

Kelvin A 1997d Closing the Gaps between Decisions, Implementation and Performance. In *Tijdschrift voor Economie en Management* (Flemish Journal of Economics and Management), Vol.XVII, 4, pp.409-423.

McLean I 1989 *Public Choice.* Oxford: Basil Blackwell.

Posner R 1975 The Social Costs of Monopoly and Regulation. *In Journal of Political Economy*, Vol.83, August, pp.803-827.

Primeaux W 1975 A Reexamination of the Monopoly Market Structure for Electric Utilities. In Phillips A (ed) *Promoting Competition in Regulated Industries.* Washington: The Brookings Institution.

Shaw S 1990 *Airline Marketing and Management.* Pitman.

Shaw S 1993 Transport, Strategy and Policy. Blackwell.

Shepherd W 1988 Entry Barriers, Contestability and Predatory Pricing. *In Revue d'Economie Industrielle*, No.46.

Schumpeter J 1934 *The Theory of Economic Development.* Cambridge, Massachusetts: Harvard University Press.

Thorelli H 1986 Networks: Between Markets and Hierarchies. *In Strategic Management Journal*, 7, pp.37-51.

Webster F 1992 The Changing Role of Marketing in the Corporation. In *Journal of Marketing*, Vol. 52, No. 4, pp.1-17.

Williamson O 1986 *Economic Organization, Markets and Policy Control.* Brighton: Wheatsheaf Books Ltd.

Xiao F and Kelvin A 1998 Strategic Blueprint to Develop Chinese Stock Market. Conference Paper, *China International Business Symposium*, The Boalong International Convention Centre, Shanghai, 27-29 May 1998.

Topic Area: A4

European Air Transport Deregulation (1986-1994): A Panel Data Approach

Ofelia Betancor

Department of Economic Analysis
Universidad de Las Palmas
(Spain)

Javier Campos

Department of Economic Analysis
Universidad de Las Palmas
(Spain)

1 INTRODUCTION

On April 1st, 1997 the formal deregulation of the airline industry within the European Union (EU) was finally completed. Since that date, any technically qualified EU (plus Iceland and Norway) airline could operate in any region of the Union, even in wholly domestic routes, without restraints either on fares or capacity. This was the final step in a large process started at the mid-1980s, after the success, and as a consequence of, non-European deregulation experiences.

One of the most defining particular features of this European process has been its two-level pattern. Previous air transport deregulation experiences in the US, Canada and Australia taught European countries that prior to, or instead of, embarking on a complete deregulation of the whole industry, governments should test it on a small range. First, at a strict national level, by means of liberalising agreements negotiated between pairs of countries (particularly UK, Ireland, Belgium and The Netherlands) which abolished controls on market entry and tariffs. And second, by harmonisation measures at the EU level, as intended by the three deregulation *packages* released in 1987, 1990 and 1992 (CAA, 1993).

Despite their common intention, the effects of these two different deregulation levels are not always multiplicative. In already liberalised routes, the harmonisation measures brought fewer improvements, and decreases in fares were only observable in those routes where the bilateral schemes that intended to maintain duopolistic rights for national carriers were removed.

The literature on European air transport deregulation has frequently addressed the study of the effects of this process by focusing on the specific impact of concrete liberalising measures (for example, Pryke, 1991, or McGowan and Seabright, 1989), and particularly, on airlines' cost or efficiency parameters (Encaoua, 1991). Our note, however, specifically focuses on prices and extends the work by Betancor and Jorge-Calderón (1996) in order to analyse the complete deregulation process on a same set of individuals (routes) during nine consecutive years.

Even reckoning that it is still too early to evaluate the effects of the latest measures, this note intends to assess empirically the results of the first phase (1986-1994) of the European airline deregulation in order to draw some conclusions on what kind of results are expected during the next five years, according to the pace and effectiveness of the process so far.

To do this, we use a panel sample of 44 city-pair intra-EU scheduled routes and estimate different standard price equations to evaluate the relevance both of the deregulation packages of 1987, 1990 and 1992 and the liberal bilateral arrangements that several countries had agreed on before.

The remaining parts of this note are divided as follows. Section 2 characterises the leading features of the European deregulation process and the context in which the main measures were adopted. In section 3 we describe the empirical model used to assess the effects of the deregulation process on prices. Section 4 is devoted to the analysis of the results from model estimation and, finally, section 5 summarises our main conclusions.

2 THE EUROPEAN DEREGULATION POLICY

When the Treaty of Rome was signed in 1957 the huge differences among Member States' air transport industries made it impossible to reach an overall agreement on how this sector should be regulated. Therefore, only the general principles on competition were enforceable for this market.

These differences widened during the subsequent years, since the absence of homogenous provisions and policy guidelines encouraged many governments to pursue particular objectives. Bilateral agreements, either to facilitate competition or to consecrate barriers to entry according to national conveniences, were settled all over Europe (Caves and Higgins, 1993). This situation sparked several conflicts between the European Commission (EC) and member states until 1987, where, as a consequence of a resolution of the European Supreme Court, the first liberalisation package, was released.

The package only applied to inter-European scheduled operations and comprised several regulations, all enforceable from January 1st, 1988. First, Council Directive 87/601 regulated the pricing policy for intra-European scheduled flights. Several *fare-zones* were created, allowing for up to sixty-five to ninety percent discount for certain restricted-conditions tickets. Council Decision 87/602 allowed capacity-distribution agreements between existing carriers and softened the conditions for new entrants, although several limits were imposed on these agreements to avoid unfair competition practices.

This decision also let governments authorise second operators at the intra-European level for certain high density corridors and created traffic rights between regional and central airports, even though these measures had not been contemplated in existing bilateral agreements. It also allowed airlines to carry passengers between states different from that of the nationality of the carrier with an upper limit of thirty percent of capacity (*fifth freedom rights*).[1]

Finally, Council Regulations 3975/87 and 3976/87 defined competition rules for air transport and authorised Commission to guarantee block exemptions regarding certain agreements among carriers as joint planning and capacity co-ordination, revenue share, tariff consultations, allocation of slots, joint ownership of computer reservation systems and land assistance services. Block exemptions should expire by January 31st, 1991.

The second deregulation package was released in June 1990 and included three important measures. Council Regulation 2342/90 replaced the existing *fare-zones* system by a more flexible one, which determined that member states should approve airlines' prices according to well-defined criteria: long-run carrier's costs, a fair margin on costs, adequate compensation to capital, consumer's benefit, the market competitive environment and the need to prevent predatory practices. The double approval system was replaced by a double disapproval one, under which both countries had to disapprove a fare in order to reject it

[1] The freedoms of the air, as agreed in the Chicago Convention (1944), are: *First Freedom*, or the right of the airline of one country to fly over the territory of another country. *Second Freedom*, or the right of an airline to make a stop in another country due to technical reasons. *Third Freedom*, or the right of an airline to carry traffic from its home country to another country. *Fourth Freedom*, or the right of an airline to carry traffic from another country to its home country. *Fifth Freedom*, or the right of an airline to carry traffic between two foreign countries on a route beginning or ending in its home country. *Sixth Freedom*, or the right of an airline to carry traffic between two foreign countries via its home country, and, *Seventh Freedom*, or the right of an airline to carry traffic between two foreign countries without stopping in its home country.

Council Regulation 2343/90 set new conditions for entry to scheduled intra-European routes and for capacity distribution agreements. Multiple designation was allowed for some high density routes. Third and fourth freedom rights were applicable all over the Community whilst limits to fifth freedom rights were amplified up to fifty percent of seats. Council Regulation 2344/90 extended blocks exemptions until December 31st, 1992.

On July 23rd, 1992 the Council adopted five measures which constituted the third package in the liberalisation of EU aviation industry and completed the market organisation of this sector. The intention of this package was to open up national markets by allowing European airlines to compete freely in an integrated market with price-setting subject to double disapproval.

Council Regulation 2407/92 on the licensing of air carriers defined the criteria to be required by national authorities for granting operator licences. It included sector-specific rules on licensing of air carriers which aimed to establish legal and economic standards while ensuring the absence of discrimination by nationality. More specifically, it dealt with effective control, majority shareholding, solvency requirements, periodic financial monitoring, and requirements for a common certificate on safety fitness.

Council Regulation 2408/92 on access for air carriers to intra-European air routes abolished most of previous restrictions. This regulation on market access granted fifth freedom rights and authorised *consecutive cabotage* between EU airports. It also eliminated capacity-sharing for airlines on routes between member states. As from January 1st, 1993 airlines were able to fly from place to place within another state. However, cabotage was introduced in phases. Until April 1997 airlines could offer a maximum of fifty percent of seats in a stopover in another member state. From that date, the restriction will be dropped.

Finally, Council Regulation 2409/92 on air fares and rates for air services established that airlines were free to set fares as from January 1st 1993, only with some safeguards intended to protect consumer and industry interests. Other regulations in the third package as Council Regulation 2410/92 and 2411/92 contain amendments regarding the application of the rules on competition to undertakings in the sector and extend again the limit of some block exemptions.

In conclusion, the European Commission has committed itself to full liberalisation of air transport by the end of the transition period (April 1st, 1997). Therefore, increased competition will come about gradually as the transition period allows free market access to EU air carriers and the freedom to fly wherever they wish within the EU territory.

3 THE EMPIRICAL MODEL

This section studies the empirical effects of the above described deregulation process on prices. To do this, the city-pair route is selected as the primary unit of analysis and a panel data sample of 44 international intra-European routes for the 1986-1994 period is constructed. We just consider passenger traffic of scheduled airlines, for which data are available and comparable from international reliable sources.

The routes in our panel dataset exhibit different degrees of liberalisation during this period. For example, in 1986 most of continental routes departing from UK had been already liberalised as a result of liberal bilateral agreements, especially with Ireland, Belgium and the Netherlands.

Other countries reached these sort of liberal bilateral agreements in later years in our sample period, whereas the remaining routes stayed highly monopolised or duopolised by national flag carriers.

Thus, the main purpose of this section is to investigate the existence of distinct and significant empirical effects on prices due to this deregulation process, both at the particular route level due to bilateral liberalisation and the overall effect of the 1987, 1990 and 1992 deregulation packages. We use different price definitions, corresponding to different fare structures currently charged by the airlines and study their relationship with the regulatory regime faced in each route and other supply and demand factors.

The standard competitive model, together with previous non-European air transport deregulation experiences support the main prediction that we test. In principle, we expect to find that, in case of the effects of deregulation being statistically significant, the level of competition will increase. In terms of price, this implies that fares in deregulated routes, as compared *vis à vis* to regulated ones, should be lower. Alternatively, other measurements of competition could be used. For example, we expect that the average number of competitors must be larger in deregulated routes, the number of discount tariffs offered to travellers must be higher and the volume of discounts, calculated with respect to a standard fare must be also larger in deregulated routes (provided no change in the standard fare).

We have controlled by demand variables, such as the number of passengers carried and supply variables, such as the number of flights. We have also used the load or seat factor, (which allows us to calculate the supplied capacity) and a density variable for each route. The availability of a panel dataset has also allowed us to test for the existence of fixed-effects at the route level. These effects could be interpreted as non-observable route characteristics (such as traffic type, safety, cultural links,...) whose omission, if relevant, would yield inconsistent estimates.

3.1 Sample selection

We have selected 44 international intra-European city-pair round-trip routes by using three criteria. Table 1 in the Appendix shows the selected routes, their number of order within the densest international scheduled European routes, their distance in kilometres and the regulatory regime they have maintained during the sample period 1986-1994.

The first criterion to include a route in our sample is its representativeness in intra-European scheduled passenger traffic.[2] Table 1 indicates that 26 out of our 44 routes are within the 75 densest routes in Europe according to ICAO Statistics. We have included six of the top ten routes and ten of the first 25 most important ones. The inclusion of, for example, all 75 densest routes would have biased our sample against the two following criteria.

The second criterion used in the sample selection was a geographical one. Though it was not possible to include at least one route by each EU member, we tried to select all types of traffics, from each possible point of departure/destination in the European Union. The average distance between the selected cities/airports is about 600 kms, but we also have 17 routes with

[2] Although Austria and Sweden were non-EU members at the beginning of our sample period, the existing EU-EFTA agreements allow us to apply them the same criteria as the other EU routes.

less than 500 kms and another 17 with more than 1000 kms. To the extent that it could constitute an important distortion when analysing prices, we have explicitly taken into account the effect of distance on our estimates.

The third criterion used in the construction of the dataset has been the regulatory regime. Apart from the deregulation packages of 1987, 1990 and 1992 the routes included in our sample face different regulatory regimes due to the existence of different types of bilateral agreements. As showed in Table 1, in 25 cases the routes are considered regulated, in the sense described above. Another 17 routes are deregulated over the whole 1986-1994 period. Note that the apparent selection bias in favour of UK routes is due both to complete the panel with a similar number of regulated (56.8%) and deregulated routes (38.6%), in order to avoid later estimation problems, and to take into account the leading role of UK in air transport deregulation. The remaining two routes are partially deregulated during the period, since its deregulation was not completed until 1988.

In conclusion, in terms of observations our panel consists of 396 observations (44 routes during nine years) although the presence of missing values renders an effective sample of about 200-250 observations for most of our performed estimations.

3.2 Data sources

In order to carry out the analysis described above, data from traffic and fares corresponding just to scheduled flights at the route level of aggregation were needed. Data on passengers, flights, seat factors and number of operators within each route were obtained from *Traffic by Flight Stage*, a yearly survey produced by ICAO, from years 1986 to 1994. Data on fares were collected from the *ABC World Airline Guides*,[3] a monthly publication with detailed information on prices.

Due to the extended practice of price discrimination existing in the air industry there is not a unique price definition, even within a same route. Therefore, to select the price, we proceeded at a two-stage level. First, we got the local currency level of the four most relevant fares, which are present in almost all routes selected. These are the standard Tourist fare (Y-class or Economy class), the Excursion fare (E-class), the PEX fare and the SPEX fare. Second, to make it possible to compare these prices both at country level and across-time, we deflated them all at 1986 prices and then converted the resulting figure to a common currency.[4]

The Excursion, PEX and SPEX fares constitute discount fares with respect to the standard one. Thus, as a final stage of the analysis, we calculated the percentage of discount of these three fares with respect to the standard Economy fare and the number of other existing

[3] Later renamed as *OAG World Airline Guides* (1990-1994). The figures on this source provided the domestic currency round-trip fare between two cities through the shortest route. In certain cases, when the round-trip fare was not available we simply doubled the single-trip one. It was not possible to obtain an average fare for each year. Therefore, we decided to select a single month as representative for the nine-year period. To avoid distortions due to the Summer and Christmas seasons (where most companies modify their tariffs) we chose November, and when multiple fares existed, we got the lowest one searching the highest incidence of the deregulation process.

[4] Since it is one of the official currencies used by ICAO (which also provides official exchange rates) and given the large number of UK routes selected, we finally chose the sterling pound. Alternatively, to check whether the currency choice was critical, we also repeated all our estimations using ECUs and a European-average price index. Our qualitative results did not change with respect to those finally reported in the Appendix.

discount fares. Usually, these fares are restricted to certain conditions related to cancellation, connection to other flights and number of days staying at destination, in the sense that the lower the fare, the stricter the conditions. A complete and detailed description of the sample can be found in the following section.

3.3 Data description

Table 2 shows the distribution of the number of passengers by years in our sample, according to the type of route considered. Note that, although the average annual growth for the period is about 20 percent, this figure is misleading, since years 1990-1991 experienced negative rates, mainly as a consequence of the world situation, particularly, the Gulf War and the subsequent fuel price shock, since both phenomena froze the expansion of the airline industry during these years.

The distribution of passengers carried in regulated and deregulated routes is almost the same and it is maintained during the period. This contributes to consider that the impact of demand factors in our estimations will be fairly represented. A similar conclusion can be drawn form Table 3, which shows, within our sample, the distribution of the number of flights by types of routes. As expected, the partial correlation coefficient between passenger and flights variables is very high (0.9087), although the observed load factors are not, as illustrated in Table 4.

With regard to the number of competitors within each route, we consider they are defined by airlines with more than 5,000 passengers a year or, in weak demand conditions, by airlines with a significant share of the market. Airlines within the same industrial group are not considered as separate competitors.

Table 5 exhibits two additional important features. First, the comparison of regulated and deregulated routes shows that for all years the average number of competitors is always larger for the second group and this difference is statistically significant at the 95 percent confidence level according to standard mean tests. This relationship favours our expected results. The second feature, however, is that the last column does not reflect an increasing number of competitors year after year, so that the effect of the deregulatory packages does not appear to be represented in this table.

This result is contradicted by last column of Table 6. The average number of discount tariffs increases from 1986 onwards, although the last three years of the sample show a moderate decline. At the same time, deregulated routes appear to offer, on average a larger number of discount tariffs, in accordance with Table 5.

Table 7 illustrates the evolution of fares distinguishing between regulated an deregulated routes. In order to make the comparison possible, the figures represent real 1986 sterling pounds per kilometre, and have been calculated using the criteria defined above.[5]

A common feature shared by the four types of fares is the fact that the deregulated ones are always larger than the corresponding regulated fares. These results coincide with those of Table 8, although referred to the percentage of discount calculated with respect to the standard fare. However, since this result may be affected by the fact that the average distance in

[5] Note that we ignore economies of scale in this first *ceteris paribus* comparison among fares. They will be considered in next section.

deregulated routes is smaller (see Table 1), detailed econometric estimations, controlling by this and other factors are required.

3.4 Model specification

Our aim is to examine the relationship between each route's characteristics, the level of deregulation affecting it, and a given price variable. To do this we use the panel database (i=1,...,44; t=1986, ..., 1994) described above and estimate both pooling and panel regressions, where the dependent variable is the fare (in different forms) or some other related variable. Several functional forms were investigated in preliminary regressions but below we only report results corresponding to the linear and log-linear specifications, which yielded the best fits. Apart from those described before, these models have made use of the following variables:

• **DEREGULATION**	Dummy variable that captures the effect of liberal bilateral agreements. This variable takes value 0 in regulated routes and 1 in deregulated ones.
• **DISTANCE**	Distance between cities of origin and destination in kms.
• **DENSITY**	Dummy variable that refers to the average number of passengers in a route. The variable is equal to 0 when there are on average 100,000 passengers or less in a given route. In other cases, the variable takes value 1.
• **LOAD FACTOR**	Average load factor
• **FLIGHTS**	Number of one-way flights on each route.
• **DISCOUNT FARES**	Different types of discount fares available on each route, independently of operators.
• **INCOME**	Index of per capita GDP of the country.
• **OPERATORS**	It includes operators with more than 5000 passengers a year or with a significant part of the market when the route suffers from weak demand.
• **YEAR 87- 94**	Dummy variables that are equal to 1 on the specified year. They capture time and deregulation packages effects.
• **Y-FARE**	Cheapest Economy airfare (round trip) in constant 1986 sterling pounds.
• **E-FARE**	Cheapest Excursion airfare (round trip) in constant 1986 sterling pounds.
• **PEX-FARE**	Cheapest PEX airfare (round trip) in constant 1986 sterling pounds.
• **SPEX-FARE**:	Cheapest SuperPEX airfare (round trip) in constant 1986 sterling pounds.

In the case of pooling regressions the estimation have been performed by OLS with error correction methods in order to get estimates robust both to heteroscedasticity and error autocorrelation problems. Since we depart from reduced forms models, an omitted-variable test has also been carried out, allowing us to reject the hypothesis that most of our models do not have important omitted variables.

In the case of panel data analysis, we have estimated cross-sectional time-series regression models, including fixed-effects (within routes) and random effects (mixed) models.[6] In general, the model is specified as: $y_{it} = \alpha + \beta X_{it} + \eta_i + \varepsilon_{it}$, where y_{it} corresponds to the price variable, X_{it} refers to the explanatory regressors (including deregulation variables), η_i stands for the (unobservable) individual effect, and ε_{it} is the random error.

[6] We have used the standard Breusch and Pagan Lagrange multiplier test for random effects, and Hausman's specification test on the appropriateness of the random-effects estimator.

4 RESULTS

We have firstly estimated a model where the fare in levels is the dependent variable; its results are reported on Table 9. Our four fare-variables, Economy (Y), Excursion (E), PEX and SPEX are regressed against a set of explanatory variables chosen after performing several previous estimations, the most important one among these, for our purposes, being the *deregulation* variable. Two types of models are considered, Model 1 and Model 2. They differ in that the second type incorporates variables in logs when feasible, thus it is a model in double-log form.

The deregulation variable behaves as expected only for the Y-fare. It seems that deregulated routes enjoy lower economy fares. According to parameter values from Model 2, such a fare would be 7 percent cheaper on average for deregulated routes. For the E-fare and PEX-fare results are not conclusive and very much dependent on the type of model chosen. Only for the SPEX-fare there would not be any difference between types of routes.

Some year-specific regressors are only significant for the Economy and PEX-fare. There seems to be a trend to reduce these fares at the beginning of the period. Bearing in mind that in 1987 a first package of deregulation measures was introduced at a European level, this could be interpreted as a preliminary effect of European air transport deregulation. Nevertheless year 1992 brought with it new increases for the economy fare followed in the subsequent year by a decrease in the PEX-fare.

For the rest of control variables we find that distance has a direct effect on fares. As expected, travelling on longer routes would be more expensive for all types of fares considered. The density variable is playing an important role only for the Y-fare case; Economy fares would be higher on denser routes, while the rest of tariffs would remain similar. The greater the load factor the smaller the level of prices, this could also be anticipated as higher load factors allow a reduction of unit costs and, hence, of fares. Finally, as it was also expected, wherever the national income is higher passengers must face also a higher level of fares.

The analysis of discounts in Table 10, implies that deregulated routes offer smaller discounts for PEX and SPEX fares, while it appears that there is no significant difference for the E-fare. These results must be interpreted in connection to those of Table 9. Since the percentage of discount are worked out in relation to the Y-fare, and this one becomes smaller on liberalised routes, we could also expect getting similar (E-fare) or lower (PEX and SPEX) percentages of discount. It seems that airlines operating in more liberalised routes have a narrower margin to offer price discounts, and therefore, these discounts expressed as percentages, are actually similar or even smaller.

Economies of scale might induce greater discounts according to the distance variable, while the discount on denser routes would be smaller only for the SPEX tariff. With respect to the number of flights and load factors variables it seems that they might be increased through a discount pricing policy. Again, the national income variable is playing an important role in the same sense as in results from Table 9, except for the SPEX-fare, that behaves independently of this index variable.

Regarding to time effects, it is important to point out that all the estimated parameters for the SPEX-fare exhibit a negative sign, whilst for the PEX-fare most estimates present a positive one. According to this result it would be happening that the level of discount for the former, affected mainly by the first deregulation package, was initially decreasing. However, just after the last two pieces of European liberalisation were passed, discounts for the PEX-fare were increasing. This result might be interpreted as a positive market response if one bear in mind that the PEX-fare is not so much restricted as its counterpart SPEX. Nevertheless the impact for the SPEX-fare is not always significant, and for the PEX-fare the last year considered in the database does not capture any significant change, so we cannot be certain about the continuity of this change.

The most striking impact of deregulation is reported on Table 11. The range of discounted fares available for passengers selection is much wider, around 87 percent higher, on routes where liberal bilateral agreements are applied. This increasing number of discount fares appears also to be the effect of European air transport deregulation packages. Time variables are significant from 1989 onwards and, although the effect takes a lag of a couple of years to appear, it stands until 1994. Competition among airlines, as the variable number of operators indicates, takes place through availability of quite a good number of different discounted fares.

Finally Table 12 refer to panel regression estimates when Hausman tests indicate that fixed effects might be important. This is only the case of the percentage of discount for the E-fare in logs form. Taking into account fixed effects, it happens that the percentage of discount is similar between both types of routes. This finding would support previous pooling estimation results.

5 CONCLUSIONS

In this note we have carried out an empirical assessment of the effects of deregulation on the pricing policies of the European air industry from 1986 to 1994 for the scheduled passengers traffic. Our basic unit of analysis is the city-pair route, since we also consider this as the basic unit of competition for this sort of traffic. Two types of deregulation effects have been modelled. First, strict route-deregulation effect, according to the existence or not of liberal bilateral agreements between the countries involved in any single route. Second, a pure time-deregulation effect, according to the progressive influence of the European Commission deregulation packages that came into place at years 1987, 1990 and 1992.

To capture these effects we compare different price definitions over forty-four different international intra-European routes consecutively observed for nine years. In order to make the comparison valuable, we control not only by deregulation variables, but also by several supply and demand variables, such as passengers-kms, number of flights, distance, load factor and per head income. We also control by unobservable individual effects that may possibly affect the validity of the estimated coefficients.

In terms of fares in levels we can only confirm that the basic standard fare (Y-fare) is around a 7 percent lower in those routes where liberal bilaterals are in force, whilst the SPEX-fare would be similar. With respect to other fares our econometric results are not conclusive. Once special features of routes are bore in mind including fixed effects, it happens that the effect of liberal bilaterals in Europe seems to be very weak.

When percentages of discount with respect to the Economy fare are calculated, we have surprisingly found that these are always lower in routes subject to liberal bilaterals, but for the E-fare. There is also an important difference between the PEX and SPEX-fare in terms of the

European liberalisation process. The discount applied to the former has been increasing at some points in time, though the trend for the last is to experienced lower percentages mainly at the beginning of the period. Thus the impact of the European deregulation process, if any, has not been the same as the one exerted by liberal bilateral agreements.

However, the most striking impact of such bilateral agreements has been the proliferation of tariffs, allowing passengers to choose among a greater range of fares that could be now on average 87 percent higher. Airlines are nowadays working with a greater number of discounted fares, this might also indicate they could be now getting lower yields if these tariffs were actually widely available in terms of seats being offered on a discount basis. This information is not published in Europe, however significance of the load factor parameter and relevant literature for the United States case (Keeler, 1991) would support it. In relation to the European deregulation packages, it is also the case that effects on levels of fares have been negligible so far. Again, its impact is found in the greater number of fares that are now available to passengers.

In conclusion, our work shows that the effects of the air transport deregulation process in Europe have been much more gradual than other non-European experiences. This is so because the European process has been phased in over a lengthy period and the nature and the intensity of government intervention varied enormously between different countries. This makes that the first two years of the Single Market (1993-1994) had not seen a uniform flourishing of competition across the European Union, either between the major carriers or from new entrants or existing smaller airlines.

However there is one caveat to our conclusions and an important starting point for future work. Since European airlines' yields by route are not publicly available we have restricted our econometric analysis only to four types of fares. For none of these variables, competition in European skies has taken the form of generalised price decreases as a result from the application of liberal bilateral agreements or the European deregulation process itself. However, we have found an important impact in terms of a newer and wider catalogue of fares among which passengers could better accommodate their preferences. Only if these are also widely available for most flights would have airline deregulation improved matters.

ACKNOWLEDGMENTS

This note presents several results of *Pricing European Transport Services*, PETS Project No. ST-96-SC.172, funded by the European Commission. The authors acknowledge the facilities provided by the Library of the Civil Aviation Authority in Gatwick (UK), and useful comments from participants at the International Air Transport Conference 1997 (Vancouver, Canada) and seminars held at the Universidad de Las Palmas.

REFERENCES

ABC World Airline Guides, (1986-1994), several months. ICAO. Canada.

Betancor, O. and Jorge-Calderón, JD (1996) A Note on Fares in Regulated and Deregulated Airline Markets, *Transport Policy*, **3**, pp. 123-125.

CAA, Civil Aviation Authority (1993) *Airline Competition in the Single European Market*, CAP 623, London.

CAA, Civil Aviation Authority (1995) *The Single European Aviation Market: Progress so Far*. CAP 654, London.

Caves, R. and C. Higgins (1993) The Consequences of the Liberalised UK-Europe Bilateral Air Service Agreement, *International Journal of Transport Economics*, **20**, pp. 3-25.

Encaoua, D. (1991) Liberalising European Airlines. Cost and Factor Productivity Evidence. *International Journal of Industrial Organisation*, **9**, pp. 109-124.

ICAO (1986-1994), *Traffic by Flight Stage*. Canada.

Keeler, T.E. (1991). The revolution in airline deregulation, in Weiss, L. and K.Klass (eds.) *Case studies in regulation, revolution and reform*. Little, Brown and company.

Mac Gowan, F. and P. Seabright (1989) Deregulating European Airlines, *Economic Policy*, October, pp. 284-335.

Pryke, R. (1991) American Deregulation and European Liberalisation, in *Transport in a Free Market Economy*, by Banister, D. and K. Button, (eds.). MacMillan Press. London.

Table 1. Sample routes.

	City-Pair Route	No. of order	Distance (Kms)	Regulation regime (1986-1994)
1	Paris-London	1	365	Deregulated
2	London-Dublin	2	450	Deregulated
3	London-Amsterdam	3	372	Deregulated
4	London-Brussels	5	350	Deregulated
5	Madrid-London	6	1244	Regulated
6	Milan-London	10	979	Regulated
7	Madrid-Frankfurt	15	1422	Partially deregulated
8	Paris-Frankfurt	17	471	Partially deregulated
9	Vienna-London	19	1272	Regulated
10	Barcelona-London	24	1145	Regulated
11	Athens-London	27	2413	Regulated
12	Barcelona-Frankfurt	29	1092	Regulated
13	Milan-Frankfurt	33	512	Regulated
14	Stockholm-Frankfurt	37	1222	Regulated
15	Madrid-Lisbon	43	513	Regulated
16	Manchester-Amsterdam	44	484	Deregulated
17	Madrid-Brussels	50	131[illegible]	Regulated
18	Athens-Frankfurt	57	180	Regulated
19	Stockholm-London	61	147	Regulated
20	Milan-Brussels	62	70	Regulated
21	Athens-Brussels	65	20[illegible]	Regulated
22	Manchester-Brussels	68	53[illegible]	Deregulated
23	Barcelona-Lisbon	70	99	Regulated
24	Barcelona-Brussels	73	10[illegible]	Regulated
25	Manchester-Dublin	74	2[illegible]	Deregulated
26	Stockholm-Brussels	75	12[illegible]	Regulated
27	Liverpool-Dublin	-	2[illegible]	Deregulated
28	Cardiff-Dublin	-	2[illegible]	Deregulated
29	Paris-Brussels	-	2[illegible]	Regulated
30	Leeds-Dublin	-	3[illegible]	Deregulated
31	Cardiff-Amsterdam	-	3[illegible]	Deregulated
32	Cardiff-Brussels	-	4[illegible]	Deregulated
33	Leeds-Amsterdam	-	4[illegible]	Deregulated
34	Leeds-Brussels	-	4[illegible]	Deregulated
35	Tees-side-Amsterdam	-	4[illegible]	Deregulated
36	Liverpool-Amsterdam	-	5[illegible]	Deregulated
37	Liverpool-Brussels	-	5[illegible]	Deregulated
38	Vienna-Frankfurt	-	[illegible]	Regulated
39	Vienna-Brussels	-	[illegible]	Regulated
40	Paris-Lisbon	-	1[illegible]0	Regulated
41	Milan-Lisbon	-	1[illegible]3	Regulated
42	Athens-Lisbon	-	2[illegible]0	Regulated
43	Stockholm-Lisbon	-	2[illegible]6	Regulated
44	Vienna-Lisbon	-	3[illegible]0	Regulated

SOURCES: *Traffic by Flight Stage* (ICAO). 1986-1994 and *The Single European Aviation Market* (CAP 654), (CAA, 1995).

Table 2. Passengers by route type

Year	Regulated Routes			Deregulated Routes		
	thousands	in %	% growth	thousands	in %	% growth
1986	5,326	47.7	-	5,849	52.3	-
1987	5,813	52.0	9.1	5,372	48.0	-8.1
1988	6,422	47.0	10.4	7,240	53.0	34.7
1989	5,883	39.6	-8.3	8,982	60.4	24.0
1990	6,555	44.8	11.4	8,070	55.2	-10.1
1991	5,957	43.5	-9.1	7,749	56.5	-13.7
1992	6,909	44.9	15.9	8,489	55.1	9.5
1993	7,226	45.5	4.5	8,654	54.5	1.9
1994	12,917	43.8	78.7	16,568	56.2	91.4

Table 3. Flights by route type

Year	Regulated Routes			Deregulated Routes		
	thousands	in %	% growth	thousands	in %	% growth
1986	66,206	53.4	-	58,184	46.6	-
1987	69,009	54.2	4.2	59,101	45.8	1.5
1988	76,316	48.1	11.0	81,238	51.9	37.4
1989	68,785	40.7	-9.8	102,115	59.3	25.6
1990	77,309	49.3	12.3	81,753	50.7	-19.9
1991	74,292	35.4	-3.9	85,935	64.9	5.1
1992	86,996	45.2	17.1	104,780	54.8	21.9
1993	95,548	47.2	9.8	107,449	52.8	2.5
1994	98,658	43.6	3.2	129,194	56.4	20.2

Table 4. Average seat factor by route type (in %)

Year	Regulated Routes	Deregulated Routes	Both types
1986	57.3	55.2	56.3
1987	61.9	51.8	56.8
1988	60.4	58.8	59.6
1989	58.5	54.9	56.7
1990	61.4	52.5	56.9
1991	55.4	53.4	54.4
1992	55.4	53.2	54.3
1993	57.[illegible]	53.1	55.1
1994	56.[illegible]	57.3	56.7

Table 5. Average number of competitors by route type

Year	Regulated Routes	Deregulated Routes	Both types
1986	2.8	3.0	2.9
1987	2.2	2.8	2.5
1988	2.2	3.2	2.7
1989	2.3	2.8	2.5
1990	2.2	3.0	2.6
1991	2.3	3.8	3.1
1992	2.6	3.3	3.0
1993	2.2	2.8	2.5
1994	2.6	2.8	2.7

Table 6. Average number of discount tariffs by route type

Year	Regulated Routes	Deregulated Routes	Both types
1986	2.41	3.75	3.08
1987	2.70	5.53	4.12
1988	2.78	6.56	4.67
1989	3.08	6.53	4.81
1990	4.38	8.76	6.57
1991	4.43	6.83	5.63
1992	8.04	9.22	8.63
1993	7.63	8.94	8.28
1994	6.63	9.72	8.17

Table 7. Average fares by route type (in £/km)

Tourist fare

Year	Regulated Routes	Deregulated Routes	Both types
1986	0.38	0.48	0.43
1987	0.36	0.44	0.40
1988	0.33	0.41	0.37
1989	0.33	0.41	0.37
1990	0.35	0.45	0.40
1991	0.35	0.49	0.42
1992	0.39	0.53	0.46
1993	0.36	0.51	0.43
1994	0.36	0.51	0.44

Excursion fare

Year	Regulated Routes	Deregulated Routes	Both types
1986	0.23	0.32	0.27
1987	0.21	0.32	0.26
1988	0.20	0.28	0.24
1989	0.21	0.26	0.23
1990	0.22	0.29	0.25
1991	0.23	0.35	0.29
1992	0.23	0.34	0.29
1993	0.22	0.32	0.27
1994	0.21	0.38	0.29

PEX fare

Year	Regulated Routes	Deregulated Routes	Both types
1986	0.19	0.30	0.25
1987	0.19	0.32	0.25
1988	0.18	0.28	0.23
1989	0.16	0.27	0.22
1990	0.16	0.29	0.22
1991	0.16	0.27	0.22
1992	0.17	0.29	0.23
1993	0.16	0.29	0.22
1994	0.16	0.29	0.23

Table 7. Average fares by route type (in £/km) (cont.)

Year	SPEX fare Regulated Routes	Deregulated Routes	Both types
1986	0.10	-	0.10
1987	0.14	0.26	0.20
1988	0.18	0.23	0.21
1989	0.15	0.20	0.17
1990	0.14	0.22	0.18
1991	0.15	0.22	0.19
1992	0.14	0.21	0.18
1993	0.14	0.21	0.18
1994	0.14	0.21	0.18

Table 8. Average discounts by route type (in % with respect to standard fare)

Year	% Discount of excursion fare Regulated Routes	Deregulated Routes	Both types
1986	34.3	28.0	31.1
1987	33.9	13.5	23.7
1988	33.3	25.8	29.5
1989	31.8	25.3	28.6
1990	33.5	29.0	31.3
1991	31.2	26.1	28.7
1992	33.1	31.0	32.0
1993	30.6	31.0	30.8
1994	31.0	24.5	27.8

Year	% Discount of PEX fare Regulated Routes	Deregulated Routes	Both types
1986	47.1	37.7	42.4
1987	49.8	25.1	37.5
1988	49.2	30.2	39.7
1989	53.5	33.6	43.6
1990	54.9	38.4	46.6
1991	52.4	43.9	48.2
1992	53.9	45.4	49.7
1993	53.7	43.0	48.3
1994	52.7	42.8	47.8

Year	% Discount of SPEX fare Regulated Routes	Deregulated Routes	Both types
1986	72.6	.	72.6
1987	67.4	34.5	51.0
1988	62.0	40.9	51.5
1989	66.4	48.4	57.4
1990	64.9	53.0	59.0
1991	63.0	52.4	57.7
1992	65.3	60.7	63.0
1993	65.0	56.9	60.9
1994	62.0	58.9	60.5

Table 9. Estimated coefficients for fares in levels (pooling regressions)

VARIABLES	Y-FARE		E-FARE		PEX-FARE		SPEX- FARE	
	Model 1 (Linear)	Model 2 (Log)	Model 1 (Linear)	Model 2 (Log)	Model 1 (Linear)	Model 2 (Log)	Model 1 (Linear)	Model 2 (Log)
DEREGULATION	-42.639*	-0.069*	-82.421*	-0.092	-45.847*	-0.046	-0.587	0.060
DISTANCE	0.243*	0.692*	0.123*	0.671*	0.054*	0.538*	0.080*	0.607*
DENSITY	35.385*	0.133*	20.068	0.100**	5.574	0.031	3.545	0.056
LOAD FACTOR	-1.480*	-0.234*	-1.813*	-0.415*	-1.674*	-0.452*	-1.104*	-0.467*
INCOME	2.866*	0.010*	5.600*	0.019*	2.518*	0.016*	1.686*	0.015*
YEAR 87	-23.970**	-0.048	21.297	0.052	-20.242**	-0.090	1.476	-0.041
YEAR 88	-44.347*	-0.127*	-13.169	-0.065	-25.639*	-0.152*	-5.326	-0.064
YEAR 89	-34.407*	-0.126*	-5.767	-0.057	-32.181*	-0.190*	-10.753	-0.143
YEAR 90	-6.137	-0.055	8.778	-0.022	-25.537*	-0.160*	-3.884	-0.040
YEAR 91	9.011	-0.019	6.388	-0.012	-16.703	-0.088	5.596	0.014
YEAR 92	35.292*	0.076**	15.205	0.021	-16.187	-0.076	5.705	0.018
YEAR 93	12.204	0.019	-6.267	-0.058	-23.277*	-0.132*	3.201	-0.031
YEAR 94	19.268	0.042	-29.748	-0.124	-15.193	-0.080	6.061	-0.033
CONSTANT	-79.938*	1.026*	-270.593*	0.752	1.276	1.891*	-49.115	1.124*
	F(13,234)=186.9	F(13,234)=143.8	F(13,172)=25.3	F(13,172)=25.3	F(13,267)=32.3	F(13,267)=41.9	F(13,145)=39.8	F(13,145)=32.6

* : Significant at 5%.
**: Significant at 10%.
Regressions have been performed using a robust regression procedure. F-test of joint signification is reported. Ramsey (1969) regression specification error test (RESET) for omitted variables and Cook and Weisberg (1983) test for heteroscedasticity have been also passed satisfactorily.

Table 10. Estimated coefficients for percentages of discount (pooling regressions)

VARIABLES	% DISCOUNT FOR E-FARE		% DISCOUNT FOR PEX-FARE		% DISCOUNT FOR SPEX FARE	
	Model 1 (Linear)	Model 2 (Log)	Model 1 (Linear)	Model 2 (Log)	Model 1 (Linear)	Model 2 (Log)
DEREGULATION	-2.046	-0.002	-7.265*	-0.090*	-6.560*	-0.041**
DISTANCE	0.001	0.087**	0.003*	0.117*	3.9e-04	0.082*
DENSITY	-9.6e-07	9.2e-08*	-8.2e-07	-5.7e-09	-7.6e-06*	-1.1e-07*
LOAD FACTOR	0.115**	0.135	0.123*	0.139*	0.230*	0.128*
FLIGHTS	4.9e-04	0.045*	2.3e-04	0.028*	6.7e-04*	0.062*
INCOME	-0.383*	-0.012*	-0.119*	-0.002*	0.144	9.9e-04
YEAR 87	0.904	0.022	-3.318	0.005	-20.149*	-0.189**
YEAR 88	0.248	0.017	-2.461	-0.053	-18.203*	-0.222*
YEAR 89	0.739	0.007	1.794	0.049	-15.088*	-0.188**
YEAR 90	0.726	8.3e-04	4.588**	0.082**	-13.515**	-0.175
YEAR 91	0.527	-2.6e-04	3.661	0.063	-12.209**	-0.164
YEAR 92	1.428	0.026	5.786*	0.100*	-9.779	-0.117
YEAR 93	-1.034	-0.033	4.925*	0.090**	-11.705	-0.139
YEAR 94	-0.166	-0.028	2.068	0.028	-11.447	-0.143
CONSTANT	52.857*	2.891*	48.697	2.443*	61.130*	2.671*
	F(14,168)=15.57	F(14,166)=19.01	F(14,265)=12.04	F(14,262)=12.66	F(14,141)=7.94	F(14,141)=12.08

* : Significant at 5%.
**: Significant at 10%.
Regressions have been performed using a robust regression procedure. F-test of joint signification is reported. Ramsey (1969) regression specification error test (RESET) for omitted variables and Cook and Weisberg (1983) test for heteroscedasticity have been also passed satisfactorily.

Table 11. Estimated coefficients for the number of discount fares (pooling regressions)

VARIABLES	NUMBER OF DISCOUNT FARES	
	Model 1 (Linear)	Model 2 (Log)
DEREGULATION	2.781 *	0.625 *
OPERATORS	0.396 *	0.248 *
LOAD FACTOR	0.060 *	0.734 *
INCOME	-0.009	-0.001
YEAR 87	0.789	0.262**
YEAR 88	0.789	0.211
YEAR 89	1.407 *	0.374 *
YEAR 90	1.363 *	0.457 *
YEAR 91	1.613 *	0.413 *
YEAR 92	3.857 *	0.949 *
YEAR 93	3.915 *	0.936 *
YEAR 94	4.071 *	0.892 *
CONSTANT	-1.675	-2.264 *
*: Significant at 5%.	$F(12,325)=16.96$	$F(12,314)=16.29$

**: Significant at 10%.

Regressions have been performed using a robust regression procedure. F-test of joint signification is reported. Ramsey (1969) regression specification error test (RESET) for omitted variables and Cook and Weisberg (1983) test for heteroscedasticity have been also passed satisfactorily.

Table 12. Selected estimated coefficients in log form from panel regressions

VARIABLES	LOG %DISCOUNT FOR E-FARE	
	Fixed Effects	Random Effects
DEREGULATION	-0.040	-0.096
LOG OF DISTANCE	--	-0.101
DENSITY	-1.04e-07	-6.04e-08
LOG OF LOAD FACTOR	0.118	0.103
LOG OF FLIGHTS	0.028	0.035
INCOME	-0.020*	-0.013*
CONSTANT	4.464*	4.602*
*: Significant at 5%. **: Significant at 10%.	$F(5, 148) = 1.79$	$Chi^2 (6) = 29.78$

Regressions have been performed using standard panel techniques. F-test and Chi^2 test are reported. Hausman specification test and Breusch and Pagan test have also been passed satisfactorily.

Topic area: A4

EUROPEAN AIRLINE INDUSTRY: A COST ANALYSIS AND ECONOMIC PERFORMANCE EVALUATION

Juan Carlos Martín
Gustavo Nombela
Manuel Romero*

University of Las Palmas de Gran Canaria
(Spain)

This study is supported by the European Commission- DGVII RTD Programme 4th Frame work programme an is integrated in the project SORT-IT ST-95-SC-402.

* Corresponding author: Mromero@empresariales.ulpgc.es

1. INTRODUCTION.

The European liberalisation process in the air industry has changed the conditions for carriers to operate in this market. Before this, it was a market were limitations to competition existed as in the domestic markets where in many cases there was a legal monopoly, or in the intraeuropean market where airlines operated with bilateral agreements between states to share the market.

The three liberalisation packages have eliminated the legal barriers to competition to established a situation of complete freedom of entry and exit for European carriers in any domestic or intrastate market, into the philosophy of the Treaty of Rome.

In this paper we study cost structure of air carriers with the main objective of analysing how the liberalisation process has affected efficiency in the production of European companies. By studying the existence of economies of scale in the industry, we can try to predict how the companies of this sector will response to the measures of the Commission. The main question to answer is if the size of the air carriers can affect to efficiency gains in costs and production.

Market structure can be affected by existence of economies of scale in the market which could bring possible tendencies of concentration in the market, and that could be answer to the bilateral agreements, joint ventures and acquisitions that can be observed actually between air carriers along European market.

Section 2 describe the sample of 22 airlines, 13 from Europe and 9 from North America for a period of six years since 1991 to 1995, that has been used to carry out this study. Data has been obtained from ICAO and IATA publications.

Section 3 presents a parametric analysis as an approach to analyse the efficiency of airlines. So for the period 1990-95 there still exists a gap between the performance of European airlines and their American counterparts, both in terms of productivity and unit costs. Although it can be observed that European are covering in terms of costs to American levels.

Although for the characteristics of output in air transport it might be estimated a desegregated cost function, the absence of information to make this have lead us to estimate an aggregated traslogaritmical cost function. As consequence, its necessary to define correctly what is understood by economies of scale and how to determine it from an aggregated cost function. Section 4 presents an Econometric analysis carry out to estimate a cost function for the industry. The use of traslogaritmical cost function specification and the cost share equations is used as a standard methodology to estimate transport cost . This is because is the easiest to estimate and interpret (the arguments of the function are in logarithms). The disadvantage comes from the number of coefficients to estimate.

The analysis of economies of scale with the traditional form and corrected following Jara and Cortés (1996) and Oum and Zhang (1997) are compared in section 5. So the presence of economies of scale is notably reinforced if the correction of the effect of changes in output and network over other exogenous factors proposed is performed. Also in this section cost complementarity and the effect of public and private ownership is analysed. Finally residuals obtained from the estimated cost function are used to estimate the potential cost reductions that inefficient airlines may achieve.

Section 6 presents the main conclusions of this paper.

2. DESCRIPTION OF SAMPLE.

Data used in this study correspond to a sample of 22 airlines from Europe (13) and North America (7 from US, and 2 from Canada), and it covers the period 1990-1995. The criterion to select the sample was initially to include all the main world airlines that reported financial information to the International Civil Aviation Authority (ICAO) during that period in order to have a sufficiently large database to obtain reliable estimates.

However, the analysis of a larger tentative sample in which airlines from other regions were also included (South America and East Asia) revealed the existence of significant differences across regions for some relevant parameters. Thus, for example, crew wages are substantially lower for some developing countries (e.g. India and Pakistan) than in other regions. Fuel costs per kilometre are higher for Asian airlines compared to average values, specially for Japanese companies. This latter result observed in our initial sample has also been reported in other works (ICAO, 1992).

These differences in cost structures and prices make efficiency comparisons among companies from different regions a difficult task, since airlines do not operate on common environments. Initial estimations using the whole sample were not successful in obtaining a cost function that satisfied restrictions to have economic meaning. We decided then to reduce the sample to European and North American airlines, which are relatively similar in their characteristics, although still there exist some differences in the prices they pay to factors.

Original cost data from ICAO publications were analysed for those airlines included in the sample, in order to detect and filter potential errors. Some inconsistencies and outliers were indeed detected and corrected were possible. In other cases, it was decided to drop directly all observations from airlines whose reported data contained a large number of temporal inconsistencies (Aviaco, Crossair and Viva Air). Another airline excluded from the sample was Virgin Atlantic, due to its specialization on transatlantic routes, which makes it different in its cost structure to non-specialised carriers.

Summing up, after corrections and filters, the available sample for estimation is formed of 105 observations corresponding to 22 airlines for the period 1990-1995. The sample cannot be used as a panel, since for most of the airlines included, financial information was not reported to ICAO in particular years. Only 8 companies reported data every year of the period covered by the sample.

The following table offers a full description of airlines used in this work. In order to assess their relative sizes, information from 1995 on total output (measured in available ton-km produced) number of planes and employees is presented in table 1:

Table 1: Airlines included in the sample (1995 data)

Region	*Name*	*Output (mill. Avail. Ton-km)*	*Number of Planes*	*Number of Employees*
Europe	British Airways	18,428	234	51,178
	Lufthansa	16,844	269	33,240
	Air France	13,711	156	37,323
	KLM	10,871	80	25,307
	Alitalia	6,368	149	17,982
	Swissair	5,096	66	17,733
	Iberia	4,964	109	23,617
	SAS	3,581	150	17,648
	Finnair	1,909	40	7,414
	Olympic	1,670	60	9,140
	TAP	1,600	37	8,226
	Austrian	1,037	28	3,862
	British Midland	513	33	4,013
North America	American	34,864	635	83,463
	United	33,053	556	81,160
	Delta	26,350	539	66,302
	Northwest	20,663	380	45,517
	USAir	11,329	394	41,033
	Continental	9,637	314	29,175
	TWA (*)	7,977	188	24,160
	Air Canada (*)	5,861	109	19,055
	Canadian (*)	4,722	80	13,677

Note: (*) Data are from 1994 (1995 not available).

An immediate observation derived from table 1 is the disparity on average in airlines' size between Europe and North America. A closer look reveals the existence of four very large US airlines (American, United, Delta and Northwest, producing more than 20.000 million ton-km a year), while in Europe only British Airways, Lufthansa, Air France and KLM have output levels that reach the American average. Meanwhile, there are a number of small airlines in Europe, producing less than 2,000 million ton-km. In order to take into account this heterogeneity in the sample, some individual characteristics of each airline are used in the econometric estimations to control for the fact that airlines are diverse in size, type of routes in which they operate, and some other factors.

Data sources

There are three types of information in our database: costs, outputs and structural variables. First, we have data on airlines' total costs and their distribution in different categories of expenditure, according to ICAO classifications: labour (only pilots, copilots and other cockpit personnel), energy, insurance, capital depreciation, interest payments, maintenance, airport and aid-to-flight charges, services to passengers, administration and other costs. This information was obtained from the ICAO annual publication *Financial Statistics*. We also collected data on average wages paid and number of employees for different worker categories, from the ICAO publication *Fleet & Personnel*.

Financial data published is already transformed from national currencies, in which airlines report the data, into US dollars by ICAO. Exchange rates employed in the transformation are carefully chosen in order to avoid misrepresentation of data in US dollars. However, it must be always kept in mind that rapid currency fluctuations in a short period may significantly alter the validity of the transformation in the sense that the costs of an airline may be understated (overstated) if the currency in which it operates has suffered a large devaluation (revaluation) against the dollar.

In order to eliminate the effects of inflation, all financial data is deflated to 1990 real values by using national GDP deflators. The choice of the instrument to deflate data is also a non-neutral matter, since some of the airlines' costs are national (labour, administration, materials and the like) while others have an international nature by definition (e.g., flight equipment, airport charges). Which is the adequate deflator to use then? Ideally, one should deflate each category with the corresponding index considered appropriate. However, the way in which ICAO aggregates the airlines' expenditure, following a functional classification, makes it impossible to proceed in this direction, since in a single category there may exist a mix of labour, materials and other types of costs. Therefore, we have opted for the use of national deflators, on the basis that most costs are nominated in local currencies, therefore subject to national rates of inflation. We believe the bias introduced by the use of a general deflator (e.g. US consumer price index or US GDP deflator) would be larger than the one we may be causing by the choice of national indexes.

Other type of information included in the sample concerns airlines' level of output and other individual characteristics. These variables were obtained form the IATA publication *World Air Transport Statistics (WATS)* which reports both total production of airlines in terms of total seats-km/ton-km offered, and the actual passenger-km/ton-km performed. Published data is presented separately for passenger and cargo services, and it is also differentiated in the part that airlines produce on regular and on charter services.

In this work, we have opted for using measures of output that represent total *production* that airlines offer in the market, instead of choosing actual *demanded* services. Although in many studies on the industry, output is defined in terms of passengers and cargo effectively transported. we believe a correct definition of output when trying to analyze efficiency and technical characteristics (economies of scale, scope, density, etc.) must be based on the real levels of production and not on demand. An airline with a very low load factor may be as efficient in terms of production as another airline with exactly the same characteristics but a high occupancy rate (although the first will probable need to revise its marketing strategy). However, if we use actual number of passengers transported as the measure of output, the second airline will show as more efficient.

Therefore, we will be using available ton-km as the main measure of output, which includes both passengers and cargo. For the econometric estimation, we use the two types of output separately, and there we define the passengers' services output in terms of available seats-km and cargo services in terms of available cargo ton-km.

From the WATS publication, we have obtained data on airlines' outputs, but also on structural characteristics, such as load factors, average stage length of routes, average speeds, number of departures, number of planes, and percentage of charter services, which are used as control variables in our estimations.

3. NON-PARAMETRIC ANALYSIS.

A first simple approach to the analysis of the efficiency of airlines is the computation of some ratios that allow us to study the relative position of companies in terms of unit costs and factors' productivity. Here, we report results on the following indexes:

a. Unit Cost (Total real cost/Ton-km)
b. Labour unit cost
c. Energy unit cost
d. Capital unit cost

All unit costs used here are defined in terms of US cents per total available ton-km. The first index is the more relevant, since it reflects the total performance of an airline in terms of how costly is for it to produce a ton-km. However, when making comparisons among airlines based on this index, it must be remembered that this is only a rough indicator for efficiency, since many factors affecting airlines' performance are left aside. The other three indexes are components of the total unit cost. They may be useful to indicate where do observed differences in total unit cost come from.

The labour cost reported here corresponds to all employees. Although not reported in the ICAO *Financial Data* publication, where only cockpit personnel cost is separated as a single item, it is possible to obtain information on expenditure on all worker categories from the *Fleet&Personnel* publication.

Energy cost is taken directly from reported data and it includes aircraft fuel and oil. Capital cost is defined as the sum of flight equipment insurance, rents for leased equipment, maintenance and overhaul expenditures (excluding labour costs spent on these tasks), and depreciation and amortization of flight and ground equipment.

The difference between total unit costs (a) and the sum of the others indexes used here (b+c+d) corresponds to the unit cost of materials and other services consumed by airlines. This input includes flight-related charges (airport, en-route facilities and station charges); and goods used in the production of passenger services, ticketing and promotion, and general administration. Again, labour costs are deducted from all this categories, using the reported average wages and number of workers.

The relative importance of each of the components may be assessed by their shares on total cost, which are reported in table 2:

Table 2: Average distribution of total cost by type of expenditure (1995)

	Europe	North America
Labour	31.2 %	27.6 %
- Pilots/co-pilots	*(6.5 %)*	*(7.2 %)*
- Other personnel	*(24.7 %)*	*(20.4 %)*
Energy	9.1 %	12.1 %
Capital	17.2%	18.4 %
Materials & other services	42.5 %	41.8%
- Flight-related charges	*(21.3 %)*	*(17.7 %)*

The indexes computed to analyze the productivity of different factors are the following:

e. Kilometers-Flown per plane.
f. Hours-Flown per pilot.
g. Available ton-km per employee.

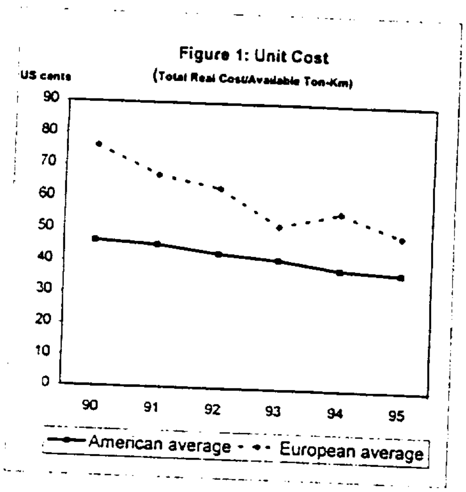
The first index represents the productivity obtained by airlines from their planes, in terms of kilometers produced. Many other indexes may be built as alternatives to this one, or as complementary indexes (e.g. number of departures, hours flown, or ton-km per plane or per seat), but we believe this is a fair representation on the intensity of aircraft use.

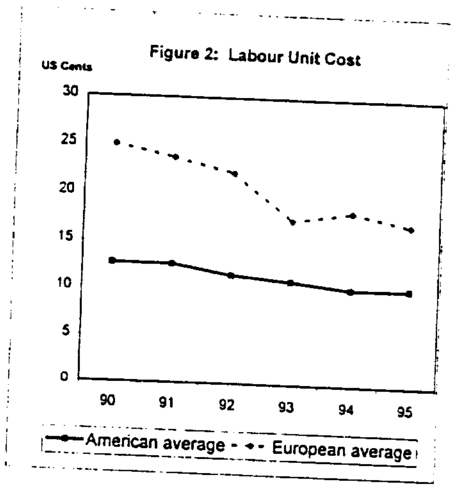
The other two indexes are related to labour productivity. The first of them (f) identifies the productivity of pilots, who constitute one of the key categories of airlines' employees. The second offers information on the overall performance of workers, in terms of total production per capita. Unfortunately, there is no information available on the actual number of working hours for all worker categories, which would allow a more refined estimate of productivity.

Cost and productivity differentials between Europe and North America

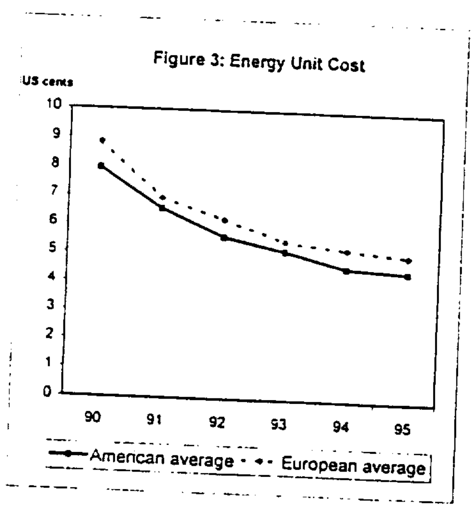
It is common wisdom in the airline industry that US airlines have higher productivities than airlines in Europe and other regions, which makes it feasible for them to produce with lower unit costs. This is also a fact that has been reported in some comparative studies. As an example, Windle (1991) uses a total factor productivity approach to conclude that US airlines have a productivity advantage of 19% over European comparable carriers. In terms of unit costs, the advantage of American firms is estimated by this author in a 7% (data used in estimations correspond to a sample of airlines in 1983).

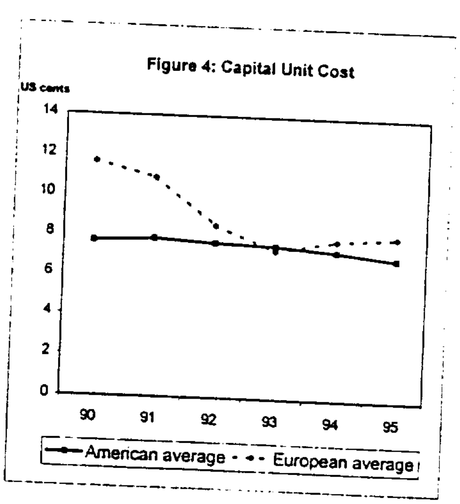
Our indexes indicate that in the period 1990-95 there still exists a gap between the performance of European airlines and their American counterparts, both in terms of productivity and unit costs. Although not very refined, since there are factors not controlled for, a graphical analysis of the cost and productivity indexes easily reveals this gap. Figures 1-4 present together the averages for European and American airlines for each of the unit cost indexes computed, and their evolution over the period.





An examination of the unit cost figures indicates that the cost advantage of US over





European airlines is still significant in the 1990's (see figure 1). On average, in 1995 the unit cost per ton-km produced was 37.7 cents for US firms, while European firms have a cost of 49.4 cents, i.e. 31% higher. Although these figures are revealing, it must be remarked again that they should only be regarded as indicative, since they are not controlled by airlines' characteristics, namely average route distances, points served, etc. Evolution of unit cost over recent years reveals an interesting fact: there is a decreasing trend in the European airlines' cost from 1990 to 1995. Therefore, it seems that European airlines are converging in terms of costs to American levels.

Figures 2-4 present the evolution over the same period of the different components of the unit cost. It is observed that the main source of difference between both regions are the labour costs. In 1995, a European firm spent 17.1 cents per ton-km produced on labour, while this cost was 10.4 cents for American firms. Energy costs are very similar for both groups and they present a common downward trend, although there is again a small gap in favour of American airlines.

Capital unit costs were higher for European firms in 1990, but in the six-year period covered in the sample, these costs have been reduced in Europe to almost match American level in 1995. Finally, the remaining component not shown in the figures (unit cost of materials) is again higher for Europe: 19.2 cents per ton-km, against 15.8 in America.

Summing up, the gross comparison of unit costs between regions indicates that, in 1995, there is gap of 11.7 cents per ton-km in favour of American airlines. From this, 6.7 cents correspond to labour, 0.5 to energy, 1.1 to capital and 3.4 to materials and other services.

Going now to the productivity indexes, it was possible in this case to compute the values for a longer period than the sample used in the study. Figures 5 to 7 present these indexes and their evolution for the period 1984-1995:

Figure 5: Km-Flown/Plane

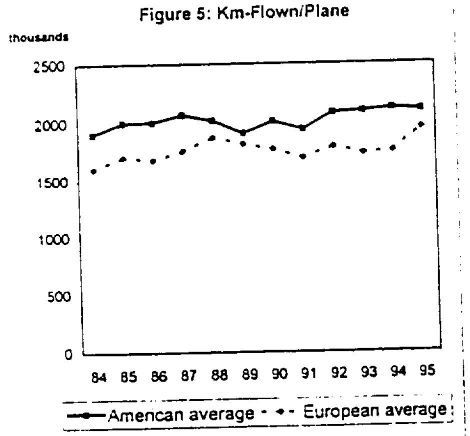


Figure 6: Hours-Flown/Pilot

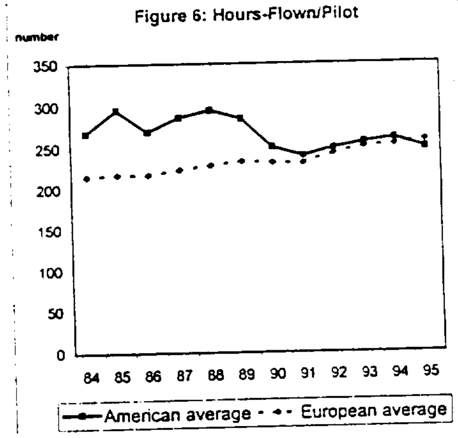
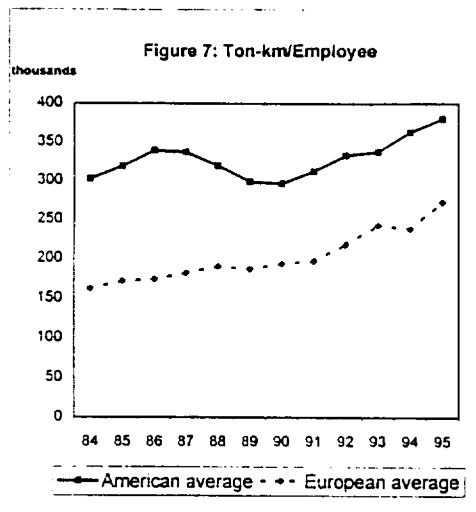


Figure 5 shows the index related to the productivity of planes, in terms of kilometers flown per year. American airlines present a more intensive use of their aircraft, with a value of 2.11 million km per plane a year, against 1.95 million for European airlines. While this index reveals a different productivity of planes, no sound inference on efficiency should be made without analyzing the number and length of routes served, and the type of planes employed.



The productivity of labour is presented in figures 6 and 7. The analysis of the hours flown per pilot reveals two interesting trends: first, although during the 1980's the American pilots were working more hours, during the 1990's there is no significant difference between pilots' productivities between Europe and America. This convergence has been achieved mainly by a reduction in the working time of American pilots. Second, it is observed a slow but steady rise in the productivity of European pilots. While in 1984 they were working on average 216 hours a year, in 1995 this figure has risen to 258 hours, even more than the American average for that particular year.

Finally, figure 7 shows the more interesting fact revealed by the productivity indexes: there is a significant gap in terms of ton-km per employee between Europe and America. In 1995, while an American carrier was producing 380.5 thousand ton-km per employee, a European firm obtained only 273.8 thousand, i.e. 28% lower. This lower labour productivity explains, at least partly, the labour unit cost difference observed in figure 2 above.

Indexes in figure 7 also show trends that are interesting: European firms seem to have been steadily improving their labour productivity over the covered period, and specially in the 1990's. Production per employee in European carriers increased in the period 1984-1990 at an annual average rate of 3%, while in the period 1990-1995 this rate rose to 7.2%. Meanwhile, American airlines' labour productivity has fluctuated over the period. While in some years at the end of the 1980's there was a decreasing trend, from 1990 onwards the productivity of employees has been growing steadily and it has been maintained above the European level. Technology improvements and a more efficient use of labour may be the likely explanations for this increase in employees' productivity in the airline industry as a whole during the 1990's.

4. ECONOMETRIC ANALYSIS.

An estimation of a cost function for the airline industry is carried out in this work, in order to have a complete picture of the performance of carriers, once all possible exogenous factors are controlled for. Furthermore, the cost function provides relevant information about the industry (returns to scale and density, cost complementarity, substitution elasticities between factors) and it allows us to test some hypothesis about ownership and change of regulation effects.

A translog specification is chosen for the cost function to be estimated. This functional form is the most common in the analysis of cost structures across industries, and in particular, it has been previously applied to the air sector by many authors. Caves, Christensen and Tretheway (1984); McShan and Windle (1989), and Baltagi et al (1995) are examples of translog cost functions specifications to analyze the US air industry, while Gillen, Oum and Tretheway (1990) have used it for the Canadian market.

A two-output specification is used for the cost function, considering passenger and cargo services provided by airlines as different products. Although passenger services are the main output of the air industry, cargo services should not be considered as merely residual in the activity of general carriers (we have not included in our sample cargo-specialized firms, as Federal Express for the US market). Moreover, the inclusion of cargo services as a separate output allows the analysis of the possible existence of economies of scope.

Structural variables are included in the specification of the cost function, in order to control for factors which are somehow exogenous to firms. These are variables that may be modified by airlines in the long run, but once a network structure is chosen, they cannot be easily changed in the short run. Variables included are: average stage of length, number of points in the airline's network, load factors for passengers and cargo, and the percentage of total output performed by charter flights. An alternative specification for these variables, in the form of hedonic functions for the output[1] was considered, though it was finally abandoned since it did not improve the results reported here.

The functional form we estimate then is:

$$\ln C = \alpha_0 + \alpha_{pub} PUB + \alpha_p \ln Y_p + \alpha_c \ln Y_c + \alpha_{pc} \ln Y_{pc} + \sum_i \beta_i \ln P_i + \frac{1}{2} \sum_i \sum_j \gamma_{ij} \ln P_i \ln P_j$$
$$+ \sum_i \delta_{ip} \ln P_i \ln Y_p + \sum_i \delta_{ic} \ln P_i \ln Y_c + \lambda_p \ln LFP + \lambda_c \ln LFC + \lambda_{ch} CHART$$
$$+ \lambda_{avsl} \ln AVSL + \lambda_{net} \ln NET + u$$

[1] The concept of hedonic functions is simply to use a re-definition of output in which production characteristics are integrated. Thus, for example, if a level of passenger-km (Y) is produced under determined values of load factor, travel distance, cities served, etc. (q_1, q_2, q_3, ...) a more parsimonious way of using all these variables is by defining a hedonic output:

$$\ln \phi = \ln Y + \sum_i \beta_i q_i$$

The new variable ϕ may be used as the output to include in the cost function. Hedonic functions have been used for example by Gillen et al (1990).

which is the usual specification of a translog cost function, with two outputs plus a set of structural variables to control for individual effects. Four inputs are considered: labour (L), energy (E), capital (K) and materials/other services (M). The variables' definition is the following:

Y_p : Passengers' output (available seat-km)
Y_c : Cargo output (available ton-km, freight and mail)
P_L : Average wage (all worker categories included: pilots, other cockpit personnel, cabin attendants, maintenance and overhaul, ticketing and sales, other personnel).
P_E : Price of energy (total fuel&oil cost per kilometer flown).
P_K : Price of capital (capital cost per plane. Costs included are flight equipment insurance, rents for leased equipment, maintenance and overhaul, depreciation and amortization of flight and ground equipment).
P_M : Price of materials and other services (cost per departure. All remaining costs not considered in the three other inputs are included here).
LFP: Passengers' load factor.
LFC: Cargo load factor.
CHART : Percentage of total output (passengers and cargo) performed by non-scheduled flights. This variable is used in levels and not in logs since for many airlines in the sample it takes a value of zero or close to zero.
AVSL : Average Stage Length (total km-flown/number of departures).
NET : Number of network points served by the airline (this information was obtained directly from the airlines, it corresponds to the actual number of network points for year 1996).
PUB : Dummy variable, value 1 if the airline is a public company. For mixed-capital airlines, the rule is to consider them as non-public only if private capital share is larger than public and there is evidence that no golden shares or other mechanisms exists for public owners to influence board decisions.

A residual u is added to the cost function specification, and it is assumed to be iid $N(0,\sigma_u^2)$. Parameters to be estimated are α_0, α_{pub}, α_p, α_c, α_{pc}, β_i, γ_{ij} (i,j =L,E,K,M), δ_{ip}, δ_{ic}, λ_p, λ_c, λ_{ch}, λ_{avsl}, λ_{net}. Since it is assumed that factor prices' cross-products are symmetric, (i.e. $\gamma_{ij}=\gamma_{ji}$), a total number of 32 parameters are to be estimated. As it was mentioned in the section describing our sample, a total number of 105 observations is available. In order to obtain more degrees of freedom, we follow the common practice of including the equations representing the share of each input over total expenditure ($S_i= P_i X_i/C$). For the translog cost function, these equations have the form:

$$S_i = \beta_i + \sum_j \gamma_{ij} \ln P_j + \delta_{ip} \ln Y_p + \delta_{ic} \ln Y_c$$

It is possible then to obtain more efficient estimators by adding disturbances to this set of equations and estimating them jointly with the cost function. Since, by definition $\sum_i S_i=1$, only three of the four share equations may be used simultaneously.

The system of equations is estimated by full information maximum-likelihood (FIML), using the assumption that disturbances follow a multinormal distribution. All variables are expressed as differences with respect to their means, so that elasticities and other parameters to analyze industry characteristics may be directly obtained from estimated coefficients.

Since all observations are deflated and expressed in real values, they are considered as comparable outcomes of a common industry cost structure. Estimation is then performed by pooling all observations, without any temporal dimension. As it was mentioned above, the possibility of treating data as a panel is not feasible (as it was our first intention), since there are too many missing observations for airlines.

Consequently, all airlines' individual effects not captured by the set of structural variables and the actual factor price levels will be present in the residual terms (u). We considered the possibility of including dummy variables for each company to capture those individual effects, but no satisfactory results were obtained. Therefore, for the airlines' efficiency analysis, the residuals u are used as the main tool. Although for each airline, its individual value of u for a particular year may also be affected by random shocks, we believe they are highly informative on the efficiency achieved by each company. After controlling for all possible structural factors, significant positive values for u are indicative that the cost of the airline is repeatedly above the efficient level indicated by the cost function.

Two arguments reinforce in our case the possibility of interpreting the complete residual u as the result of companies' outcomes in terms of efficiency. First, random shocks that might be affecting to airlines (e.g. depressing effect of the Gulf War on passengers' traffic, sudden price rises, etc) are likely to be affecting in a similar way to all European carriers performing international scheduled services, since all of them operate in very similar markets. And second, the possibility of observing some residuals for each company allows a reduction of the risk of making wrong inferences if a systematic pattern is detected.

5. ECONOMIES OF SCALE AND OTHER RESULTS.

This section presents the results obtained in the estimation of the air industry cost function. A full description of estimated coefficients, standard errors and performed tests may be found in the appendix. Before studying the efficiency results, some characteristics of the industry which are derived from the estimated function are presented and compared to others in previous works.

Returns to density and returns to scale

Definitions followed here are those common in the literature, although there still exists a debate in the profession about the more adequate measure. Returns to density are defined as the effect on costs of a proportional increase in all outputs considered, keeping network size and other characteristics as constant. They are measured by the inverse of the sum of the elasticities of costs with respect to outputs. Meanwhile, returns to scale are defined as the effect of a proportional increase in outputs *and* network size. For our sample, the following values are obtained:

- Returns to density: $D = (\varepsilon_{Y_p} + \varepsilon_{Y_c})^{-1} = 1.057$ (s.d. 0.0548)

- Returns to scale: $S = (\varepsilon_{Y_p} + \varepsilon_{Y_c} + \varepsilon_{net})^{-1} = 1.198$ (s.d. 0.0773)

In both expressions above, ε_i represents the elasticity of costs with respect to variable i. The obtained results indicate the presence of slight economies of density and scale for airlines, similar in size to those of previous works. Caves et al (1984) report returns to density between 1.21 to 1.29 for US carriers, while Gillen et al (1990) find values that lie between 1.15 and 1.26 for Canadian firms. In our case, returns to scale are higher than returns to density, since we obtain in our sample that an increase in the number of points served results in some net cost savings.

According to Oum and Zhang (1997), these traditional measures studying the presence of economies to scale suffer from a fundamental drawback, which may explain why there seems to exist a contradiction between the constants returns to scale obtained in the literature and the observed trend to larger airlines and more concentration in the industry (see appendix 1). The point is that other structural variables apart from network size may have been overlooked in the computation of returns to scale. Changes in output or in network configuration may have an effect on some structural variables, which are supposed to be constant when analyzing returns to scale.

In order to try in our work the correction proposed by Oum-Zhang, the following auxiliary equations are estimated by OLS (between parenthesis, t-statistics):

$$\ln LFP = \underset{(58.6)}{4.2} - \underset{(-.48)}{.0042} \ln Y_p + \underset{(1.25)}{.024} \ln NET - \underset{(-2.9)}{.062} \ln P_L - \underset{(-.257)}{.0049} \ln P_E + \underset{(.066)}{.0015} \ln P_K + \underset{(6.366)}{.0743} \ln P_M$$

$$\ln LFC = \underset{(-.80)}{-.47} - \underset{(-.137)}{.0065} \ln Y_c + \underset{(.678)}{.089} \ln NET + \underset{(5.74)}{.696} \ln P_L + \underset{(1.948)}{.178} \ln P_E - \underset{(-.0527)}{.0377} \ln P_K + \underset{(8.258)}{.0581} \ln P_M$$

$$\ln AVSL = \underset{(17.2)}{6.268} + \underset{(6.997)}{.294} \ln NET - \underset{(-4.42)}{.382} \ln P_L - \underset{(-1.736)}{.133} \ln P_E + \underset{(.277)}{.0213} \ln P_K + \underset{(8.171)}{.457} \ln P_M$$

Two separate equations are estimated for load factor of passengers (LFP) and cargo (LFC) and an equation for the average stage length (AVSL). Contrary to the case of Oum and Zhang (1997), our equations for load factors indicate that the effects of output and network size are not significant, therefore there is no need to correct for them. However, the average stage length is positively affected by an increase in the number of points served. Taking this effect into account, we compute a corrected coefficient to determine the degree of returns to scale:

- Full elasticity: $F = (\varepsilon_{Y_p} + \varepsilon_{Y_c} + \varepsilon_{net} + \varepsilon^{C}_{avsl}\, \varepsilon^{avsl}_{net})^{-1} = 1.576$ (s.d. 0.13398)

Although the obtained coefficient would be indicating the existence of large returns to scale, it must be considered that its standard error is relatively large, therefore it has not been estimated very precisely (a 95% confidence interval would include values from

1.31 to 1.84). Moreover, the cost elasticity with respect to average stage length estimated in our sample (ε^{C}_{avsl} = -0.682) seems to be larger, in absolute value, than the one obtained in other studies. Caves et al (1984) report a value of –0.148 for the US case, and a non-significant positive value of 0.006 in a different work (Caves et al, 1987). Gillen et al (1990) report a value of –0.181 for the Canadian case. The high elasticity in our sample may be originated by the fact that we are including airlines of very different size and type of network served. Since we believe its value may be affecting to the estimated coefficient for economies to scale, it is simply presented here as an application of the correction proposed in Oum and Zhang (1997) to our sample of airlines.

Cost complementarity

Another salient aspect which may be analyzed from our two-output specification for the cost function is the possible existence of cost complementarities between products. In order to study if the production of one of the products has effects over the marginal cost of production of the other product, the cross derivative of the cost function with respect to both outputs may be analyzed. For the case of the translog function:

Since we are only interested in checking the sign of this expression, and by definition,

$$\frac{\partial^2 C}{\partial Y_p \partial Y_c} = \frac{C}{Y_p Y_c}(\alpha_{pc} + \alpha_p \alpha_c)$$

the first term on the RHS of the expression above is always positive, it suffices to estimate the value of the second term. From our estimated parameters we obtain:

$\alpha_{pc} + \alpha_p \alpha_c = 0.0327$ (s.d. 0.072473)

The positive sign obtained would be indicating that no cost complementarity exists between the two products considered (passengers and cargo). However, again it is important to observe that the standard error for the estimated coefficient is large, therefore it would also be possible to accept a null coefficient or even a negative one. No clear conclusion may then be provided from our cost function about this point.

Public Ownership

One hypothesis we are interested in testing on our sample of European and American airlines is the existence of a negative effect of public ownership on firms' efficiency. Although this question has been previously analyzed by other authors, it is interesting to revise if privatizations which have taken place in some countries and the general process of liberalization have had an impact on improving the performance of publicly owned airlines. As a benchmark of reference, Windle (1991) estimated that European airlines had 10.5% higher unit costs compared to US firms in 1983, due to government ownership.

In our cost function, we capture the effect of public ownership of airlines with a dummy variable (PUB) with value one for public firms. A positive sign for the coefficient associated to this variable (α_{pub}) will be indicating higher costs for public airlines, and moreover, we may be able to quantify the effect for an average sized carrier. From the estimated cost function:

$$\alpha_{pub} = 0.0742 \qquad \text{(s.d. 0.0653)}$$

As it is the case for the cost complementarity analysis, although the coefficient presents indeed a positive sign as it was a priori expected, its standard error is not small enough to discard completely the possibility of a null effect. A 95% confidence interval yields values for α_1 in the range (-0.056, 0.205). Although this interval is suggestive of the likely presence of a positive effect of ownership on costs, we cannot state unambiguously its presence in our sample of airlines.

Keeping in mind this caveat, if the actual estimated coefficient α_{pub} may be assumed to be valid, it would be indicating the presence of a cost difference of 7.7% between a public airline and a private one, for the average firm size in the sample (i.e. an airline with an average output level of 9,763 mill. available ton-km). Compared to the 10.5% value reported by Windle (1991) referred to 1983, the smaller value obtained in our sample for the period 1990-1995 could be indicative of an improvement in the outcomes of publicly-owned European airlines. However, the detected cost-augmenting impact of public ownership on costs would lead to recommend more privatizations in the sector for those countries that still keep their flag airlines as government-owned firms, if they want to improve their efficiency.

Efficiency results of individual airlines

Residuals obtained from the estimated cost function are used here to estimate the potential cost reductions that inefficient airlines may achieve. Since the complete value of the term u in the cost function is interpreted as departure from the efficient frontier, on the assumptions mentioned above, by definition we obtain positive values for u but negative for others. Therefore, the negative values reported in the following table must be interpreted as the cost savings that highly efficient firms are already obtaining with respect to the average frontier in the industry.

There are some surprising results in table 4, which seem to contradict some common wisdom in the European air industry. These are namely the high efficiency values that Alitalia and Olympic show, and the large potential cost reduction obtained for Lufthansa. Our reading of these results is that one should be extremely careful when interpreting comparative studies between firms from different countries, since the simple fluctuation of exchange rates may be introducing distortions on the firms' observed outcomes. For the case of Lufthansa, Oum and Yu (1997) have concluded that an appreciation of the German mark may be the main cause of the low position in the world airlines' efficiency ranking obtained by them for this company using 1993 data, and a similar effect is found in their work for the Japanese company JAL.

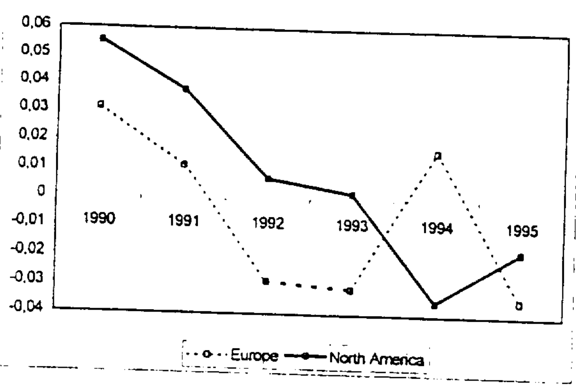
Table 4: Potential airlines' cost reductions

Europe		North America	
Air France	8.14%	Air Canada	9.72%
Alitalia	-8.88%	American	6.35%
Austrian	7.70%	Canadian	2.85%
British Airways	-5.31%	Continental	-3.44%
British Midland	-0.99%	Delta	-4.84%
Finnair	5.74%	Northwest	-3.66%
Iberia	13.69%	TWA	-5.54%
KLM	-7.63%	United	3.14%
Lufthansa	8.59%	USAir	4.35%
Olympic	-10.71%		
SAS	24.56%		
Swissair	-3.73%		
TAP	13.19%		

Our suspicion is that the same currency effect may be the cause of our results for Alitalia and Olympic, on the opposite direction to that of Lufthansa. In fact, during the period 1990-1995 both the lira and the dracma have suffered considerable depreciations against the dollar. The lira was devaluated several times and finally excluded from the European Monetary System in 1992, and since then it has followed a decreasing trend. In 1995, its value against the dollar was around 25% lower than at the beginning of our covered period. A similar pattern is observed for the dracma, which lost around 30% of its value against the dollar during this 6-year period. Estimated efficiency results for both these companies are then likely to be affected by this rapid fluctuation of their national exchange rates, and should not lead to conclude that Alitalia and Olympic are highly efficient airlines.

A final exercise performed using the residuals from our estimated cost function is to analyze the existence of some temporal variation on the efficiency patterns. This cannot be done for all individual firms, since it has been mentioned several times along the work that there are many missing observations in our sample, so that for some airlines only 2 or 3 observations out of 6 may be available. Instead, we have opted for computing for each year the average value of residuals of those companies for which data are available. This is done separately for European and American firms to compare the evolution of airlines' efficiency in both regions. The obtained averages are presented in figure 8.

Figure 8: Evolution of average residuals



The absolute value of averages should not be interpreted as the potential cost reduction of the region for that particular year, since averages are computed over a changing number and mix of companies, therefore the presence or absence of a extremely (in)efficient firm may affect the results. The idea of these averages is simply to check if any systematic trend is observed.

As a matter of fact, the analysis of figure 8 seems to indicate the presence of a decreasing pattern in the evolution of the residuals' averages, both for Europe and North American airlines, although for the case of Europe the observation corresponding to year 1994 seems to lie away from the general trend. The interpretation of these trends is that airlines in both regions have been improving their outcomes in the direction of becoming more cost efficient during the period 1990-1995.

6. CONCLUSIONS.

- A descriptive analysis shows differences between European and North American airlines during the period 1990-95, both in terms of unit costs and productivity. American firms have lower unit costs, and this is mainly due to labour unit cost differentials, but also to some energy cost advantage. Productivity per employee is also much higher for American airlines, although from 1990 onwards, this is not the case for pilots, which work a very similar number of hours per year to pilots employed by European airlines.

- European firms seems to have improved their performance over the period in terms of unit costs and productivity. Labour cost has been constantly decreasing from 1990 to 1995, probably through workforce shedding and some improvements in employees' productivity. Indeed, the indicator showing the production per employee has substantially grown during the period, although there is still a large gap when compared to American levels.

- The estimated translog cost function provides more reliable efficiency comparisons, in the sense that all exogenous factors affecting airlines' production are controlled for. Some findings from our estimates are relevant to be mentioned: first, mild returns to density and returns to scale are obtained for the industry, with coefficients of 1.06 and 1.2, respectively. However, the presence of economies of scale is notably reinforced if the correction of the effect of changes in output and network over other exogenous factors proposed by Oum and Zhang (1997) is performed. In that case, a value of 1.58 is obtained, although we believe this high value may be in part affected by the large elasticity of costs to average route distance that we obtain in our work (-0.68). Another technical result is that no significant cost complementarity between passenger and cargo services is detected.

- Regarding the effect of public ownership, we estimate that for an average airline producing an output of 9,800 million ton-km a year, there exists a 7.7% cost differential if the company is publicly owned. However, the estimated parameter to check this effect is only weakly significant, therefore the result should be carefully taken. In any case, the value is in the range of that reported in other studies (Windle (1991) obtained a value of 10.5% for year 1983).

- The analysis of airlines' efficiency is performed using the residuals from the estimated cost function. Average values over the period for each company are used, to eliminate random factors as much as possible. Using these averages, potential cost savings are computed for airlines, with respect to the estimated frontier. For the group of European firms, British Airways and KLM appear as the more efficient, with costs below the average efficient values. Strange results are obtained for the cases of Alitalia and Olympic, which show as efficient firms, but we believe their observed outcomes may be affected by currency fluctuations. This type of exchange rates' effect has been previously detected by Oum and Yu (1997), specially for the case of Lufthansa, for which we also report a non-expected inefficient profile. The more inefficient firms in the European group are SAS, Iberia and TAP.

- For the North American group, the more efficient US airlines are in our sample Continental, Delta, Northwest and TWA. Both Canadian firms included in our sample show up as relatively inefficient, with a poorer performance for the case of Air Canada.

References

Baltagi, B.H.; Griffin, J.M. and Rich, D.P. (1995): "Airline Deregulation: The Cost Pieces of the Puzzle", *International Economic Review*, 36 (1), pp. 245-258.

Caves, D.W.; Christensen, L.R. and Tretheway, M.W. (1984): "Economies of Density versus Economies of Scale: Why Trunk and Local Service Airline Cost Differ", *Rand Journal of Economics*, 15, pp. 471-489.

Caves, D.W.; Christensen, L.R.; Tretheway, M.W. and Windle, R. (1987): "An Assessment of the Efficiency Effects of US Airline Deregulation Via an International Comparison", in Bailey, E. (ed): *Public Regulation: New Perspectives on Institutions and Policies*, MIT Press, Cambridge, MA.

ICAO (1992): "Regional Differences in Prices and Costs of International Passengers and Cargo Air Services", Circular 254-AT/104, Montreal.

Gillen, D.W.; Oum, T.H. and Tretheway, M.W. (1990): "Airline Cost Structure and Policy Implications: A Multiproduct Approach for Canadian Airlines", *Journal of Transport Economics and Policy*, 24, pp. 9-34.

Jara-Díaz, S. and Cortés, C. (1996): "On the Calculation of Scale Economies from Transport Cost Fucntions". *Journal of Transport Economics and Policy*, May, pp. 157-170.

McShan, S. and Windle, R. (1989): "The Implications of Hub-and-Spoke Routing for Airline Costs and Competitiveness", *Logistic and Transportation Review*, 25, pp. 209-230.

Oum, T.H. and Zhang, Y. (1997): "A Note on Scale Economies in Transport", *Journal of Transport Economics and Policy*, 31 (3), pp. 309-315.

Oum, T.H. and Yu, C. (1997): "Cost Competitivenes of Major Airlines: An International Comparison", mimeo; paper presented at the ATRG Conference, University of British Columbia, Canada.

Windle, R. (1991): " The World's Airlines: A Cost and Productivity Comparison", *Journal of Transport Economics and Policy*, 25 (1), pp. 31-49.

Appendix 1: Estimation of Economies of Scale from aggregate cost functions.

Defining product in air transport generate problems. What must be considered as production, the number of passenger carried between Madrid and London?. It can be considered a different product, passenger carried in business class and tourist class? Or even the different fares for tourist class that force to passengers to carry out specific conditions? Neither can be considered the same product, a direct flight between Madrid and London, that an indirect flight through Paris or Barcelona. In general transport industry and in particular air transport can be defined as an industry characterised by multiproduction.

A precise definition of product in air transport would require at least an n dimension vector to recover each origin-destination (see Jara-Díaz, 1996). This make very difficult to estimate cost functions because is necessary to have available the cost components for each journey type. The use of aggregate cost functions tries to solve this information problem.

So a vector of aggregate products $(\breve{y})$, tonnes-kilometres or passenger-kilometres, and a vector of qualities (q), load factor, number of points seved or average stage lenght, try to represent the true output of the company (see Jara and Cortés, 1996).

So we have a real cost function since we would have to estimate the economies of scale.

$$C(W, Y, X)$$

And we have an aggregated estimated cost function to obtain them.

$$\tilde{C}\left(W, \tilde{Y}, q\right)$$

So any estimation of $\hat{C}(\breve{y}, q)$ can be considered as an implicit representation of the true cost function C(Y).

$$\hat{C}(Y) \equiv \tilde{C}\left[\tilde{Y}(Y), Q(Y)\right]$$

Either $\breve{y}(Y)$ as q(Y) depends on the true desegregated output Y.
Marginal Cost respect to components Y_i of Y can be obtained as:

$$\frac{\partial \hat{C}}{\partial Y_i} = \sum_{j=1}^{m} \frac{\partial \tilde{C}}{\partial \tilde{Y}_j} \frac{\partial \tilde{Y}_j}{\partial Y_i} + \sum_{k=1}^{p} \frac{\partial \tilde{C}}{\partial q_k} \frac{\partial q_k}{\partial Y_i}$$

So the estimated cost elasticity respect to Y_i:

$$\hat{\eta}_i = \sum_{j=1}^{m} \varepsilon_{ji} \tilde{\eta}_j + \sum_{k=1}^{p} \varepsilon_{ki}^{q} \eta_k^{q}$$

where:

ϵ_{ji} = aggregated output $\breve{y}_i$ elasticity respect to Y_i.
ϵ_{ki}^{q} = quality output q_k elasticity respect to Y_i.
η_j = cost elasticity respect to aggregated output = traslog coefficient

η_k^q = cost elasticity respect to quality = traslog coefficient.

Then estimated index of economies of scale can be obtained as:

$$\hat{s} = \left[\sum_i \hat{\eta}_i\right]^{-1}$$

$$\hat{s} = \left[\sum_{j=1}^{m} \alpha_j \tilde{\eta}_j + \sum_{k=1}^{p} \alpha_k^q \eta_{q_k}\right]$$

where:

$$\alpha_j = \sum_i \varepsilon_{ji}$$

$$\alpha_{q_k} = \sum_i \varepsilon_{q_{k_i}}$$

Therefore, products and qualities elasticities are compensated by weights to obtain the level of economies of scale from the aggregated cost function.

The most important question is that to obtain the level of economies of scale all aggregated output variables and all qualities must be included.

For aggregated output measures, Tonn-kilometres and Passenger-kilometres, ϵ_{ji} , have value 1 (see Jara and Cortés, 1996), so it's not necessary to weigh the elasticities obtained directly from the cost equation estimated.

For quality measure, average stage length, the weight to compensate elasticity of this quality have value 0, so this quality must not be included in the calculation of economies of scale (Jara and Cortés, 1996). For the quality measure, average load factor, a sensitivity analysis must be done between 0 and 1 (Jara and Cortés, 1996). In the first case that would mean that additional increments in demand is compensated by an increase in the frequency to maintain load factor constant. In the second case an increase of demand affects directly to load factor because frequency is maintained constant. As alternative for this variable (Oum and Zhang, 1997) make an estimation of the elasticity of load factor respect to output directly.

Appendix 2: estimation results

Method: Full Information Maximum Likelihood
Equations: Costs ShareL ShareK ShareMEndogenous Variables: LCOST SL SK SMConvergence Achieved after 8 Iterations Log of Likelihood Function = 929.166

Number of Observations = 105

Parameter	Estimate	Standard Error	t-statistic		
α_0	8.09162	.034530	234.334α_{pub}	.074247	.065351
	1.13614α_p	.899812	.071401	12.6023α_c	.046165
	.073606	.627194α_{pc}	-.877938E-02	.015889	-.552553
β_L	.298475	.787987E-02	37.8782		
β_E	.041686	.065702	.634469		
β_K	.163176	.187522E-02	87.0168		
β_M	.423682	.697966E-02	60.7024		
γ_{LL}	.164447	.023266	7.06825		
γ_{EE}	.478189	.426951	1.12001		
γ_{KK}	.100389	.724344E-02	13.8593		
γ_{MM}	.147563	.019613	7.52390		
γ_{LE}	.035056	.029829	1.17523		
γ_{LK}	-.047149	.740266E-02	-6.36915		
γ_{LM}	-.057877	.019046	-3.03886		
γ_{EK}	-.031717	.665419E-02	-4.76641		
γ_{EM}	-.070314	.028228	-2.49090		
γ_{KM}	-.054244	.507834E-02	-10.6814		
δ_{Lp}	-.093457	.033024	-2.82999		
δ_{Ep}	-.312558	.175433	-1.78164		
δ_{Kp}	.015013	.738983E-02	2.03161		
δ_{Mp}	.073998	.027250	2.71550		
δ_{Lc}	.073590	.026576	2.76905		
δ_{Ec}	.266696	.160444	1.66223		
δ_{Kc}	-.920714E-02	.660879E-02	-1.39317		
δ_{Mc}	-.073718	.021773	-3.38577		
λ_p	-.587879	.355514	-1.65361		
λ_c	-.066608	.072180	-.922806		
λ_{ch}	-.118364	.363659	-.325479		
λ_{avsl}	-.681593	.144055	-4.73148		
λ_{net}	-.110937	.074551	-1.48807		

Equation Costs

Dependent variable: LCOST

Mean of dependent variable = 8.15123
Std. dev. of dependent var. = .957915
Sum of squared residuals = .785391
Variance of residuals = .747992E-02

Std. error of regression = .086487
R-squared = .991772
Durbin-Watson statistic = 1.97060

Equation ShareL

Dependent variable: SL

Mean of dependent variable = .299019	Std. error of regression = .042379
Std. dev. of dependent var. = .075261	R-squared = .679969
Sum of squared residuals = .188575	Durbin-Watson statistic = 2.61761
Variance of residuals = .179595E-02	

Equation ShareK

Dependent variable: SK

Mean of dependent variable = .163162	Std. error of regression = .011739
Std. dev. of dependent var. = .036166	R-squared = .893631
Sum of squared residuals = .014470	Durbin-Watson statistic = 2.25017
Variance of residuals = .137805E-03	

Equation ShareM

Dependent variable: SM

Mean of dependent variable = .423124	Std. error of regression = .036562
Std. dev. of dependent var. = .069013	R-squared = .717274
Sum of squared residuals = .140361	Durbin-Watson statistic = 2.58134
Variance of residuals = .133677E-02	

S5-03
385673
p 18

Overview of Regulatory Changes in International Air Transport and Asian Strategies Towards the US Open Skies Initiatives

by

Tae Hoon Oum

Van Dusen Foundation Professor of Management
Faculty of Commerce and Business Administration.
The University of British Columbia
2053 Main Mall
Vancouver, B.C. V6T 1Z2, Canada
Phone: 1-604-822-8320; Fax: 1-604-822-8521
E-mail: tae.oum@commerce.ubc.ca

* The earlier version of this paper was presented at the opening session of the First Asia Pacific Transport Conference: International Transport Liberalization in Seoul, Korea, December, 1997. I would like to thank the participants of that PECC Conference, Trevor D. Heaver and Chunyan Yu for helpful comments. I acknowledge gratefully the research grant support of the Social Science and Humanities Research Council of Canada (SSHRC) and travel support by the Pacific Economic Cooperation Council (PECC) Canadian Office.

Overview of Regulatory Changes in International Air Transport and Asian Strategies Towards the US Open Skies Initiatives

by

Tae Hoon Oum

This paper identifies major issues facing Asian airlines and governments when they deal with the U.S. open skies initiatives directed towards Asian countries, and suggests how they might deal with those issues strategically and practically. The paper is organized as follows. Section I is a brief history of international air services regulation including the recent US initiatives for open skies and creation of European single aviation market. Section II identifies some key problems associated with traditional air services treaty negotiations. Key lessons from the US-Canada Open Skies agreement are described in Section III. Section IV identifies major challenges that the US open skies initiatives bring to Asian carriers and governments. Section V describes the suggested strategies for Asian carriers and governments to deal with the US open skies initiatives. The paper ends with a summary and conclusions.

History of International Air Services Regulation

History of Bilateral System. Prior to World War II, U.S. airlines negotiated directly with foreign governments for the rights to serve foreign territories. Although the State Department sometimes assisted U.S. airlines, only in 1943 did the U.S. government begin to assume responsibility for air service negotiations (Taneja, 1976, p.258). [1] At the 1944 Chicago Convention on International Civil

[1] The basic rule of international law regarding commercial aviation was established at the Aeronautical Commission of the Peace Conference in 1919 in Paris. The Paris Convention established the International Commission for Air Navigation to revolve any technical problems arising between countries. Although the US did not ratify this convention, the Pan American Convention signed in Havana in 1928 agreed to most of the principles

Aviation, the United States pressed for an open, multilateral regime for postwar international air services.[2] The Convention failed to produce a multilateral agreement on commercial air transport rights for international air transport services. Since then, all commercial aspects of international air transport matters have been governed by bilateral air treaties between the countries involved. The US and UK signed the first bilateral agreement in 1946, known as "Bermuda I", which has provided a framework for other bilaterals to follow (Kasper, 1988, p.5).

The Chicago Convention also set up the International Civil Aviation Organization (ICAO), an inter-governmental agency which provides a forum for discussion of key aviation issues and the basis for world-wide coordination of technical and operational standards and practices. Acting as a counterweight to ICAO, IATA was established in 1945 to represent the interest of airlines, and is involved in technical and commercial aspects of aviation. IATA served as an effective industry cartel for a long time.

Bermuda I was a fairly liberal agreement in that it included no capacity limit on 3rd/4th freedoms, multiple carrier designations, and substantial 5th freedom rights. However, thirty years later in 1976, the UK gave notice of termination of Bermuda I, claiming that under the terms of the treaty, the US carriers had a disproportionate share of traffic. The US was forced to sign Bermuda II agreement in 1977 which accommodates British demands to virtually eliminate multiple carrier designations, limit capacity supplied, and give up some of US carriers' "beyond rights" to carry traffic between Britain and other countries. It was a devastating policy setback for the US (Toh, 1997).

Bilateral agreements typically regulate carrier and route designations, capacity and frequency of services, pricing, and other commercial as aspects of doing business. Bilateral agreements are based on the principle of reciprocity, an equal and fair exchange of rights between countries very different in size and with airlines of varied strength. Bilateral agreements vary in form, but they generally specify services and routes to be operated between the two countries, designate airlines and

---

of the Paris Convention.

[2] This U.S. intent was consistent with its national interest. After WW- II, the U.S. emerged as just about the only nation in the world who could successfully launch commercial scale international airline services. The U.S. had aircraft, technology, trained personnel and financial ability while the war had devastated the European countries and Japan

capacity to be provided by each airline, stipulate fare setting mechanisms, and specify conditions under which passengers may be taken or picked up in each country and flown to third countries (fifth freedom rights). There is, at present, an extensive network of bilateral agreements. Each international airline faces a complex web of bilateral air services agreements signed by its home state. The existence of these bilateral agreements has greatly constrained the freedom of individual scheduled airlines, and limited competition in the international air transport industry (Oum and Yu, 1997, ch.3).

Towards Competitive System - US Initiatives. The deregulation of the U.S. domestic air transport markets in 1978 has demonstrated the advantages of competitive airline system. On international air services, Carter Administration launched the pro-competitive policy by signing the Presidential Statement on International Air Transport Negotiations in August 1978. The underlying philosophy of the policy (which became the main trust of the International Air Transport Competition Act of 1979[3], IATCA) was that "maximum consumer benefits can best be achieved through the preservation and extension of competition between airlines in a fair market place". This broad aim was to be achieved through renegotiation of bilateral air services agreements (Dresner and Tretheway, 1987). A series of crucial bilateral negotiations were thus conducted over the period 1977-82, resulting in the liberal bilateral agreements signed between the United States and 23 countries including the Netherlands, Germany, Belgium, Israel, Singapore, Thailand[4], Korea, and the Philippines (Haanappel, 1983). The effect of these liberal bilaterals was dramatic expansion of the number of airlines operating, the total scheduled capacity offered in those markets, and the number of US gateway points with direct services to European or Asian destinations.

The new US aviation policy also directly affected IATA's price-setting activities. In June 1978, the US Civil Aeronautics Board (CAB) issued an order requiring IATA and associated parties to show cause why CAB should not withdraw its approval of, and consequently anti-trust exemption

---

[3] United States, Public Law 96-192, 1980, 94 STAT. 34.

[4] Thailand renounced its air service agreement (ASA) with the U.S. in 1990, claiming the agreement favored US airlines. A new agreement was signed in May 1996 to open their aviation markets to each other's carriers.

for, IATA's Traffic Conferences and other related agreements[5]. Without exemption from anti-trust legislation, airlines participating in pricing agreements would risk being taken to U.S. court when flying to the United States. The immediate short-term effect of the Show Cause Order was the withdrawal of all US airlines from IATA membership. Over 40 percent of IATA member airlines' international traffic was to and from the United States, so the potential threat to IATA was considerable. Although the Show Cause Order was subsequently abandoned amidst protests from governments worldwide, it undoubtedly seriously undermined IATA's influence in the industry.

In March 1992, the United States offered to negotiate transborder "open skies" agreement: with all European countries. The first US "open skies" deal was signed in September 1992 betwee: the U.S. and the Netherlands. In February 1995, US and Canada signed an open skies agreemer with a three year phase-in provision. In May 1995, open skies agreements were signed between tr United States and 9 European countries including Switzerland, Sweden, Norway, Luxembour , Iceland, Finland, Denmark, Belgium, and Austria[6]. One year later, an open skies agreement w s signed between the U.S. and Germany (Kayal, 1997). The U.S. also signed a phased open sk s agreement with the Czech Republic in December 1995, the first such pact with a former Eastern b: c country[7]. Talks between the US and UK over an "open skies" accord are underway as a prerequi te for approval of the proposed BA-AA alliance[8]. In all, about 40% of Europe-US traffic flies un er open skies (Hill, 1997).

Following the successes in Europe, the U.S. started to shift the focus of its internatic al aviation policy to Asia. The U.S. Open Skies initiative in Asia was announced in summer 1996, nd by April, 1997, Singapore became the first country in Asia to sign an open skies agreement. Du ing the 1997, Brunei, Malaysia, Taiwan and New Zealand have also agreed on open skies accords ith the United States (US DOT News 91-97).

---

[5] United States, Civil Aeronautics Board, Order 78-6-78, June 12, 1978.

[6] According to Air Transport Association of America (1995), the United States signed new libera agreements or amendments with 16 countries in 1995.

[7] It offered a similar agreement to Poland too, but still needs to work it out.

[8] The United States has made open skies a condition for approving codeshare alliances.

Towards Competitive System - European Initiatives. The European Union has been active in deregulating its internal market through the adoption of the three packages for liberalization (Tretheway, 1991, and Marin, 1995). From April, 1997, the EU created a single aviation market similar to the US domestic market. Any EU-registered carrier has the right to run domestic services within any of the EU's 15 member countries, as well as in Norway and Iceland. The single European aviation market thus became the world's largest single aviation market with more than 370 million potential passengers. National ownership rules have been replaced by EU ownership criteria. Airlines have been given freedom to set fares, with safeguards against predatory pricing through competition rules.

So far, these changes do not apply to extra-EU agreements. Negotiation on foreign carriers' access to EU member states presently remains with individual members of the community. Many of its Member States have been pursuing liberal bilateral air services agreements with non-EU states, including 'Open Skies' agreements with the US (Button, 1997). However, the European Commission opposes independent negotiation by individual states, and is making efforts to negotiate air treaties on behalf of member states as a bloc. The EU transport ministers recently decided to authorize the Commission to negotiate a multilateral aviation agreement with the United States (Barnard, 1996). The Commission is promoting a deal with the United States as a model for EU-wide accords with third countries.

Bilateral and Multilateral Approaches for Liberalization

Flaws in Current Bilateral Process and Proposed Solutions. In many countries, flag carriers are allowed to influence bilateral negotiation process. This is especially true when a country has only one airline. Carrier interests are bound to dominate the bilateral negotiation process while consumer interests tend to take a back seat. In this environment, although consumers gain, governments would not agree to increase competition unless their flag carriers can also win. This definitely is one of the reasons why the countries with competitive carriers are pro-liberalization while other countries oppose liberalization. This bilateral process is, therefore, unworkable unless liberalization offers win-

win situation to the carriers of both countries involved. It is inherently flawed because increased competition usually makes some players to win and some to lose.

In order to make the bilateral process to work, aviation should be included in the negotiations for the broader goods and services trade. This would offer a better chance for striking a compromise between countries. This would allow the theory of comparative advantage takes its course in determining winning industries of each country. It is arguable that the European countries were able to form a single European air services market because the aviation was included as a part of the whole economic integration among the EU member states. It was possible to agree on a single aviation market despite the fact that some countries will eventually lose their airlines and much of the associated employment base.

There are two additional ways to improve the bilateral air negotiation process. First, as countries deregulate their domestic markets, new entrants will emerge. Sooner or later, some of these new entrants will be allowed to enter international markets. This will tend to reduce the influence of flag carriers in the bilateral negotiation process as the governments need to deal with conflicting interests between the competing carriers, and it needs to be seen to play fair to the multiple carriers. There is also a strong empirical evidence that countries with multiple carriers make efforts to increase competition via multiple designation of carriers. In addition, deregulation of domestic airline markets has positive effects for increasing competition in international markets. Secondly, economic advancement tends to enhance consumer power and encourage consumer movement. This will likely add to the weight for consumer benefits of increasing competition relative to the weight given to the carrier interests.

Multilateral Approach. There is no obvious reason why international aviation matters should be handled any differently from other international trade matters. Especially, telecommunications services have been included in the General Agreement on Trade in Services (GATS) framework. Multilateral fora give better chances for liberalization on a regional or global scale. Eventually, international air transport matters should move towards multilateral fora which can strike package deals among participating countries. It is nearly impossible for countries to agree on a multilateral liberalization package on air transport without the opportunities to tradeoff with other sectors of economy. Therefore, ICAO would not be an effective forum to discuss liberalization of air transport because liberalization of air transport will always create winners and losers. WTO, APEC and/or ASEAN stand a better chance of liberalizing air services along with other goods and services because most countries will be able to find some winning industries.

Lessons from the Success of the US-Canada Open Skies Agreement

Until WTO and/or APEC becomes an effective multilateral fora to negotiate air services liberalization, the aviation industry is stuck with bilateral air treaty process. Liberalization between like-minded countries are probably the only option in the short run. In this case, US-Canada open skies agreement signed in February, 1995, serves as a successful example with some useful lessons.

Prior to February, 1995, the US and Canada had one of the most restrictive bilateral air services agreements although they share the largest bilateral air services market in the world. Experts agreed that, in the event of an open skies agreement, Canadian carriers would be structurally disadvantaged as compared to the major US carriers. Canada's fear was based on the following reasons. First, US carriers have well developed continental services network supported by large population and strong and defensible hubs. Second, since the majority of transborder travelers originate from or destined to eight major cities in Canada, the US carriers would be able to reach over 80% of Canadian transborder market cost effectively by extending their spokes to these Canadian cities from their US hubs. Third, Canadian carriers may not be able to access landing slots, gates and counters at some congested U.S. airports, so they may not be able to initiate new services or provide high frequency services.

Although there were disagreements on the extent of these problems, both sides agreed that these problems existed. In order to remedy the situation and create a level playing field, the two countries agreed on the following measures. First, US carriers entry into major Canadian markets (Toronto, Montreal and Vancouver) are to be relaxed gradually over a three-year phase-in period[9]

[9] In fact, a two-year phase-in period was adopted to Montreal and Vancouver while the full three-year period was used for Toronto.

while allowing Canadian carriers into the US market from day 1 without any limitation. Second, the U.S. guaranteed that Canadian carriers get some additional airport slots and gate spaces at the congested US airports such as Chicago and LaGuardia in New York.[10]

In addition to these efforts to create the level playing field, there were several important factors which helped conclude the open skies agreement. First, both of the two major Canadian carriers (Air Canada and Canadian Airlines International) had alliance relationship with at least one major US carriers. Air Canada had the alliance with United while Canadian had an equity alliance with American Airlines (Oum and Park, 1997).[11] These alliance relationships reduced some fear of Canadian carriers. Second, shortly before the open skies agreement with the U.S., Canada transferred the operating rights of four major airports (Vancouver, Montreal, Edmonton, Calgary) to the local airport authorities. These airport authorities representing the local business interests played an important role in lobbying vigorously for the open skies agreement. Third, the negotiation on the open skies air services was conducted taking into account the overall economic and political relationships between the two countries. These other relationships were taken into account indirectly because President Clinton and Prime Minister Chretien appointed their respective special negotiators. At this high level of negotiation, other economic and political factors could play an important role at least indirectly.

The most important lesson learnt from the US-Canada open skies agreement is that it is possible to create level playing field even if the flag carriers of the two countries are not equally competitive. For example, if airlines in China feel insecure about liberalization of bilateral agreement with, say, Korea. Koreans may be able to offer significant concessions such as doing codesharing alliance with the Chinese flag carriers via which they can pool traffic and/or revenue. Even though these measures may be construed as an anti-competitive behavior in western industrialized countries, the opening up of Chinese aviation market itself increases competition and thus benefit air travelers.

---

[10] The three-year anniversary report published by the US DOT (1998) indicates that Air Canada has done outstandingly well and Canadian has done very well during the last three years. The total US-Canada transborder passenger traffic has increased by 37.2% (12.1 million to 16.6 million).

[11] Air Canada also had alliance with Continental which it had 28.5% ownership. American owns 33.3% equity shares of Canadian.

Challenges Posed by the U.S. Open Skies Initiatives on Asian Carriers and Governments

The US Open Skies Initiatives. The U.S. government announced its Open Skies initiative in Asia in summer 1996. In January 1997, Singapore became the first country in Asia to sign an open skies agreement with the United States[12]. Since then the U.S. government has accomplished open skies air service agreements (ASAs) with Brunei (January, 1997), Taiwan (February, 1997), Malaysia (June, 1997), and New Zealand[13]. Most of these agreements allow airlines from both countries fly between any point in the U.S. and any point in that country with no restrictions on capacity or frequency. The agreements also provide unlimited beyond traffic (5th freedom) rights to both countries' carriers. In addition, at least the agreements between the U.S. and Singapore and Brunei includes Seventh Freedom traffic rights on cargo (hubbing rights in foreign territory). The latter provision is intended to help Federal Express and UPS to set up mini-hubs in Asia.

The U.S. government has started to work on other countries including (South) Korea and Thailand. In particular, the U.S. is seeking change of gauge rights (change of aircraft size) as a very important element for doing Open Skies agreement with Korea. The main reason is that the U.S. carriers who already have extensive 5th freedom rights in Korea wish to operate small aircraft on their intra-Asia routes to/from Seoul while taking advantage of economies of larger aircraft size in transpacific markets. On the other hand, the Korean side is concerned about "past imbalance" in the US-Korea ASA and is very reluctant to allow the change of gauge.[14] Korea will also need to worry about potential retaliation by Japan if Korea allows US carriers the change-of-gauge rights. This is because U.S. carriers would be able to take away a significant portion of the Japan's international travellers from the struggling Japanese carriers, and route them via Seoul.

---

[12] The U.S. also reached agreements on open skies with Taiwan and Brunei in early 1997 (US DOT News 48-97).

[13] Similar agreements were signed with six Central American Countries during the same month (US DOT News 82-97).

[14] A U.S. official is reported as saying that the U.S. has "change of gauge" rights with the twelve European nations with which it signed open skies agreements (Ballantyne, 1997).

Despite the denial by a senior U.S. government official,[15] the progress in Asia parallels the U.S. approach in Europe, where a series of open skies treaties with "soft targets" eventually led Germany into signing a deal. The U.S. is now working on the U.K. and France. In Asia, it appears that Washington's strategy includes forcing Japan to liberalize.[16] Of course, in this approach Korea holds a key to the U.S. policy given its proximity to Japan and somewhat liberal attitude on international air transportation matters. The new US policy toward Asia has shifted away from focussing directly on Japan to working with the rest of Asian countries because successes with other Asian countries will later pressure Japan to sign a truly open skies bilateral.

Undoubtedly, the U.S. government will have open skies or nearly open skies treaties with a number of Asian countries within a few years. Since many of these open skies agreements may include extensive fifth freedom and some seventh freedom rights (hubbing or change of gauge rights), U.S. carriers may be in a position to set up intra-Asian services more freely than most Asian carriers can. This can happen because bilateral agreements between Asian countries have quite restrictive 3rd/4th freedom traffic rights. For example, most of intra-Asian ASAs apply the "equal benefits" principle for determining capacity and frequency of services while the U.S. carriers could have complete freedom to set their flight frequency and prices in the same markets. Because the potential negative consequences of such an anomaly has caused enough worry to some countries, the ASEAN transport ministers have established a group to study this problem and to develop a competitive air services policy as a prelude to an eventual open skies regime in ASEAN.

---

[15] Mr. Mark Gerchick, Deputy Assistant Secretary of State for Transportation, has said in his interview published in *Orient Aviation* (June/July, 1997 issue) that the U.S. government approach to Asia does not include a strategy of "divide and conquer", designed to pressure the toughest target of all, Japan, into U.S. liberalization demands.

[16] Although Japan signed a fairly liberalized agreement with the U.S. in January1998, it has not changed Japan's basic stands of regarding the bilateral with the U.S. as being "unfair"and "unbalanced". In the new four-year deal, Japan recognizes the unlimited beyond rights to the three U.S. carriers (United, Northwest and Federal Express). It also allows All Nippon Airways increased access to a number of U.S. cities in exchange for increasing opportunities for the U.S. MOU (Memorandum of Understanding) carriers on 3rd/4th freedom markets between the two countries.

Dismantling Restrictive Intra-Asian Bilateral Agreements.

Although the US has open skies agreements with many European countries, the EU countries can deal with the situation without much difficulty because they formed a single unified aviation market from April, 1997. In other words, European carriers would enjoy more freedom in the intra-European markets than any US carriers. However, the situation could get serious in Asia if US carriers start to take full advantage of the open skies agreements in Asia, and set up efficient intra-Asian network. The Asian carriers would not be able to compete effectively with the US carriers in their own continent because what they can do is limited by the restrictive bilateral agreements with their Asian neighbors. They will need to persuade their governments to dismantle those restrictive bilaterals.. Therefore, if enough number of Asian countries sign open skies agreement with the US, this would lead to a situation where the restrictive bilaterals between Asian countries will need to be dismantled wholesale.

Strategies for Asian Carriers and Governments

Intra-Asian Open Skies First.

Ideally, open skies should occur first among the Asian countries, and then, with countries outside of Asia. Creation of the open skies continental air transport market is in the interest of Asian carriers and consumers. Such a pro-competitive policy will help Asian carriers in several ways.[17] First, it will allow the Asian carriers to compete effectively with the US carriers in their back yard. Second, it will allow major Asian carriers to set up an efficient multiple hub network covering the entire Asian continent effectively. This will help put Asian carriers in equal status as the US and European mega carriers in forming global alliance service networks (Oum, 1997).[18] Third, Asian carriers based in

[17] In fact, open competition may lead to failure of some carriers and changes in the industry structure and carrier networks.

[18] Since none of the Asian airlines has effective coverage of entire Asian markets, a U.S. or European carrier seeking partners in Asia aligns with more than one competing Asian carriers. Therefore, they will be able to play one Asian carrier against another in order to extract better alliance conditions. In January 1998, Singapore Airlines (SQ) announced its alliance with Lufthansa, and most likely seek a membership in STAR alliance. This would put SQ at odds with Thai International who is already a member of STAR alliance.

the countries where input costs are rising fast would be able to shift their significant cost bases including employment to the countries which enjoys low input costs. This will lengthen the period in which the Asian carriers can enjoy unit cost advantage vis-a-vis US and European carriers.

Practical Measures.

Since it is impossible to achieve consensus among all Asian carriers and governments, liberalization among like-minded countries should be negotiated first. This would demonstrate benefits of liberalized air transport regime as well as illuminate the threat of traffic diversion from the protective countries. From the earlier discussions, the following measures may be fruitfully applied for liberalization within Asia.

(1) *Linking air bilateral with the negotiation on goods and services trade issues:* As discussed previously, this increases opportunity for compromise because each country may find some winning industries. This may require a significant change in institutional structure of governments involved. Currently, in most countries the Ministry of Transport personnel are the main people who control negotiation process for air bilaterals. This should be changed accordingly if trade-offs between air transport and other goods and services trade matters are to be made.

(2) *Compensating for differential competitiveness of carriers:* If carriers in a certain country are less efficient or structurally disadvantaged than other countries' carriers, it may be desirable to devise a method of compensating those carriers. This is important especially when dealing with China and India because their flag carriers are not competitive. For example, Chinese carriers are less competitive than other major Asian carriers such as Singapore or Korean Air. It is possible for Singapore or Korea Air to compensate the Chinese carriers in such a way that the benefits from the liberalized markets be shared nearly equally with Chinese carriers. Another way of compensating the disadvantaged carriers is to adopt some safeguard measures to protect those carriers for some time. For example, when the US-Canada Open Skies agreement was signed, the U.S. carriers were allowed in the three major Canadian cities only on a gradual basis (3-year phase-in) while Canadian carriers were allowed in the US market unlimited from Day 1.

(3) *Setting a time table for achieving open skies:* It is helpful to set a specific time schedule for liberalization and eventually achieving open skies even though the dates may be far into the future. This helps prepare both the carriers and governments for the eventual open skies.

(4) *Liberalize easier items first:* It is easier to liberalize the following items first.

- Relaxing foreign ownership limit on the second level flag carriers
- Relaxing charter and freight services.
- Relaxing scheduled services to and from secondary and local airports
- Relaxing third and fourth freedom schedule services rights
- Move towards multiple designation of carriers

VI. Summary and Conclusions

The U.S. open skies initiatives targeted towards Asian countries appear to have two clear objectives. First, it recognizes direct benefits for the U.S. carriers of having open skies agreements with Asian economies whose aviation markets are expected to grow very rapidly in the future. Second, despite the U.S. denial, the U.S. strategy appears to include a 'divide and conquer' strategy for forcing Japan to the open skies regime. Despite Japan's repeated threat to repeal its 'unbalance' 1952 Air Services Agreement with the U.S., it is not possible for Japan to take that course of action because of its fear of U.S. retaliation in the areas of general goods and services trade. Given the fact that Japanese international carriers are not cost competitive relative to the U.S. or other Asian carriers, the rational policy for Japan is to postpone the US-led open skies initiatives as long as possible. Japan may be counting on the fact that Korean carriers enjoy enormous market shares in the markets to and from Japan, and thus, it may be possible for Japan to discourage Korea from singing an open skies agreement with the U.S. Japan also knows that Korea is reluctant to give away change of gauge rights to the U.S. carriers. Korea plays a pivotal role concerning the U.S.-Japan air bilateral matters because Seoul can be used to siphon away traffic to and from Japan. The U.S. initiatives are not yet likely to succeed in the Northeast Asian market because of these factors. In addition, it is premature for either the Chinese government or Chinese carriers to even consider open skies with the U.S. This leaves some breathing room for Japan to fend off the threat of the U.S. open skies initiatives in the region if Korea does not sign an open skies with the U.S.

Unlike the U.S. or European carriers, none of the Asian carriers has efficient traffic collection and distribution network covering the entire Asian continent effectively. Essentially, each Asian airline has a fairly extensive network to and from its own capital city, but does not have any hubs in other parts of Asia. Therefore, major US or European carriers looking for Asian alliance partners have an incentive to align with more than one Asian carrier. Since these Asian carriers are mutual competitors in Asian market, they are at disadvantage in joining a global alliance network such as STAR Alliance. When two or more Asian carriers join a global alliance network, other senior partners in the global alliance network may be in a position to play one against another Asian carriers and thereby extract better conditions for alliance.

The recent U.S. open skies initiatives directed to Asian countries pose a major threat to Asian carriers. The U.S. wishes to negotiate for unlimited freedom for setting up hubs (star-burst operations) in Asian countries so that the U.S. carriers can provide high frequency services using smaller aircraft in the intra-Asian markets while enjoying economies of larger aircraft in the trans-Pacific routes. Since most Asian countries already have far more liberal bilateral agreements with the U.S. than among themselves, if one or two countries situated in strategic locations in Asia (such as Korea, Taiwan and Hong Kong) agrees to give unlimited seventh freedom rights or change of gauge rights to the U.S. then this will lead to dismantling of the system of restrictive bilateral agreements among Asian countries. This would happen because Asian carriers would be far more constrained in their own intra-Asian markets than the U.S. carriers. Most bilaterals between Asian countries have restrictions on seat capacity and/or frequency and pricing even on the third/fourth freedom traffic.

Therefore, it is better for Asian countries to create open skies bloc (or substantially more liberalized air transport region) before allowing the U.S. carriers to do hub (or star burst) operations in Asia. This will induce the major Asian carriers to set up an efficient multiple hub airline network covering the entire continent. This will also enhance their status in global alliance networks. In addition, this would allow the Asian carriers based in the countries where input costs are rising fast to shift their significant cost bases to the countries which enjoy low input costs. This will help prolong the period in which Asian carriers will have unit cost advantage vis-a-vis the U.S. or

European carriers.

Since it is impossible to achieve consensus among all Asian carriers and governments, liberalization among like-minded countries should be negotiated first. The following measures may be fruitfully applied for liberalization within Asia.

- Linking air bilateral with the negotiation on goods and services trade issues.
- Attempt to compensate the losses to the carriers' in developing countries who are expected to be disadvantaged in an open skies environment and/or to build in temporary safeguards for protecting those carriers.
- Setting future time table for achieving open skies to get carriers and governments prepare for the eventual open skies.
- Liberalize easier items first such as freight, charter, services to/from secondary airports, foreign ownership of secondary carriers, etc.

References

Air Transport Association of America (1995), *International Affairs Memoranda,* April 13, July 27, and December 8, Washington, D.C.

Ballantyne, T (1997), "Open Skies in Asia: Today's U.S. Perspective", *Orient Aviation,* June/July 1997, pp.22-26.

Barnard, B. (1996), "EU Wins the Right to Cut Air Deals with the US", *Journal of Commerce,* June 18, 1996, 1A

Button, K. (1997), "The Effects of Open Skies in the European Union," a paper presented at *the First Asia Pacific Transport Conference: International Transport Liberalization, 5-6 December, Seoul, Korea.*

Dresner, M.E. and M.W. Tretheway (1987), "Policy Choices for Canada in International Air Transport", *International Business/Gestion Internationale,* Proceedings of the Administrative Sciences Association of Canada, Vol. VIII (8), ed. Ian Gregory, 83-94

Haanappel, P.P.C. (1983), *Pricing and Capacity Determination in International Air Transport,* Kluwer: Deventer, The Netherlands.

Hill, L. (1997), "Bilateral Ballistics", *Air Transport World*, 2/97, 53-61

Kasper, D.M. (1988) *Deregulation and Globalization: Liberalizing International Trade in Air Services.* An American Enterprise Institute/Ballinger Publication.

Kayal, M. (1997), "European Airlines Flying in Open Skies", *Journal of Commerce*, March 31, 1997, 1B.

Marin, P.L. (1995), "Competition in European Aviation: Pricing Policy and Market Structure", *The Journal of Industrial Economics,* Vol. XLIII, No. 2, June, 141-159

Oum, T.H. (1997), "Challenges and opportunities for Asian airlines and governments," in (C. Findlay, C.L. Sien, and K. Singh eds.) Asia Pacific Air Transport, pp.1-20, published jointly by Australia-Japan Research Centre, Chartered Institute of Transport, Pacific Economic Cooperation Council (PECC) of Singapore.

Oum, T.H., and C.Yu (1997). *Winning Airlines: Productivity and Cost Competitiveness of the World's Major Airlines* (Kluwer Academic Press, New York, London), December, 1997.

Oum, T.H., and J.H. Park (1997). "Airline Alliances: Current Status, Policy Issues, and Future Directions," *Journal of Air Transport Management*, vol. 3, no.3 (1997), forthcoming.

Taneja, N.K. (1976) *The Commercial Airline Industry.* Lexington Books (Lexington, MA)

Toh, R.S. (1997), "Towards an International Open Skies Regime: Advances, Impediments, and Impacts" in Oum, T.H. and B.D. Bowen (eds), *the Proceedings of the Air Transport Research Group Conference* (June, 1997), vol. 1, no.1, published by Aviation Institute, University of Nebraska at Omaha, forthcoming in *Journal of Air Transport Management.*

Tretheway, M.W. (1991), "European Air Transport in the 1990s: Deregulating the Internal Market and Changing Relationships with the Rest of the World", Working Paper #91-TRA-003, Faculty of Commerce and Business Administration, The University of British Columbia, Vancouver, Canada.

U.S. Department of Transportation (1998), "The Impact of the New US-Canada Aviation Agreement At Its Third Anniversary," a Report published by Office of Aviation and International Economics, February.

A4

56 03

385674

p16

AVIATION POLICY IN SOUTH EAST ASIA: ALLIANCES, "OPEN SKIES" BILATERALS AND REGIONAL AIRLINE MARKETS

Paul Hooper, Associate Professor, Institute of Transport Studies, University of Sydney, NSW, 2006, Australia. Tel: 61+2+9351 0082; Fax: 61+2+9351 0088; Email: paulh@its.usyd.edu.au.

Chakrit Duangphastra, Institute of Transport Studies, University of Sydney, NSW, 2006, Australia. Tel: 61+2+9351 0068; Fax: 61+2+9351 0088; Email: chakrit@its.usyd.edu.au.

1 INTRODUCTION

Over the past decade, booming economies within South East Asia and in adjacent regions, especially North East Asia, have provided a foundation for strong growth in airline travel. Despite the potential for expansion, Thai International, Philippines Airlines and Garuda International have faced financial constraints and their competitive positions have weakened. They have lacked sufficient finance to grow and to upgrade their fleets, they have accumulated sub-optimal mixes of equipment, and they have been expected to provide uneconomic services that governments deem necessary. To a large extent, these same problems have beset Malaysian Airlines while Singapore's has, by necessity, remained focused on its international markets.

Faced with these challenges, government policies in South East Asia that protected flag carriers have given way to privatisation and a more liberal approach to competition. Increasing reliance has been placed on private sector airlines to supplement capacity as competition in domestic airline industries has been liberalised. A step that has followed soon after has been multiple designation in international markets (Hooper, 1997). In the process, aggressive new entrants have been accommodated in dynamic markets. However, aviation policy in Asia continues to be characterised by a close relationship between the flag carrier, dominant business groups and the government (Bowen, 1997). The underlying approach to policy change can best be described as "pragmatic" (Bowen and Leinbach, 1995) and it is not evidence that governments in the region have committed themselves unequivocally to an ideology of free and open airline markets.

Nevertheless, policies continue to be challenged. The expansion of airlines from source or destination markets outside the region is one of the key ones, particularly since these carriers attempt to align themselves with airlines based in the region. Singapore Airlines, for example, has been linked to Delta Air Lines and Swissair in the Global Excellence alliance. United Airlines and Lufthansa have been associated with Thai International, but as Singapore Airlines shifts its allegiance to the Star Alliance involving these two airlines along with Air New Zealand and Ansett Airlines, the role of Singapore as a regional hub has been strengthened at the expense of Bangkok. Governments in South East Asia have to deal with ever more complex alliance arrangements and a concentration in market power. When the alliances involve airlines from the USA, an additional consideration is the pressure that is exerted to enter into an "open skies" bilateral agreement.

These open skies agreements, with generous provisions for fifth freedom traffic, give the airlines from the USA a competitive advantage through their more advantageous access to intra-regional traffic (Findlay *et al.*, 1997). Bilateral agreements between ASEAN economies[1] have tended to remain restrictive on the issue of fifth freedom rights. As a result, it has been difficult for the airlines to use their equipment to maximum advantage within the region let alone to consolidate hub-and-spoke networks. Alliances among airlines are being used to circumvent the regulations, but the focus has been on agreements with carriers based in Europe and North America. The hubs based in ASEAN play their parts within global networks but their capacity to distribute traffic efficiently within the region is limited. At the same time, there have

[1] ASEAN's current members are Brunei Darussalam, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

been impediments to the development of new routes providing direct links between contiguous growth areas.

Progress on reform of airline regulation on a multilateral level has proven to be a slow process, but broader initiatives to liberalise trade accelerated the process in Europe and in North America (Button, 1997). Various regional trade agreements in South East Asia have been developed, including the ASEAN Free Trade Area, the Northern Growth Triangle (IMT-GT), the East ASEAN Polygon (BIMP-EAGA), the Southern Growth Triangle (IMS-GT), the Greater Mekong and Golden Quadrangle Growth Areas. The geography of South East Asia, however, places considerable reliance on efficient air and maritime transport to promote regional integration. The need for more flexible aviation arrangements has become clear and this prompted the ASEAN transport ministers to commit themselves to an "open skies" policy. The policy requests member countries to remove many of the current restrictions on market entry to international aviation with their markets and to support free competition between the airlines. Within APEC there is even broader commitment to free trade and an agreement to review ways to achieve a more competitive environment for air services.

The current economic situation in Asia will force the airlines to consolidate their positions for at least the short-term. All of the region's carriers are facing gloomy economic prospects and it is possible governments will adopt a more protectionist stance. However, the IMF bail-out packages require governments to commit themselves to free trade. The economies of the region have prospered by broadening markets and it is likely that the drive to expand intra-regional trade will remain a strong force. In addition, the major airlines in South East Asia are participating in "global" alliances that demand better systems of feeder services. Also, the USA already has concluded several open skies agreements and it will continue to exert pressure on other countries to follow suit.

There is sufficient momentum behind the formation of alliances and the creation of regional markets that airline competition in South East Asia will become more and more competitive over time. This paper describes these forces and makes observations about the impact they will have on the development of intra-regional airline service. In particular, we raise the question what South East Asia can learn from experiences with single aviation markets elsewhere, particularly Europe. Inter-related questions concern the benefits that can be expected to flow from a single market, whether the regional airline market is a step towards a more liberal, multilateral framework, whether a particular group of economies is optimal for the airlines and whether new members will be permitted to join. Finally, we examine the global forces of alliance formation and open skies agreements with the USA and ask whether regionalism will combine with these forces to create a more competitive international airline sector.

2 AVIATION POLICIES IN ASEAN

Airline services in South East Asia developed initially as a set of links in a network radiating from European countries to their satellites. This network was strengthened in the two decades following World War II, but it was the introduction of long-haul, wide-bodied jets and the emergence of aggressive airlines in South East Asia that transformed the market. Singapore and Bangkok, in particular, were located strategically as stopovers and interchange points on the rapidly growing long-haul services between Europe and Australasia (Rimmer, 1996).

The emerging carriers in South East Asia possessed competitive advantage in terms of the location of their home base and their lower input costs and they were able to establish a strong presence in the long haul markets (Findlay, 1985). Furthermore, the rapid economic growth in Asia over the past fifteen years has presented ample scope for these airlines to pursue expansionist strategies. As a result, airline services between ASEAN and North-East Asia have undergone considerable development (Rimmer, 1996). Economic growth and broadening intra-regional markets did have an impact and the network of airline services within South East Asia was beginning to improve. For example, the network in 1979 included Hanoi, Vientiane, Yangon, Bangkok, Kuala Lumpur, Singapore, Jakarta, Manila and Bandar Seri Begawan (Brunei) and 11 other cities. By 1996, Phnom Penh and an another 17 non-capital city airports had been added to the network (Bowen, 1997). Most of the new airports were in Malaysia and Indonesia, but all of the South East Asian nations were opening up secondary ports for cross-border traffic.

The key airports in South East Asia now have the potential to be used by the airlines as hubs to consolidate regional traffic from feeder routes. An additional feature at Singapore is the use of these hubs by carriers based in the United States and Australia to transfer on-line passengers between various points in their home continents and countries other than Singapore. These arrangements allowed the carriers to make more efficient use of their wide-bodied aircraft and have permitted increases in frequencies into the hub. Singapore took a lead when it agreed to the UK's request for break of gauge rights within their air services agreement, increasing the potential for traffic consolidation and feeder services. The strategic placement and use of these hubs have mitigated some of the weakness in the region's route network development.

The aviation policies adopted by the ASEAN economies have adapted to their changing circumstances. All promoted a single, government-owned flag carrier that was expected to take on unprofitable services to assist in nation-building. This was particularly important for Malaysia to link the Peninsula with East Malaysia and for the Philippines and Indonesia, both archipelagos. Each of the ASEAN carriers faced the challenge of establishing their presence in a market very much under the control of the metropolitan powers generating the bulk of the traffic. During the 1970's, though, a more liberal environment began to emerge. Competition among the carriers made it progressively more difficult for governments to control fares. Promotional fares proliferated as scheduled airlines learned to cope with floating currency exchange rates and competition from charter airlines (Lyle, 1995). Progressively, there was less attention to pricing regulation in the bilateral agreements and the major objectives for the ASEAN carriers were to gain access to markets and to get approval to increase their capacity. However, the pace of change varied from country to country.

Thailand maintains tight regulatory control over all aspects of international aviation. In its bilateral regulations it has sought "order in the air" through the balancing of economic benefits in the exchange of traffic rights, a careful monitoring of controls over capacity, the multilateral establishment of tariffs through IATA and a general acceptance of airline cooperative practices such as pooling. Thailand also is reluctant to deregulate its domestic market because its minor domestic airlines are not strong enough to withstand open competition. However, Thailand recently ended its policy of designating only one international carrier and Thai International is being privatised to enhance its capacity to manage more commercially and efficiently.

In contrast, Singapore has pursued expansion of its international air transport links with a very open approach to setting capacity. Singapore has signed numerous bilateral air agreements that do not require reciprocal capacity entitlements for Singapore Airlines. Wherever possible, Singapore exchanges rights based on opportunities rather than on absolute reciprocity in traffic or operational terms. Nevertheless, Singapore has had to be ready to reach a compromise and in many of its agreements it has accepted some restrictions on route access, traffic rights, capacity and tariffs. When the USA turned its interest in concluding open skies agreements to Asia, Singapore was the first to move. From April 1997, US carriers have been permitted to fly beyond Singapore while Singapore Airlines enjoys similar benefits in the USA. The privatised Singapore Airlines has been free of community service obligations and it is noted for its commercial success.

The Philippines has ended Philippine Airlines' monopoly in the domestic market and five new carriers have been free to compete on domestic routes. One of these new entrants (two more had applied) was given the second official flag carrier status for regional routes. Indonesia has opened 23 gateways for international tourism and air traffic rights have both Indonesia and the Philippines have liberal air services agreements with Singapore.

Partners in bilateral agreements have been under similar pressures and multiple designation and capacity increases have been negotiable in many situations. However, cross-border links in ASEAN are under-developed as a result of the bilateral system. Bowen (1997) has argued that there is over-servicing of the routes between Malaysia and East Malaysia and under-servicing on routes from Malaysia to adjacent Sumatra and that the "...pace of change is slow and distorted by the inherent biases in the bilateral system" (Bowen, 1997, page 136). We now examine how alliances can alleviate this problem.

3 ALLIANCES AND AIRLINE SERVICES IN SOUTH EAST ASIA

International airlines have used alliances to circumvent restrictive regulations that prevent them from pursuing network strategies within which a hierarchy between feeder and trunk services would emerge. These alliances are organised around code-sharing, joint frequent flyer programmes and marketing, shared computer reservations systems, joint use of resources, combined purchasing and co-ordinated schedules. Thus far, the airlines based in South East Asia have been more interested in forming alliances with major carriers from the USA and from Europe. This gives credence to the argument that alliance formation among international airlines is an attempt globalise within the regulatory constraints (Gialloreto, 1988; Tretheway, 1991; Doganis, 1994).

According to one line of argument, the major airlines will determine the location of key hub airports and the lesser airlines will be relegated to feeder roles (Shenton, 1995). When United Airlines and Lufthansa formed their alliance in September 1993, United had to choose whether to use London/Heathrow as its mini-hub in Europe, but chose to use its code-share flights with Lufthansa for intra-European services. Similar effects are emerging as Singapore Airlines is admitted to this alliance. Lufthansa's link to Thai International is weakening and a consequence is that Lufthansa will concentrate its services to South East Asia through Singapore. As this Star Alliance adds new partners such as Air New Zealand and Ansett International, Singapore's role as a regional hub is enhanced.

However, there are concerns that the smaller carriers within these alliances will be relegated to the role of feeder airlines. The proposal for British Airways and Qantas Airways to extend their code-share agreement on routes between Australia, Singapore and Europe raised the concerns of Australia's International Air Services Commission (IASC) for this reason (Findlay *et al.*, 1997). The IASC refused to approve the proposal when it was first raised in 1997 on the grounds that the Australian carrier would play too small a role within the alliance. From Australia's point of view, the emerging alliance between American Airlines and British Airways ensures Qantas is part of a powerful airline group. However, if this comes at the price of Qantas being relegated over time to being a feeder airline there are important implications for Australia (Bureau of Transport and Communications Economics, 1994).

Policy makers in South East Asia will have to balance their concerns about increasing market power of the major alliances (Burton and Hanlon, 1994), the possibility that the region's airlines will be relegated to the status of feeder airlines and the benefits of concentrating traffic through hub airports. The USA has the clearest policy regarding these types of alliances – they are acceptable provided they operate within an 'open skies' regime and if dominant positions on less competitive routes are weakened. Interest among the world's airlines to enter into alliances with their counterparts in the USA has given the latter country the leverage to negotiate very liberal air services agreements. Ten European nations have acquiesced (Jennings, 1996; Odell, 1997) and the USA is pursuing a similar approach in Asia (Ballantyne, 1997; Jennings, 1996). The protectionist approach taken by some of the key nations in Asia has discouraged alliances with airlines from within the region, but even Japan has not been able to sustain its opposition to alliances under the pressures of competition from the European and North American airlines.

In April 1997, Singapore entered into an open skies agreement with USA and similar agreements have been concluded between the USA and Brunei, New Zealand and Taipei with discussions in place with Malaysia and South Korea. The Singapore - USA agreement allows for access to all gateways in the USA and beyond, greater flexibility in code-sharing and the freedom to create a wide variety of commercial relationships with US and third party carriers. Key points of the agreement are (Chin, 1997):

- Termination of restrictions on pricing, capacity, type of airlines, and number of flights and routes
- Liberal charters

- Right to fly between any point in the US and any point in the other nation and beyond to third nations
- Open code-sharing
- Prompt conversion and remission of hard currency
- Self-handling provisions for carriers to perform or control airport activities that support their operations
- Non-discriminatory operation and access to computer reservations systems
- Fair competition in commercial activities such as airport charges
- Membership of international conventions on safety and security

The USA is attempting to draw a critical mass of Asian countries into these liberal agreements. It is realistic to assume that countries in South East Asia will be unable to stand in the way of alliances involving the mega carriers and it will be very difficult to resist the pressure to enter into open skies agreements. This poses difficult questions about how to promote effective competition while positioning regional airlines in such a way that they can exercise influence within the alliance (Oum and Taylor, 1995). At the same time, the open skies agreements that have been negotiated with the USA put the regional carriers at a disadvantage – their access to intra-regional traffic is less favourable than is becoming the case for the US airlines (Findlay *et al.*, 1997). In addition, if the hub airports are to live up to their potential, the South East Asian airlines will have to develop strong regional, feeder services. It is not so much a question of whether a more liberal regime will emerge in Asia as it is a question of timing and form. It is possible that more liberal access to markets and more competitive conditions will be granted on a bilateral basis, but another path is within regional airline markets.

4 TOWARDS A COMPETITIVE, REGIONAL AIRLINE MARKET WITHIN SOUTH EAST ASIA

Although the matter will be raised again by the World Trade Organisation (WTO), air traffic (landing) rights or services directly related to the exercise of traffic rights remain outside the framework of GATS. The principles of bilateralism and reciprocity dominate negotiations concerning international trade in airline services. As a general proposition, though, multilateral initiatives to promote free trade tend to become bogged down in complex sectoral issues. More substantive progress has been achieved in recent years through regional trade agreements. Associations of states agree to reduce barriers to trade within their region in order to allow industry access to larger markets and to reap economies of scale and to improve efficiency. Alternatively, a regional trade agreement can be formed to give the member states greater negotiating power in external markets. The regional trade agreement also can be an agent of change designed to promote regional political co-operation and possible integration.

It is more likely that regional trade agreements will be formed by economies that are located in the same geographic area, but it is helpful if the participating states share a common history and that they have reached similar levels of economic development and have compatible trade policies. Regional integration generally is the result of a combination of market and policy factors, but it can proceed in a variety of ways. For example, the European Union (EU) is an attempt to achieve broad regional integration based around a single market. The North American Free Trade Agreement (NAFTA) has progressed along the lines of a traditional approach to free trade among member countries based on tariff reductions. The EU has been able to set up supranational institutions whereas the NAFTA approach relies upon enforcement by national authorities.

In January 1992, the Association of Southeast Asian Nations (ASEAN) announced its intention to form the ASEAN Free Trade Area (AFTA) by 2008. In September 1994, ASEAN Member Countries agreed to accelerate progress with AFTA by reducing the initial time frame from 15 to 10 years. The primary objective of AFTA is to enhance ASEAN's position as a competitive production-based economic region geared towards servicing the global market. This is to be achieved by expanding trade relations, making it possible to increase specialisation and exploit economies of scale. ASEAN members also participate in Asia Pacific Economic Cooperation (APEC) and share in the commitment to remove trade barriers by 2020.

These regional trading agreements have provided a foundation upon which more liberal airline regulations can be introduced for a group of countries. Since April 1997, for example, there has been a single aviation market in the European Union and airlines from member economies are able to operate anywhere within the region. Canada has signed an open skies air services agreement with the USA, but this is separate from NAFTA (Tretheway, 1997). Argentina, Bolivia, Brazil, Chile and Paraguay recently signed a regional agreement (Mercosur group) and this has been mooted as a step towards a pan-American "civil aviation network governed by a single multilateral regional air transport agreement" (Pereira, 1996). The single aviation market between Australia and New Zealand is another example of a regional approach within the context of a broader trade agreement. ICAO has identified 50 such groupings of states that are, or could become, involved in the regulation of aviation. Clearly the potential exists to form a similar arrangement in Asia particularly to cater for the new airlines.

In 1994, Indonesia, Malaysia and Thailand signed a joint Memorandum of Understanding under which regional flights would be encouraged within the 'Northern Growth Triangle'. Each of the signatories was free to designate two airlines that would be permitted to operate whatever capacity they wish between secondary airports on a scheduled or charter basis, carrying passengers and/or cargo. In situations where this arrangement was at variance with air services agreements, the latter were to take precedence.

Since then, the Philippines and Brunei have joined and the group is known as BIMP-EAGA (Brunei, Indonesia, Malaysia, Philippines - East Asia Growth Area) and it covers a market with a potential of 250 million air travellers (Ballantyne, 1996). Discussions between Thailand, Myanmar, Vietnam, Cambodia, Laos and Yunnan Province of China have mooted another aviation bloc. The EAGA group has been working together to improve transport links that have been neglected. Indonesia has declared Kalimantan and Sulawesi unrestricted to foreign carriers from other Southeast Asian countries. EAGA governments have agreed to set up a new regional airline, Saeaga, a joint venture between a Malaysian company and the State governments of Sabah and Sarawak. Saega has been designated as Malaysia's second airline for points in EAGA.

Although Japan has a more protectionist approach to aviation policy, it attempted in 1995 to create an Asian aviation forum to achieve regional cooperation on aviation policies (Ballantyne, 1995). APEC, through its Transport Working Group, also is examining ways to promote a more competitive air services regime. More tangible progress, though, was made in ASEAN in February 1997 when the transport ministers reiterated the importance of the development of a Competitive Air Services Policy as a gradual step towards open skies in ASEAN. The first step is to introduce air services liberalisation within or between sub-regional groups such as BIMP-EAGA, IMT-GT, IMS-GT. The second step is to develop the ASEAN Open Sky Policy. The final step is to implement the ASEAN Multilateral Agreement on Commercial Rights on Non-Scheduled Services among ASEAN countries.

The intention in AFTA is to accelerate the growth in business and foreign investments, tourism and trade. Deregulation within individual economies is an additional force. ASEAN transport ministers have stated that "The competitive environment in international air transport within ASEAN shall be developed and promoted, with no restrictions in frequency, capacity and aircraft type for point to point access". However, the proviso was added that this competitive regime must be based on the progressive, orderly and safeguarded change in international air transport regulations on the basis of fair and equal opportunity for all member countries."

5 A REGIONAL AVIATION MARKET IN SOUTH EAST ASIA: SOME ISSUES

Attempts to create a competitive, regional airline market in South East Asia have been motivated by the desire to strengthen ties between economies in the region through an improved network of airline services. Given the experience with aviation in the European Union, it is worth examining what is similar in South East Asia and what can be learned from Europe. For that matter, what can be learned from other attempts to create single aviation markets within Mercosur and Closer Economic Relations (CER) between Australia and New Zealand? Several inter-related questions arise. One is what benefits can be expected to flow from a single market, particularly in terms of new routes and strengthening of feeder services and hubs? Is the regional airline market a step towards a more liberal, multilateral framework? These questions cannot be answered without also considering whether any particular group of economies is optimal for the airlines and whether the defined group remains the optimal set in a dynamic industry. On what terms are new members permitted to join? Finally, to what extent are the global forces of alliance formation and open skies agreements with the USA complementary to the formation of regional markets? Will the two sets of forces combine to create a more competitive international airline sector or will one be set against the other?

Button (1997) has commented on the lessons that Asia can draw from the European experience. He pointed out that the formation of the single aviation market lagged behind trade liberalisation and built upon experiences of deregulated domestic markets. The European Union had developed prior experience in the transport sector through the road transport sector. Europe presents the airlines mostly with short-haul markets that were relatively mature. In some respects South East Asia shares some of these characteristics. Key among these is that liberalisation of aviation competition is dealt with as a part of a much broader programme of trade and cultural integration. However, it is notable that progress on aviation reform was slow in Europe. Despite Europe's ability to agree on supra-national organisations to manage competition policies, it has been difficult to establish a level playing field in the competitive airline industry. Arguments about state subsidies to airlines, unfair competition, consumer protection, safety and environmental issues continue to arise. The comprehensive framework within the European Union, though, has allowed it to deal with issues such as a code of conduct for computer reservation systems and to examine the pricing of packaged travel products.

The pace of economic growth has been a major factor motivating liberalisation of airline markets in South East Asia. The recent economic difficulties might ease the pressure on regulatory reform, though it is possible it will give even more reason why airlines should be set free to adjust to prevailing conditions. There are good reasons to believe that the time frame for liberalising airline markets will be shorter in South East Asia. One of the interesting developments to come out of the currency crises of 1997-98 has been that the Asian Development Bank will take on a central role in setting standards for financial management and reporting. This is a long way from the European model that created supra-national regulatory mechanisms, but it is an important step nevertheless.

The formation of a single aviation market in Europe has resulted in the formation of new airlines, the expansion of services on secondary routes, altered relationships among the carriers and increasing competition among hub airports. The charter airline sector has been highly influential in Europe, carrying at least as many passengers as the scheduled airlines. Charter airlines provide strong price competition in leisure markets, but they also have played a key role in the development of new routes. In South East Asia, the charter market is not such a strong force and this could prove to be a constraint on the expansion of cross-border routes between growing sub-regions.

To some extent, South East Asia has more to learn from Latin America's attempts to improve intra-regional services. Through the 1990's, the airlines in Latin America realised that their costs were higher than those incurred by their large US rivals. Government policies prevented the region's airlines from working together within cross-border alliances (Cameron, 1996) At the same time there were few impediments to the Latin American airlines entering into alliances with the USA's carriers. This has allowed some of the region's carriers to improve their financial position, but they have had to play a secondary role. When the Mercosur trade group was formed, though, there was immediate interest in the development of new north-south routes to connect growing sub-regions. Within the group of member countries, a liberal approach appeared conducive to the establishment of new services, but an added attraction is that these would operate free of direct competition from the powerful carriers from the USA. Thorough studies of the Latin American experiment with a regional airline market would be likely to provide valuable insights for policy makers in South East Asia.

There is a distinct possibility that the formation of regional aviation markets could result in greater competition within, but the barriers could rise for airlines from outside the region (Ballantyne, 1996). ICAO has addressed this matter, but there is insufficient experience with trade blocs to make any firm predictions. Protectionist blocs with large internal markets could use their power to the disadvantage of smaller parties. Spurred on by competition from within the bloc, efficient airlines drawing upon a large market could become dominant carriers on inter-bloc routes (Nuutinen, 1992). Indeed, the Director General of the International Air Transport Association was reported to have urged African nations to pursue a strategy of liberalising competition within a bloc to promote efficiency and development, but to use the bloc as a countervailing force to deal with powerful external interests (Vandyk, 1995).

So far, regional integration agreements have proved to be compatible with multilateral free trade. Possibly there has been a "honeymoon effect" within which liberal attitudes are reinforced and as awareness and commitment to international rules governing trade relations grows (Chichilnisky, 1995). However, this could give way to more protectionist approaches as vested interests realise the potential to divert trade and to extract rents. Since free trade agreements emphasise rules of origin, it is likely they will face resistance to open membership rules that would allow them to become a genuine step towards multilateral free trade (Krueger, 1995). Regional trade agreements are more likely to foster global free trade when they are formed in order to reap external economies of scale and to eliminate inefficiency (eg. optimising cross-border airline services). Bowen (1997) argues that the strong links between governments in South East Asia and the airlines and the politicisation of the industry has resulted in powerful vested interests in maintaining the status quo and he has raised the possibility that AFTA will be undermined by exclusions. Furthermore, he regards the consensus approach within ASEAN as an obstacle to progress.

APEC is committed to non-discriminatory liberalisation but there are practical issues to consider such as the problems airlines have in gaining access to congested airports. The terms upon which new members can join the free market are important, but this begs the question whether there is an optimal set of members. It is not difficult to appreciate that an airline market based on ASEAN member countries focuses attention on Singapore and Bangkok as hub airports, but some of the busiest routes in the region are concentrated on Hong Kong (Rimmer, 1996; Bowen, 1997). Airlines plan their services based upon groups of countries that make up natural markets and the networks they have been able to develop. The conflicts that emerged between Australia and Hong Kong during 1996, for example, highlight the problems that can occur. Disputes arose because Qantas Airways was carrying passengers originating in Hong Kong to Bangkok and Singapore. A region defined as ASEAN or some sub-regional grouping might make sense from the point of view of economic and cultural integration, but it might not make good sense from the point of view of the economics of airline operations. The bilateral approach to negotiation of air services agreements constrains the way regulators and airlines consider markets (Findlay and Round, 1994; Alamdari and Morrell, 1997), but regionalisation is likely to encounter similar problems.

Generally, airlines do not derive a cost advantage by extending their networks, but there is an argument these are more important in international market (Findlay *et al.*, 1995). We have pointed out that alliance formation is focused on relationships with carriers from outside the region rather than from within South East Asia. However, the greatest potential to increase traffic exists by encouraging alliance partners to co-ordinate beyond-gateways is to (Park and Cho, 1997). Some of the new entrants in South East Asia have provided feed traffic to their country's flag carrier with equipment suited to lower density routes. In Europe, though, the major carriers have consolidated their positions by acquiring regional airlines or at least entering into appropriate, vertical alliances. KLM, for example, has a small home market and it has been dependent upon concentrating European traffic through Amsterdam. Its investments in regional carriers have been designed to protect this position. At the same time, British Airways and Lufthansa have expanded their influence across Europe via their relationships with regional carriers.

Singapore Airlines had expressed interest in taking equity in Indonesia's Sempati Airlines, but generally there has been little evidence thus far that the South East Asian carriers will be permitted to invest in each other. The experience in Australia has been that liberal policies, coupled with financial constraints on airlines makes it necessary to have an open attitude to foreign investment. Air New Zealand has become a 50% owner of Ansett Airlines. Singapore Airlines is forging an alliance with both of these carriers and is evaluating an investment in Ansett. Possibly Singapore is responding in the same manner as KLM, but it emphasises again that the optimal market might not be bounded by ASEAN.

6 CONCLUDING COMMENTS

Regionalism is not a force that acts alone. It has been pointed out that the Latin American airlines see the Mercosur regional airline market as an opportunity to develop markets as they cope with the pressure of competition from the major US carriers under liberal bilateral agreements. In Asia, the USA has concluded several open skies agreements and its carriers now enjoy opportunities to carry intra-regional traffic on more advantageous terms than the airlines based in the region (Findlay *et al.*, 1997). One way to counter this is to enter into liberal bilateral agreements with each other. New Zealand and Singapore already have done this. The formation of regional aviation markets takes this a step further. However, the USA becomes a de facto member of the groups where it has signed its open skies bilaterals with the significant partners. This is a factor that could lead to a more open approach to membership of the regional groups. Bowen (1997) argues that the US open skies agreements are a progressive step in an opening salvo to liberalise the transpacific market in the same way the Atlantic was liberalised in the mid-1990's. Much will depend, though, on the way the governments in South East Asia respond to the open skies agreements and in the way the cope with their current economic problems and the pressure that these are placing on their airlines.

7 REFERENCES

Alamdari, F. and P. Morrell (1997). Airline alliances: a catalyst for regulatory change in key markets? **Journal of Air Transport Management 3** (1), 1-2.

Anon. (1996). The battle for regulatory authority, **Avmark Aviation Economist**, **13** (8), 2-4.

Ballantyne, T. (1995). Japan urges Asian forum, **Airline Business**, **11** (7), 10.

Ballantyne, T. (1996). New group on the bloc, **Airline Business**, **12** (9), 100.

Ballantyne, T. (1997). US cracks softest nuts, **Airline Business**, **13** (3), 14.

Bowen, J. (1997). The Asia Pacific airline industry: prospects for multilateral liberalisation, pp 123-153 in C. Findlay, C.L. Sien and K. Singh (eds.), **Asia Pacific Air Transport. Challenges and Policy Reforms**, Institute of Southeast Asian Studies, Singapore.

Bowen, J.T. and T.R. Leinbach (1995). The state and liberalization: the airline industry in the East Asian NIC's, **The Association of American Geographers**, **85** (3), 468-491.

Bureau of Transport and Communications Economics (1994). **International Aviation**, Report 86, Canberra, Australian Government Publishing Service.

Burton, J. and Hanlon, P. (1994). Airline alliances: cooperating to compete? **Journal of Air Transport Management**, **1** (4), 209-228.

Button, K. (1997). Developments in the European Union: lessons for the Pacific Asia region, pp 170-180 in C. Findlay, C.L. Sien and K. Singh (eds.), **Asia Pacific Air Transport. Challenges and Policy Reforms**, Institute of Southeast Asian Studies, Singapore.

Cameron, D. (1996). Everything that rises must converge, **Airfinance Journal**, **183**, 26-29.

Chichilnisky, G. (1995). **Trade Strategies for NAFTA and the WTO**, mimeo, Columbia University.

Chin, A.T.H. (1997) Open-skies between East Asia and the US: implications on airport development and strategy, **Globalization and Continentalization of Air Transport Industry and Related Strategic, Public Policy, Planning and Operational Problems and Issues**, University of British Columbia, Vancouver, B.C., Air Transport Research Group of the WCTR Society.

Doganis, R. (1994). The impact of European liberalisation on airline strategies and operations, **Journal of Air Transport Management**, **1** (1), 15-25.

Findlay, C. (1985). **The Flying Kangaroo. An Endangered Species? An Economic Perspective of Australian International Civil Aviation Policy**, Sydney, Allen & Unwin.

Findlay, C., Forsyth, P. and Bora, B. (1995). The role of regional trading arrangements in regulatory reform: the international air transport industry, **Air Transport Roundtable**, 3 March 1995, Australia-Japan Research Centre, Australian National University, Canberra.

Findlay, C, Hooper, P. and Warren, A. (1997). Resistances to and options for reform in international air transport, paper presented at **The First Asia Pacific Transport Conference**, Pacific Economic Cooperation Committee, 4-6 December, 1997, Seoul.

Findlay, C. and D. Round (1994). Managing the transition to competition: the International Air Services Commission, **The Australian Economic Review**, 2nd quarter, 43-56.

Gialloreto, L. (1988). **Strategic Airline Management**, London: Pitman.

Hooper, P. (1997). Liberalising competition in domestic airline markets in Asia - the problematic interface between domestic and international regulatory policies, **Transportation Research E, 33** (3), 197-210.

Hooper, P. and Findlay, C, Warren, A. (1997). Developments in Australia's aviation policies and current concerns, paper presented at **The First Asia Pacific Transport Conference**, Pacific Economic Cooperation Committee, 4-6 December, 1997, Seoul.

Jennings, M. (1996). US is set to open up Asia, **Airline Business, 12** (11), 14.

Krueger, A.O., 1995. **Free Trade Agreements Versus Customs Union**, National Bureau of Economic Research, Working Paper No. 5084, Washington.

Lyle, C. (1995). The future of international air transport regulation, **Journal of Air Transport Management**, 2 (1), 3-10.

Nuutinen, H. (1992). The tortuous path to plurilateralism, **Avmark Aviation Economist, 9** (4), 14-19.

Odell, M. (1997). BA-AA: a hell of a furore, ***Airline Business***, **13** (2), 8.

Oum, T.H. and Taylor, A.J. (1995). Emerging patterns in intercontinental air linkages and implications for international route allocation policy, **Transportation Journal**, Summer: 5- 26.

Park, N. and Cho, D.-S. (1997). The effect of strategic alliance on performance: a study of international airline industry, **Globalization and Continentalization of Air Transport Industry and Related Strategic, Public Policy, Planning and Operational Problems and Issues**, University of British Columbia, Vancouver, B.C., Air Transport Research Group of the WCTR Society.

Pereira, C.R.C. (1996). Latin American regional body eyes expansion throughout the hemisphere, **ICAO Journal, 51** (10), 12.

Rimmer, P.J. (1996). Airlines as information networks: Qantas and Singapore Airlines, pp 63-94 in H. Dick (ed.), **Airline Deregulation in the Asia-Pacific. Towards 'Open Skies'?**, Institute of Transport Studies, University of Sydney, Sydney.

Shenton, H. (1995). Codesharing only part of the big picture: the GAO's report on alliances, **Avmark Aviation Economist, 12** (4), 2-5.

Tretheway, M.W. (1991). Globalisation of the airline industry and implications for Canada, **The Logistics and Transportation Review, 26** (4), 357-367.

Tretheway, M. (1997). Canada – US open skies, pp 154-169 in C. Findlay, C.L. Sien and K. Singh (eds.), **Asia Pacific Air Transport. Challenges and Policy Reforms**, Institute of Southeast Asian Studies, Singapore.

Vandyk, A. (1995). AFRAA backs more state control, **Air Transport World**, 32 (8), 18.

57-03

Paper number 1164

Topic Area A4

CR 385675 p12

An Economic Effect of Duopuly Competition in International Airline Industry : The Case of Korea

Jongseok Kim
The Korea Transport Institute
968-5 Daechi-Dong, Kangnam-Gu, Seoul, Korea
Tel: 82-2-538-3536 (ext. 302)
Fax: 82-2-553-1343
E-mail: jskim@ke.re.koti

ABSTRACT

There are two types of international routes in and out of Korea. One is single-tracked route where only one Korean carrier operates, and the other is double-tracked route where both of Korean carriers operate simultaneously. In this paper, we analyze whether there is a price competition between the two Korean carriers and thus whether single and double tracked routes show difference in price performance. On the basis of the analysis, we calculate how much passengers are benefited due to price competition.

1. Introduction

Effective competition among international airlines is not expected under restrictive bilateral agreements. These restrain tariffs, routes, flight frequency, aircrafts and so on. The routes connected to and from the US territory are an main exception. The US has pursued an open-sky regime. Most of the countries has signed liberal bilaterals with the US since 1980.

Korea also maintains restrictive bilaterals with one exception of that with the US. However, the entry of the second carrier, ASIANA into international airline industry in 1989 has changed the conventional pattern of competition on routes in and out of Korea. Conventional pattern of competition is to have a market preserved for each international airline by restricting the types of traffic rights exercised by each airline. This restrictive pattern is also reinforced through means such as restriction on ticket-buying places. For instance, a traveller from Korea to Japan cannot buy the ticket in Japan. Thus pricing practice of each national carrier at its home base is to be respected.

The entry of ASIANA changes this market protecting behavior. Because KAL and ASIANA have the same home base, the two carriers without cooperative measures are to compete at least for national traffic which originates from Korea.

There are several dimensions of competition other than price : the number of flight frequence, the quality of in-cabin services, route network and etc.. However, restrictive bilaterals do not allow for competition in some important dimensions such as flight frequencies and route network. The latter dimension is only subject to long run competition because the internal guideline of Korea[1] which prescribes which route is to be served by which airline does not allow free entry into any international city-pair markets. The guideline stipulates the criterion for double-tracking, meaning that there is some critical number of passengers beyond which the second carrier can enter the market.

One cannot find the presence of the two national carriers in every route. Also even after the density of passengers is such that the second carrier can enter, the number of flight frequencies given to the new entrant is doubly restricted through the bilateral agreements and the internal guideline. The former defines the total number of frequencies and the latter, the number given to the second carrier. What this means is that duopoly competition is conducted only on the dimension of pricing.

[1] Since the entry of ASIANA, Korean government has set the rules stipulation which route is to be cerved by which airline by how much. The rules are contained in the internal guideline. See Kim(1996) for details

The Transpacific routes connecting Korea and the US have been liberalized since 1980. When the two countries signed a bilateral which allows for liberal pricing (double disapproval system), free determination of flight frequency and routes. The full effect of the liberal bilateral was being realized after 1988, when the new set of the US international carriers turned their eyes to booming Asian markets, especially Korea and Taipei[2]. ASIANA launched its 1st transpacific flight in 1990 on the route between Seoul and LA. On the routes between Korea and the US, the addition of a new player needs not intensify competition, since it was already there.

The economic shakeout in early 1990s, however, has made the US carriers lean towards cooperative flight with foreign carriers. Codesharing and blockseat sales agreements among international carriers became a norm. This means that fierce competition to capture significant market share between Korean and the US carriers is lessened to such an extent that both sides become cooperative partners. For instance KAL codeshares with Delta, and ASIANA with Northwest. Other US carriers including UA and Continental restructured its operation and reduced flight frequencies to and from Korea. After this incidence, the only competition on the routs is virtually between the two Korean airlines. The internal regulation still does not allow free determination of flight frequency, and the two should compete on price.

On the basis of above arguments, we can classify two types of international routes, depending on competition between the two Korean airlines:

- single tracked routes where only one Korean carrier operates
- double tracked routes where both of the Korean carriers operate.

In this paper, we analyze whether there is a price competition between the two Korean carriers and thus whether single and double tracked routes show difference in price performance. On the basis of the analysis, we calculate how much passengers are benefited due to price competition

2. The Model

Competition on the single tacked routs is patterned after the joint profit maximization of a national carrier and a foreign carrier. The joint profit maximization may be a reasonable hypothesis in view of the IATA tariff setting mechanism. The unamity rule

[2] To operate over Korea and Taiwan has a purpose of surrounding Japanese market. Also, congestion at Narita contributed to the diversion.

is used and each participating airline can secure reasonable level of profits.

Let i, k denote the national carrier and the foreign counterpart respectively. Then on single-tracked route r, the airlines set the prices P_r^i, P_r^k in such a way that they will maximize joint profits $\pi_r^i + \pi_r^k$, where π_r^i is the profits of carrier i on route r and π_r^k is that of carrier k. Profit is composed of two components of revenue and cost. Let d_r^i, d_r^k denote the numbers of passengers carried on route r by carriers i and k respectively, then $P_r^i \cdot d_r^i$, $P_r^k \cdot d_r^k$ represent revenues of carrier i and k respectively. Also let C_r^i, C_r^k denote cost functions of carriers i and k on route r, respectively, and each function has arguments of number of passengers d_r and flight distance θ_r. That is

$$C_r^i = C_r^i(\theta_r, \ d_r^i) \quad \& \quad C_r^k = C_r^k(\theta_r, \ d_r^k)$$

Then the prices are set to solve the following problem:

$$(1) \quad \max_{P_r^i, P_r^k}(\pi_r^i + \pi_r^k)$$

From the first order condition, we obtain

$$(2) \quad \frac{\partial \pi}{\partial P_1} = \frac{\partial d^i}{\partial P^i} \cdot P^i + d^i - MC^i \cdot \frac{\partial d^i}{\partial P^i} + \frac{\partial d^k}{\partial P^i} \cdot P^k + MC^k \cdot \frac{\partial d^k}{\partial P^i} = 0$$

From (2), we can have

$$(3) \quad P^i = MC^i - d^i \cdot \frac{\partial P^i}{\partial d^i} - (P^k - MC^k)\frac{\partial d^k}{\partial P^i} \cdot \frac{\partial P^i}{\partial d^i}$$

For modelling competition on double-tracked routes, we assume that the Korean carriers compete on prices for maximizing each airline's individual profit. That is, the Bertrand hypothesis is adopted.

Let i and j denote Korean carriers and k denote a foreign carrier which operates on router. Then the profit π^i of carrier i on rout r is

$$(4) \quad \pi^i = P^i d^i (P^i, P^j, P^k, m, m^k)$$

Where P^i, P^j, P^k are prices of carriers i, j, k on route r respectively and d^i is the number of passengers carried by airline i. m and m^k denote purchasing power of Korea and foreign country concerned on route r. The cost function C^i has a same meaning as before.

Then given P^i, P^k, airline i set its price P^i to solve

(5) $\max_{P^i} \ \pi^i$

From the first order condition assuming the existence of interior solution, we will get

(6) $$\frac{\partial \pi_i}{\partial P_i} = d^i + \frac{\partial C_i}{\partial d_i} \cdot \frac{\partial d_i}{\partial P_i} = 0$$

Rearranging (6), we have

(7) $$\frac{\partial \pi_i}{\partial P_i} = 0 \Rightarrow P_1 = MC_1 - d_i \cdot \frac{\partial P_i}{\partial d_i}$$

- **Regression Equations**

The airlines aiming at joint profit maximization solve equation (3) simultaneously. The solution prices must satisfy.

(8) $$P^i = MC^i - d^i \cdot \frac{\partial P^i}{\partial d^i} - \left(P^k - MC^k\right)\frac{\partial d^k}{\partial d^i} \cdot \frac{\partial P^i}{\partial d^i}$$

(9) $$P^k = MC^k - d^k \cdot \frac{\partial P^k}{\partial d^k} - \left(P^i - MC^i\right)\frac{\partial d^i}{\partial d^k} \cdot \frac{\partial P^k}{\partial d^k}$$

From (9) and at solution,

(10) $$P^k = MC^k - d^k \cdot \frac{\partial P^k}{\partial d^k} - \left(P^i - MC^i\right)\frac{\partial d^i}{\partial d^k} \cdot \frac{\partial P^k}{\partial d^k}$$

Thus to put (10) into (8), we obtain

(11) $$P^i - MC^i = \frac{-d^i \cdot \dfrac{\partial P^i}{\partial d^i} + \dfrac{\partial P^k}{\partial d^k} \cdot \dfrac{\partial d^k}{\partial P^k} \cdot \dfrac{\partial P^i}{\partial d^i}}{1 - \dfrac{\partial P^k}{\partial d^k} \cdot \dfrac{\partial P^i}{\partial P^k} \cdot \dfrac{\partial d^i}{\partial P^i}}$$

If we denote the denominator of the R.H.S by K, the coefficient of d^i in numerator by A, and the coefficient of d^k by B, we have

(12) $P^i = MC^i - \frac{A}{K}d^i + \frac{B}{K}d^k$

Because the marginal cost function MC^i of airline i is a function of the number of passengers and flight distance, it can be estimated with

(13) $MC^i = \alpha + \beta\theta + \gamma d^i$

Where α, β, γ are unknown parameters to be estimated. Thus price equation P^i is estimated through the linear equation.

(14) $P^i = \alpha + \beta\theta + \left(\gamma - \frac{A}{K}\right)d^i + \frac{B}{K}d^k$

If we replace the coefficients of d^i and d^k of equation (14) by β_2 and β_3 , β_1 for β and add an error term, our final estimation equation is

(15) $P^i = \alpha + \beta_1\theta + \beta_2 d^i + \beta_3 d^k + \varepsilon_i$

In equation (15), β_1 measures change in the marginal cost that an incremental change in flight distance will generate. β_2 and β_3 include not only direct effects of price change on numbers of passengers but also indirect effects of the change in the latter on costs of involved airlines.

On the double tracked routs, the regression equation is obtained from each national airline's profit maximization problem, the equation (6). Therefore, the regression equation is

(16) $P^i = \alpha + \beta_1\theta + \beta_2 d^i$

Where α, β_1, β_2 have the same meaning as in equation (15).

We combine equations (15) and (16) into one equation in order to clearly see the difference of prices between the single-tracked routes and the double-tracked routes. The following equation will do the job:

(17) $P_r^i = \alpha + \beta_1\theta_r + (\beta_2 + \delta_r\beta_3)d_r^i + \delta_r\beta_4 \cdot d_r^k$

Where P_r^i denotes price set by a national carrier i on route r, θ_r is the distance of route r, d_r^i is the number of passengers carried by airline i, and finally d_r^k denote the number of passengers carried by all the foreign carriers operating on route r. δ_r is a dummy variable whose value is 1 on single-tracked route and 0 otherwise.

- **Results**

For estimation purpose, we gather data on routes where national carriers operate for the year 1995. The numbers of passengers carried by each carrier (foreign as well as national) over the year were used.

We obtain price data of each airline at one point during the year. Normal fares are used. The data on flight distances is compiled from the real flight distance data reported by national carriers.

Estimation is conducted for three cases: KAL alone, ASIANA alone, and consolidated. KAL alone estimation shows difference in pricing behavior between when it is confronted with ASIANA and when it is the sole national carrier flying on a particular route. ASIANA alone estimation has the same meaning. And consolidated estimation examines whether there exists aggregate change in pricing behavior.

In the consolidated estimation, it is shown that the estimate β_3 has a statistically significant positive value. This means that, ceteris paribus, price is higher on single tracked route than on double tracked routes. It also indicates that overall there exists price competition between KAL and ASIANA.

	α	β_1	β_2	β_3	β_4
Estimated value	189	0.07	-0.0001	0.0028	0.0006
Standard error	0.0001	0.0001	0.3004	0.0013	0.0419
R_2	0.89				

An airline alone estimation produces a similar result. KAL levies higher price on single tracked routes. However it turns out that ASIANA alone shows little difference in pricing behavior irrespective of the existence of KAL on routes ASIANA flies. However, ASIANA result may not be a useful conclusion because the number of samples applied for estimation of ASIANA-alone case is as many as 19 out of which the number of single tracking routes is only 3. This means that the latter number may not be helpful in discriminating the two cases of single-tracked and double-tracked routes.

	α	β_1	β_2	β_3	β_4	R^2
KAL	197 (0.0022)	0.073 (0.0001)	-0.0001 (0.3955)	0.0027 (0.0012)	0. 0008 (0.1194)	0.89
ASIANA	244 (0.0003)	0.069 (0.0001)	-0.0008 (0.0630)	-0.0006 (0.8555)	-0.000724 (0.0750)	0.92

※ Numbers in parenthesis refer to standard errors of the corresponding estimates.

In consolidated estimation, the estimates for β's except for β_2 have positive values. The estimate for β_2, however, is not significant. This means that the effect of cost reduction due to passenger increase is offset by the positive effect of passenger increase. The same result takes place for KAL-alone estimation. ASIANA-alone case shows many insingnificant result due to deficiency of data on single tracking routes.

3. The Economic Effect due to Double Tracking

In this section, we estimate the net benefit of passengers generated through lowered price due to double tracking.

Changes in consumer surpluses are the basis for the calculation of the net benefit due to double tracking. Consumer surpluses are calculated as a difference between what the passengers would pay if the presently double-tracked routes were operated by KAL alone and what they actually pay. If a route r is operated by KAL alone, KAL will set the price P_r^k according to what is estimated in the previous section. That is,

$$P_r^k = \hat{\alpha} + \hat{\beta}_1\theta_r + \left(\hat{\beta}_2 + \hat{\beta}_3\right)d_r^k + \hat{\beta}_4 d_r^f$$

Where $\hat{\bullet}$ denoted the estimated value of parameter $\bullet$ and d_r^f is the number of passengers carried by foreign airlines. d_r^k is that of KAL.

If the route r were double tracked, the price P_r would be expressed as,

$$P_r^k = \hat{\alpha} + \hat{\beta}_1\theta_r + \hat{\beta}_2 d_r^k$$

So the price differential ΔP_r is

$$\Delta P_r = P_r^k - P_r^k = \hat{\beta}_3 d_r^k + \hat{\beta}_4 d_r^f$$

The following table shows the changes in consumer surplus due to multiple tracking for the year 1995.

Route	single tracked fare	Double tracked fare	Net consumer surplus
Seoul-Guam	766.38	429.40	81530594
Seoul-Nagoya	840.16	243.60	228048600
Seoul-New York	1753.06	1051.00	306538831
Seoul-Tokyo	2213.15	178.90	2180145061
Seoul-Manilla	633.69	384.20	55669259
Seoul-Bankok	1213.46	434.30	383861036
Seoul-San Franscico	1176.76	1017.10	45941104
Seoul-Sydney	1039.16	838.10	25084652
Seoul-Singapore	710.74	487.70	48928144
Seoul-Okinawa	278.54	290.90	12509
Seoul-Honolulu	1397.90	736.10	247269982
Seoul-Hong Kong	1070.46	341.80	392734966
Seoul-Hukuoka	713.68	217.00	168851413
Seoul-Hiroshima	234.92	259.60	-765817
Seoul-LA	2046.92	1036.60	664648018
Total Benefit			4828498357

※ Units are USD for the 2nd, 3nd column and 1,000won for the last column.
In 1995, 1 USD was about 800won.

The table shows some unreasonable results. The route of Seoul-Tokyo exhibits price differential of 10 times as high as (the double tracking price is ten times as low as) that of single tracking. This result seems to be produced due to excessive difference in number of passengers carried on the route relative to the sample mean. The case of Seoul-Hiroshima route tells that double tracked price is higher than single-tracked one. This takes place due to the excessive differences in the size of explanatory variables relative to other routes. In these particular cases, it seems that time series data on each of these will produce better estimate in setting down the hypothesis whether the double tracking and single tracking show significant difference in pricing behavior.

4. Concluding Remarks

Entry of a new carrier, ASIANA turns out to be successful in promoting passenger welfare. Price differential between single tracked and double tracked routes are significant. Korean Air seems to feel competitive pressure from ASIANA, which was never felt when the former was the monopolist. It also means that restrictive bilateralism is not successful in enhancing competition between a national carrier and a foreign carrier. If also implies that to have more than a national carrier and make them compete is a welfare improving measure if market can sustain it.

In this paper, duopoly competition is analyzed using Bertrand hypothesis that one airline competes on the price dimension with fixed conjecture on the pricing behavior of the other airline. This may be extended to include more general conjectural variation. Also the model adopted here is short-run in nature in the sense that flight freguency and network of airlines air given. However, this restriction may be relieved to capture long run effect of network and flight frequency competition even under the restrictive bilateral framework. The extension of our model will facilitate comparison between restrictive bilateral regime and open-sky rigime in terms of the network configuration.

References

Bresnahan, M. (1986), "Empirical studies of Industries with Market Power", ch. 17 of 「Handbook of Industrial Organization」, Vol II, ed. By Schmalensee, R. and R. Willing, Northttolland.

Dresner, M. and M. Trethway, (1992) "Modelling and Testing the Effect of Market Structure on Price", Journal of Transport Economics and Policy.

Kim, J. S. (1997), "An Economic Effect of Duopoly Competition in Domestic Air Transport Markets in Korea", a paper presented at the Air Transport Research Group (ATRG) Conference of the WCTR Society, Vancouver, Canada.

Kim, J. S. (1997), "Multiple Designation Policy in Korea", in 「Asia Pacific Air Transport」, ed. By Chia Lin Sien, C. Findlay and K. Singh, Southeast Asian Studies.

Kim, J. S. (1998), 「Economics of Deregulation with Focus on airline and airport Industry」, Sunhak publishing co. (in Korean).

Topic Area: A4, Airports and Aviation (SIG)

S8-03

385676

p. 18

CORPORATE INVOLVEMENT IN THE SHORT HAUL BUSINESS TRAVEL MARKET IN THE EUROPEAN UNION

By

Keith J Mason
Senior Lecturer in Transport Studies

Centre for International Shipping and Transport
University of Plymouth
Drake Circus
Plymouth
PL4 8AA
UK

Contact:
Tel: +44 1752 232 441
Fax: +44 1752 232 406
E-Mail: KMason@Plymouth.AC.UK

Presented at
8th WCTR
Antwerp, Belgium
July 1998

1. INTRODUCTION

The importance of corporate involvement in the decision making process for business related air travel is being increasingly recognised the literature. Business travellers consume air services (i.e. they take airline flights), however, they may not be the principal decision maker in the purchase. Also it is the organisation that employs the traveller that incurs the cost for air travel. Consequently this research addresses the relationship between the traveller and his/her employing organisation in the purchase of air travel.

In this paper traveller opinions on his/her corporate travel policy are evaluated using a Likert summated rating scale. The benefits sought, by the traveller, from the air service are also investigated and these benefits are used to segment the short haul business air travel market in the EU. Changes in the market for short haul business travel since the full liberalisation of the aviation market in the EU are evaluated by comparing the data to an earlier study of similar travellers in 1992.

The common notion of business travellers is that they tend to travel more frequently then leisure travellers and they tend to pay higher prices for these services. The business travel sector of the market is prepared to pay higher fares as it is the company and not the individual traveller that bears the cost of the travel. This cost is then subsumed within the costs of the business. Airlines, not surprisingly, value this segment of the market very highly. Airlines can practice price discrimination in fare structures as business travellers have been prepared to pay higher fares to ensure travelling flexibility (i.e. to be able to change their flight bookings freely should, say, a business meeting run-over). In the domestic US market about 50% of passengers are travelling for business purposes, however, this market represents two-thirds of passenger revenues (Stephenson, and Bender, 1996). In the EU the passenger number figure may be as high as two-thirds (Doganis, 1991), indicating the revenue figure would be even higher. The business travel market is, therefore, very important to the EU airlines.

The airline industry in the EU until recently has been one in which operators face very little competition. Bilateral agreements between national governments within the EU had ensured that most routes were only served by two airlines. Duopolistic arrangements ensured that consumers were given little choice of airlines, schedules, and prices. The market for short haul air services in the European Union has experienced a period of major change since 1990 when the first effective initiatives to liberalise the market were introduced. The final elements of a single market for airline services, completed in April 1997, has created an regulatory regime where any airline can offer any route within the EU at any price. Evidence suggests that increasing competition can have a significant effect on the market. Studies indicate that when more than two airlines operate on a particular route, tariffs and yields fall significantly, although there tends to be an increase in passenger numbers stimulated by the falling prices (Barrett, 1991, Doganis, 1994). The number of routes where more than two airlines operate has been small (only 2% of European routes in 1992) but changes in the industry can be observed. A number of marketing agreements and alliances have been created between short haul operators and larger transcontinental operators in a bid to gain from potential economies of scale and scope, and marketing benefits (e.g. increased interline business through code-sharing agreements, and shared frequent flier programmes) (Williams, 1993, Doganis, 1994). Opportunities to use the tariff as a competitive tool has been taken by a number of start-up airlines. Fourteen new carriers of this nature begun operations between March 1995 and September 1996 (Jones, 1996). These no-frills, low cost operators who offer lower prices as they:-

- sell directly to passengers, thereby avoiding travel agency commissions.
- tend not offer flights through a computer reservation system (CRS) thereby avoiding these costs.
- tend not offer in-flight food, seat assignments, and interlining.
- outsource as many services as possible
- operate from uncongested airports with low charges (Whittiker, 1998).

The concept has proved to be sufficiently popular in the US that major operators have introduced their own low-cost subsidiaries to halt declining market-share. In what can be seen as a similar move, British Airways has also announced its plan for a low-cost subsidiary operating in Europe.

As the supply side of the airline industry with the EU changes, airlines need to assess whether the factors of demand for their services will also change. If the principal concerns of business travellers are having fully flexible tickets, free in-flight food and beverages, and the opportunity to earn points on frequent flier programmes, then increased choice, and reduced tariffs in the traditional market and the introduction of low-cost operations will not greatly affect the business travel sector of the short haul market. If, however, the lack of airline and schedule choice and the non-availability of heavily discounted fares has meant that the market has been required to pay higher fares then a re-assessment of the attitudes and likely future behaviour of the market is appropriate. This paper, therefore, is concerned with investigating the business travel market.

2. THE BUSINESS TRAVEL MARKET

The behaviour and attitudes of the business travel market has been the focus of a number of recent studies. The most substantive and comprehensive of these studies is the Stephenson and Bender's analysis of the US business travel market (1996). From a noted reduction in the proportion of business related travel in the market from 55% in 1979 to 48% in 1993, the authors dismiss this reduced proportion as the result of an increase in non-business related travel and investigate the reasons for the reduction in business travel, attempt to determine the effect of air travel substitution by other modes of travel and increased use of telecommunications such as videoconferencing and the internet. The paper is based on two studies; one of 421 corporate travel managers and one of 701 business travellers as part of the 3,061 people surveyed as part of a national travel study. They found that the demand for business related air travel was reducing. This finding was supported by both travel managers and the travellers. They conclude that the primary reason for reduction in business travel is both companies and travellers frustration with high airline prices, and internal corporate pressure to reduce travel expenditure. Evidence was also given for significant substitution by other modes and also alternative communications methods.

The cost of travel in demand for business travel has been traditionally viewed as being not important as the employing company bear the cost. In Stephenson and Bender's study it is not surprising that cost is identified as being important as they survey corporate travel managers. Corporate involvement in the business travel market has been somewhat limited in the academic literature but more acknowledged in commercial studies of the industry.

Quoting figures from the American Express Travel & Expenditure Expense Survey, Bourne (1991) notes the growth of large companies employing travel managers. For UK companies, this figure had grown from 11% in 1986 to 42% In 1991. Skapinker (1992) notes pressures by companies on both their travelling employees and on their travel agents to reduce the cost of travel by down-grading (forcing business travellers to travel on economy tickets) and also to evaluate in a more systematic way the purpose and value of travel.

Although liberalisation is leading to more competition, some evidence indicates that its overall effect on cost is not downward. In 1996, spending on travel via the Guild of Business Travel Agents who handle about 75% of UK corporate travel increased by 17%, while the number of flight increased by 8.5% (Cohen, 1997). The author then argues that strong involvement in the management of travel expenditure is vital by corporations that have large travel costs.

Another UK based study of corporate travel (Cook, *et al*, 1994), undertaken by the University of Westminster, indicates the some of the ways that corporations are involved in the business travel market. A s rvey of 128 companies revealed that 77% had a written travel policy, but that 70% of these policies granted travel choice discretions to travelling executives. However 20% were looking to reduce this choice in future. Indeed IATAs 1997 Corporate Air Travel Survey showed that 70% if business travellers were willing to try "no-frills" airlines (IATA, 1997).

Corporate involvement in the purchase of business air travel can be in seen in a number of activities. Firstly, travel policies either written or unwritten may be used to influence choice of airline, and fare type thus reducing cost. Travel managers or travel departments may be involved in the selection, and purchase process of airline tickets. Travel management may include bulk purchasing deals from preferred airlines thereby influencing future travel choices. Travel managers may use their travel agent to find the airline ticket which gives them the greater perceived value for money.

Individual travellers may be adverse to corporate influence in their travelling behaviour. Corporate choices may be contrary to the preferred choice of the traveller if the traveller is a member of a frequent flier programme (FFP), or if the choice of airline is perceived to reduce the travelling, comfort, flexibility, status, or convenience. A number of studies have tried to assess the effectiveness of FFPs to influence airline choice. One empirical study of the US market concluded that FFPs have a significant effect on airline choice (Nako, 1992). This view is partially supported by a study of Australian business travellers. Browne, *et al*, (1995) found that membership of a FFP was a factor considered by travellers in the purchase decision but not one as important as on-time performance, schedule convenience or low fares. Gilbert (1996) concludes that the proliferation of FFPs and the build up of unredeemed rewards have affected the effectiveness of these schemes.

Mason & Gray (1995) argue that corporate involvement in the business travel purchase decision is sufficiently important that the market should be treated for marketing purposes as a hybrid market, displaying characteristics of both consumer and industrial markets. A stakeholder model of the purchase decision process is used to analyse the market. They identify three stakeholders in the purchase of air travel; the traveller, the travel organiser and the employing organisation, and argue that each stakeholder will have a set of purchase benefits. The actual purchase benefits sought will be based on the competition between the stakeholders. A sample of 824 business travellers is segmented into three distinct market groupings based on the key purchase benefits and demonstrate that these groupings are affected by corporate involvement in the purchase decision.

This brief consideration of the demand side of the business travel market has shown that the validity of the high consumption, high yield airline passenger is questionable, and that traveller choice may well be influenced by corporate involvement in the purchase. This combined with the changing supply side of the industry, further investigation of the business travel market is required so that marketing strategies may be based on a sound understanding of the factors that affect the market.

3. METHODOLOGY

To investigate corporate influence in the EU short haul business travel market a quantitative survey was undertaken. The survey was administered in Stansted in the UK over two separate periods. Agreement to survey passengers was gained from Air UK Ltd. which operates the largest number of flights from this airport. The survey was carried out over three days in April 1997 and five days in November 1997. A scale of traveller attitudes towards corporate travel policies was included. Behavioural data regarding the traveller, the travel organiser and the employing organisation were collected. An attitude scale of business traveller purchase benefits previously developed by the author (Mason, 1995) and was included to evaluate the importance to travellers of various product elements. An earlier survey of business travellers was undertaken at the same airport on the same target sample in 1992. Thus the new survey provided data to enable an examination of the reliability of this scale, and will allow the investigation of changes in the market over a five year period. 1,000 self-completion survey forms were distributed to short haul international and domestic travellers of which 450 useable survey forms were collected. This represents a 45% response rate for distributed survey forms, which is a similar to the response rate achieved by Stephenson and Bender (1996) in their Corporate Travel Manager study. Analysis of the passenger figures during the survey period indicates that the sample represents about 5% of all Air UK travellers (both leisure and business) from this airport during the survey periods. The sample size allows an estimate of average number of trips to be calculated with 95% confidence within a 1.5 trip interval. Although this does not meet a preferred 1 trip confidence interval as achieved in the earlier survey (Mason and Gray, 1995) this sample is deemed to be acceptable.

Demographic data about the respondent and his/her company were collected. Also data about the respondent's travelling behaviour including the number of trips taken in the twelve months, how the flight was selected, and booked, whether the respondent's employing company had a corporate travel policy (CTP) or a travel manager or department.

Fifteen attitude statements about corporate travel policies were developed through the views about travel policies comments reported in various trade journals and also from asking a number of business travellers their views about such policies. The most extreme and some fairly neutral comments were kept for inclusion in the survey. These comments were both positive and negative, and are included in Appendix I. Attitude statements regarding 25 product attributes were also included in the survey. This list (see Appendix II) is similar to the list included in the earlier survey and reported in Mason and Gray (1995). The authors indicated that repeated survey administration and comparison would provide data to evaluate the validity of the results of the first study and this study will allow this.

4. RESULTS

A demographic profile of the respondents did not reveal any surprises. The sample was predominately male (90.3%), with the vast majority working in senior roles in their respective organisations. 19.3% of the respondents indicated that they were company directors, a further 34.0% worked as senior managers, while another 26.4% worked in "other management" positions. Together this means that 86.9% of the respondents fell into the A or B social stratifications. An age profile of the respondents shows business travellers tend to be in middle age. 36.3% were aged between 35 and 44, with a further 40.8% aged between 45 and 64.

The respondents worked in many different industries and from very small to very large companies. The majority (64.1%) of respondents worked in services industries of various types. 27.9% of the sample were employed in the manufacturing sector while extractive industries accounted for 19.7% of business travellers in the sample. The author believes that the large extractive industries sector is partially influenced by the routes offered by Air UK at Stansted. The east Scottish coast and Stavanger in Norway, both which have significant oil sectors, are both important destinations for Air UK at Stansted. However the large services sector is surprising. 19.8% of respondents worked for small companies with less than 100 employees. 23.2% of the sample worked in medium size companies (up to 1000) employees with the remaining 57.0% of the sample working for companies with more than 1000 employees.

The respondents on average made 19.75 business trips per annum. This may be compared to the figure found in the earlier survey which was 16.61 (Mason, 1995). Assuming the sample to be normally distributed (although it is slightly skewed), the amount of trips made by business travellers in 1997 is significantly higher than in 1992. This results provides some evidence to the on-going importance of the business travel market in the EU and distinguishes this market from the US market were Stephenson and Bender (1996) provide evidence that the market seems to be travelling less. EU short haul business travellers make fairly short business trips. 30.1% of the sample were making a day return, with a further 28.1% staying just one night. 91.3% of all respondents made trips of no more than 2 nights away. Respondents, on average were members of 1.99 frequent flier schemes. Free flights were the main benefit claimed from membership of such schemes with on average, each respondent redeeming 1.03 free flights during the preceding twelve months. This benefit seems about three times more popular than free upgrades, of which 0.34 were claimed by respondents during the year on average.

Business travellers collect information about available flights from three key sources. 40.1% of respondents made travel agency enquiries, while 19.0% used in-house travel managers or departments to find out about available flights. 27.7% of travellers planned their flights using airline printed schedules. The large amount of flights taken by the sample would infer that travellers become familiar with the available airlines operating from a particular airport and may collect printed schedules directly from the airline. The majority of flights (71.0%) are booked through specialist business travel agents, with a further 10.9% of flights booked directly with the airline.

The majority of short haul business travellers still select their own flight. 64.0% of the sample indicated they selected their own flights. This figure, however, is significantly lower than the figure in the 1992 survey where 69.8% or travellers selected their own flights. Business travellers it would seem are becoming less involved in the purchase decision for air services. This reduced involvement may be explained by greater corporate involvement in the market.

42.7% of respondents worked for companies that either employed a travel manager or who had a travel department (this figure has risen from 36.3% in 1992), and 70.7% worked for companies that had a corporate travel policy (60.3% in 1992).

The survey does provide some evidence that fewer companies provide their travelling executives with full-fare fully flexible travel. 14.4% of the sample were travelling on full-fare tickets while this figure was 25% in 1992. This figure cannot be fully off-set by a rise in the proportion of travellers that do not know the fare type they are travelling on (29.3%, as opposed to 25% in 1992), but the fact that such a large proportion of travellers do not know what type of ticket they hold indicates low involvement in the purchase.

This brief analysis shows that business travellers seems to becoming less involved in the selection and booking of airline services, while travel managers and travel department have an increasingly important roles to play in this area. The effect of corporate involvement is having some identifiable effect on the selected airline service, and that this effect is tending toward cost reduction rather than increased traveller flexibility.

4.1. An attitude scale for corporate travel policies

A Likert summated rating scale was used to assess business traveller attitude towards corporate travel policies (CTPs). Fifteen attitude statements, some positive and some negative in nature, were developed for use on the scale. Respondents were asked to indicate their level of agreement with each of the statements on a five point scale, from "strongly agree" to "strongly disagree". Statements that were positive about CTPs were scaled from five for "strongly agree" to one for "strongly disagree", and vice versa for negative statements. A total attitude score for each respondent was calculated by totalling the individual item scores. Therefore the range of potential scores on the total scale was between 15 to 75. The mean score was 50.06 with a standard deviation of 6.21. The lowest score, i.e. most opposed to CTPs, was 27 and the highest 72. The scores were normally distributed, and to assist in the analysis of the scale respondents were divided into three equal groups; respondents against CTPs, respondents with neutral attitudes towards

CTPs, and those with positive attitudes towards CTPs. A correlation of the summated scores with the scores given for each individual item shows the statements in the scale that most discriminated between respondents attitudes. These were:-

"CTPs are a good idea" ($r^2 = 0.6036$)
"CTPs are a constraint which serve no great purpose" ($r^2 = 0.6395$)
"CTPs are a hindrance when planning a business trip" ($r^2 = 0.6399$)
"CTPs tend to infringe of employment travel benefits" ($r^2 = 0.6588$)

A chi-square test of independence was used to identify which demographic and behavioural variables influenced respondent's attitudes towards CTPs. Table 1 below provides a tabulation of variables that were shown, at the 95% level, to influence respondent attitude to CTPs.

Table 1: Business traveller attitudes towards corporate travel policies.

	Anti-CTPs (%) 33% of sample	**Neutral to CTPs** (%) 33% of sample	**Pro-CTPs** (%) 33% of sample
Company size			
1-99 employees	35.0	13.4	11.8
100-999 employees	17.9	28.6	17.6
> 1000 employees	47.0	58.0	70.6
Company has a CTP			
Yes	55.2	84.7	93.2
No	44.8	15.3	6.8
Company has travel manger or dept.			
Yes	33.1	49.6	57.1
No	66.9	50.4	42.9
CTP type			
Written rules to be adhered to	20.0	25.7	35.7
Written guidelines	46.3	50.5	46.4
Written rules open to interpretation	13.8	5.7	7.1
Unwritten rules	20.1	18.1	10.8
Respondent selected own flight	70.9	65.2	63.1
Source of flight information			
ABC, OAG etc.	9.6	9.2	12.5
Airline produced schedule	28.9	36.8	16.1
Travel agent enquiry	51.8	25.0	44.6
Travel Manager/Dept. enquiry	9.6	28.9	26.8
Flight booked by:			
Traveller	30.0	16.2	14.4
Traveller's department	29.1	39.6	32.4
Travel Manager/Dept.	25.5	34.2	36.9
No of trips in last year			
1-5 trips	48.1	53.2	30.9
6-10	26.9	25.2	32.7
more than 10	25.0	21.6	36.4

The table shows that business traveller attitudes towards CTPs are influenced by the size of company that he/she works for. 70.6% of respondents who had positive attitudes towards CTPs worked for companies with more than 1000 employees. This figure can be compared to the proportion of the respondents with negative attitudes towards CTPs, where 47%

worked for companies with more than 1000 employees. A larger proportion of the group with negative attitudes towards CTPs worked for small companies with less than 100 employees compared to the positive group (35.0% compared to 11.8%). It would seem therefore that business travellers who work for larger companies are more likely to have positive attitudes towards CTPs.

Business traveller attitudes towards CTPs may be partially explained by knowledge of CTPs based on their experience of working with them. 93.2% of the group with positive feeling towards CTPs worked for companies with CTPs, whereas only 55.2% of the group with negative attitudes did. Those that were anti-CTPs were more likely to select their own flight (70.9%), while those with a positive attitude towards CTPs were more likely to allow others for select their flight (36.9% did not select their flight). This behaviour may be explained by the frequency with which each group travel. The results show that the negative group had made fewer trips in the last year compared to the positive group.

The presence of a travel manager or department within a company seems to have some effect on business travellers opinions regarding CTPs. 57.1% of the positive group worked for companies that employed travel managers, while this figure was only 33.1% of the negative group.

It is surprising that, when questioned about the nature of the CTP employed in their company, a larger proportion of the group positive about CTPs indicated that their CTPs was quite rigid with written rules to be adhered to. About half of all respondents, however, indicated that the CTP under which they make business trip are written guidelines. This may be compared to the results in table 2 below which shows a cross-tabulation of respondent attitudes towards CTPs and the class of travel accorded to those at different corporate levels within the employing company. It would seem that, while the proportion of traveller allowed to fly on business class increases with corporate status in all groups, the hierarchical bias is most obvious in the group of travellers that hold negative feeling towards CTPs. Business traveller attitudes towards CTPs may be most affected by companies that create travel policies that favour those at the top of the corporate hierarchy.

Table 2: Hierarchical corporate travel policies and business travel attitudes.

	Anti-CTPs (%)	Neutral to CTPs (%)	Pro-CTPs (%)
Flight allowance for various hierarchical levels in respondents company			
Company directors			
-Business Class	52.9	67.9	64.3
-Economy Class	47.1	32.1	35.7
Senior Management			
-Business Class	36.7	46.4	44.8
-Economy Class	63.3	53.6	55.2
Other Management			
-Business Class	15.5	18.7	30.1
-Economy Class	84.5	81.3	69.9

Table 1 above also shows differences between the groups in terms of the way in which they find out flight information, and also book their flights. The negative group were most likely to source flight information from travel agents, while the neutral and positive groups were more likely to make enquiries on in house travel managers or departments or airline produced schedules. The positive group were also much less likely to book the flight themselves, relying more heavily on others in their departments or in-house travel departments.

The analysis of the scale of traveller attitudes towards CTPs shows that company size obviously will affect the likelihood of a company employing a travel manager or having a CTPs and thus it would seem that marketing approaches for different size of company may be appropriate. The evidence provided here shows that corporate involvement in the air service purchase is greater in larger companies, and it would seem that these travellers on the whole are positive or at least neutral about this involvement.

4.2. Business travel market purchase benefits

Each respondents rated the importance of each of 25 product elements on a 5-point ranked continuum scale. Principal component analysis of the 25 purchase benefit elements was performed to identify any underlying purchase benefits. The data performed well under test of sampling adequacy (KMO = .82848) and sphericity (Bartlett = 3046.8, significance = .0000) indicating the suitability of the data for principal component analysis (PCA). Six principal factors identified by PCA accounted for 59.6% of the variation in the data set. Tests of the internal consistency of the data (Cronbach's alpha) provided evidence of the reliability of the attitude scale. In the earlier study six factors were also identified with a very similar amount of variation (60.6%). Table 3 below shows the variables that are closely associated with each factor.

Factors 1, 2, 4, 5, and 6 each have a bundle of product attributes associated with them which are very similar to those discovered in the earlier study. This provides further evidence of the reliability of the attitude scale, and indicates that there are the following purchase factors in the EU short haul business travel market; Business class value, in-flight comfort and experience, price, schedule, and local airport. Factor 3 in this survey includes duty free shopping and free newspapers, and beverages. In the earlier study this factor included ease of reservation, seat allocation, quality of ground service, and was called "air service user-friendliness". Further testing of the attitude scale is needed to investigate the reliability of this area of purchase benefits.

Table 3: Factor analysis of business travel purchase benefits.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Cronbach Alpha	*.7678*	*.7883*	*.7202*	*.7619*	*.6957*	*na*
Business Class value						
No ticket restrictions	.57065	.23780	.02897	.15668	.08844	-.19996
Seat allocation	.65922	.31436	.03391	.19398	-.04366	.02103
Return Boarding Card	.55925	.07233	.09119	.19720	.12523	.35450
Business lounge	.6878	.16340	.32410	-.04926	-.05598	.21021
Business Class Check-in	.77315	.17992	.19039	-.14428	.00784	.09457
In-flight comfort & experience						
In-flight service	.08924	.55975	.49488	.00936	.00112	.02188
Seat comfort	.07395	.76291	.20197	.03497	.00881	.07153
Airline punctuality	.30155	.68146	.02857	.00530	.18568	.14435
Past experience of airline	.23953	.60507	.03287	.11572	.16232	.14435
Airline safety record	.14483	.65546	.06982	.13651	.04056	-.03888
in-flight user benefits						
Duty Free available	.12644	-.01874	.60404	.30118	-.00777	-.14626
Free newspapers	.16246	.19153	.78667	.03470	.10578	.09102
Free beverages	.03503	.20303	.81290	.05237	-.05495	.06001
Price						
Ticket price	.03640	.09447	.08475	.87992	-.05149	.10873
Ticket discount	.02671	.10934	.17720	.88152	-.06530	.13262
Schedule						
Timing of outward flight	-.06644	.08326	-.02686	-.09181	.83461	.09406
Timing of return flight	.08124	.12469	.02307	.03476	.83967	.05213
Airport						
Local airport	.00479	.12538	-.04223	.13195	.05995	.81510

Following the principal component analysis, factor scores for each respondent were calculated and saved to be used in a cluster analysis to identify segments within the business travel market.

4.3. Business travel segmentation analysis

An iterative clustering algorithm was used, and a robust three cluster solution was reached after only four iterations. To evaluate the validity of the segments, a cross-validation procedure was applied to the solution. The cluster analysis was re-applied to the top half of the sample and each respondent's cluster membership in the validation process stored. The final cluster centres of this process were then used as the initial cluster centres in the application of the cluster analysis in the bottom half of the sample. Again the validation cluster memberships were stored. The validation cluster membership data were correlated with the original cluster membership data, the correlation coefficient was 0.8799 for the top of the sample, and 0.7701 for the bottom. The result of the cross-validation procedure was deemed satisfactory.

The chi-squared test of independence was used to identify the variables which differ significantly between the clusters. The variables that influenced segment membership were; management level/social classification, size of employing company, age (at the 90% level), the number of trips taken during the past twelve months, whether the company had a CTP, and the Likert score on the CTP attitude scale. Details of the differences are shown in table 4 below.

Table 4: Business travel segmentation profile

	Segment 1 (%)	Segment 2 (%)	Segment 3 (%)
	20.5% of sample	34.8% of sample	44.7% of sample
Management level			
Company director	18.2	17.4	32.9
Senior management	66.2	67.4	57.8
Other management	15.6	15.2	9.2
Age			
(significance 0.09982)			
25-43	27.3	30.5	17.6
35-44	37.7	34.4	38.2
45-64	35.1	35.1	44.1
Number of trips in last 12 months			
1-5 trips	48.1	56.5	36.9
6-10	19.5	24.4	33.3
more than 10	32.5	19.1	29.8
Company Size			
1-99 employees	15.6	15.3	26.2
100-999	23.4	26.7	19.2
more than 1000	61.0	58.0	54.7
Company has CTP			
yes	75.0	77.9	65.1
no	25.0	22.1	34.9
Views of CTP			
Anti-CTPs	11.7	39.6	34.5
neutral to CTPs	35.0	30.2	35.2
Pro-CTPs	53.3	30.2	30.3

Analysis of variance was used to examine the difference importance placed by each segment on product elements 1 to 25. This process revealed significant differences for product elements 1 to 22. These differences are significant at the 95% level. In the attitude scale, scores can range from 1 (highly important) to 5 (low importance). Table 5 below shows the mean attitude score for a number of purchase element for each segment and is organised to show the most important factors first. The segment that rates each product element the highest is highlighted.

Table 5: Purchase benefits sought by business travel segments

	Segment 1 mean attitude score	**Segment 2** mean attitude score	**Segment 3** mean attitude score
Most important purchase factors			
Timing of outward flight	1.0519	1.9015	1.0058
Timing of return flight	1.3247	2.1818	1.1503
Local airport	1.2597	1.7803	1.5202
Punctuality	1.4545	1.8939	1.6127
Seat comfort	1.4416	1.8106	1.7341
Fast-track check-in	1.6047	1.9615	1.6716
In-flight service	1.8961	2.1818	2.1445
Lack of ticket restrictions	2.7532	2.2803	2.0405
Frequent flier programme	2.6134	2.4987	2.0142
Ease of reservation	3.1169	2.3712	1.9191
Business lounge available	2.7662	2.5758	2.4220
Price	3.4675	2.5227	2.1792
Duty free available	4.0260	2.4091	3.4162

These tables are used as a basis to develop a profile of each segment.

4.3.1. Profile of segment 1

The first segment is made up of 20.5% of the respondents of the survey. A large proportion of members are employed in senior management positions. The age profile of this group is fairly even across the spectrum, however, the largest proportion of the segment (37.7%) are aged between 35-44. This is consistent with the management positions they hold.

With regard to business travel consumption, the largest proportion of the segment (48.1%) have made five trips or less in the last twelve months. However, when compared with the other segments, this segment has the largest proportion of the members who have made more than ten trips in the last year (32.5%). Members of this segment are most likely to work for large companies, with 61% of the group working for companies with more than 1000 employees. 75.0% of members of this segment work for companies that have a CTP, with 53.3% of the group holding positive attitudes towards these policies.

By identifying the product attributes that most closely associate with the purchase factors identified in the factor analysis above, we can see that segment one seems to rate factors 2 (in-flight comfort and experience) and 6 (local airport) most highly. Local airport is the most important purchase item to members of this segment. Members of this segment are keen to ensure that their time is not wasted, and thus airline punctuality and fast-track check-in are important purchase considerations. It is interesting to note that it is this group that rates airport business lounges least highly of the three segments, but this may reflect the groups propensity not to waste time. Once on board it is members of this segment that rate seat comfort and in-flight service more highly than members of the other segments, but is the group that places least importance on the price of the airline service.

This segments, therefore, works for large companies, is not interested in the price of the product but wants a smooth and pleasant product delivery during the consumption of the service. As long as these items are met, members of this segment would be least bothered by corporate involvement in their travel arrangements.

4.3.2. Profile of Segment 2

Representing 34.8% of the sample, a similar proportion of this segment are employed in senior management positions (67.4). The age distribution of this segment is similar to that found in segment 1, however this group tends to travel the least of all the groups. 56.5% of this segment have made five or less trips in the last twelve months. Although a smaller proportion of this group work for very large companies (58.0%), 77.9% of this group work for companies that have CTPs. The effect of corporate size on attitudes towards CTPs may explain the high proportion of the group with negative attitudes towards CTPs.

As can be seen by the table 5, members of this segment on average do not rate any product attributes more highly than members of other segments with the exception of duty free shopping. Consequently to investigate this segment we will look at the product attributes they rated most highly and also look at those product attributes where this group recorded a similar score to segment that scored the product highest. The most important factor to this group is local airport, which is rated higher than the timing of the outward flight, as is punctuality and seat comfort. The availability of a business lounge is relatively important as is the ease in which tickets may be reserved.

The profile indicates that members of this segment tend to travel less than the other segments. As they travel less the evidence suggest they get more involved in the purchase of their flights, and have negative feelings towards CTPs. To market to this segment, airlines should concentrate on the traveller not the corporation, given the travellers negative feelings towards CTPs, promote ease of access to the local airport, the connections available from the airport and quality of the duty free shopping and the business lounge facilities.

4.3.3. Profile of Segment 3

Representing 44.7% of the sample, this segment is the largest group of business travellers. 32.9% of the segment indicated that they work as company directors, with a further 57.8% working in senior management. This segment has the largest proportion of members who work for small companies (26.2%), although over half (54.7%) work for companies with more than 1000 employees. Members of this group are fairly evenly distributed in the frequency of business trips made. 29.8% of the group have made ore than 10 trips in the last year but 36.9% have made five or less. The age distribution is more distinctive, however, with 44.1% of the group being aged 44 or over.

With regard to CTPs members of this group were the least likely to work for a company that had a CTP. However this figure was still 65.1% demonstrating the reach CTP have in the business travel market. Attitudes towards CTPs were fairly evenly distributed between members of this segment, the largest proportion holding neutral opinions (35.2%).

The identifiable characteristics of this segment however are the purchase factors that they rate highly. Table 5 shows the large amount of product elements that members of this segment rated more highly than members of other segments. The scheduling factors were most important but members of this segment also rated purchase factors 1 (Business class value), and 4 (price), more highly than other segments.

This segment represents a large section of the short haul business travel market that want good schedules at low prices but also want to have the ability to change their flight bookings without restriction, and want to use well equipped business class lounges.

These factors combined with the slight tendency of this segment towards smaller companies possibly indicates that travellers in this segment have a greater involvement in the purchase decision than, particularly segment 1 where there seems to be more evidence of corporate involvement. Airlines or travel agents may wish to develop products aimed at this market segment that reduces the need for traveller involvement and makes the purchase easier. Travel agency management of smaller companies travel expenditure accounts may be mutually beneficial for the companies and agents.

This research has identified and profiled three market segment within the EU short haul market that are not obviously comparable with the market segments identified in the earlier study. The most striking difference between the earlier study and this research is that company size can be used to distinguish between segments in this study, whereas this was not possible in the earlier study. Company size is obviously a useful segmentation basis and when combined with the findings regarding corporate travel policies and corporate involvement in the purchase decision and procedures, the findings in this survey are very useful.

5. CONCLUSION

This paper has provided additional information regarding the business traveller and his/her employing organisation in the purchase of air travel. The scale for traveller attitudes towards CTPs can be evaluated by its application in other markets. Other attitude statements could be developed that might gain greater insight into business traveller attitude constructs. The scale for purchase attributes which was previously developed has been assessed and surprisingly similar results were found in terms of the key purchase attributes in the short haul business travel market which provides strong evidence of the key purchase benefits sought by the business travel market. A new market segmentation based on these product elements reaped further in-sight into the market and how it has changed in the last five years.

ACKNOWLEDGEMENTS

The author would like to thank Elaine Argent of Air UK ltd. for her help in obtaining authorisation to survey passengers at Stansted airport, and David Edwards who assisted in the collection of the data.

REFERENCES

Barratt, S. (1991), "European airline deregulation", in Banister, D. and Button, K. **Transport in a Free Market Economy**, London, Macmillan, pp. 242-249.

Bourne, J. (1991), "How to control runaway expenses", **Business Traveller**, June, pp. 15-17.

Browne, W., Toh, R., and Hu, M. (1995), "Frequent-Flier Programs: The Australian Experience", **Transportation Journal 35**, No. 2, Winter, pp. 35-44.

Cohen, A. (1997), "Corporate travel: Serious travel budgets need serious management", **The Times**, 6/2/97, page not known.

Cook, A., Davies, M., and Haver, P. (1994), **Corporate Travel Survey**, Unpublished survey for the Institute of Travel Management, July/Aug., Transport Studies Group, University of Westminster.

Doganis, R. (1991), **Flying Off Course: The Economics of International Airlines**, 2nd edit., Harpers Collins, London.

Doganis, R. (1994), "The impact of liberalization on European airline strategies and operations", **Journal of Air Transport Management 1**, No.1, March, pp. 15-26.

Gilbert, D. (1996), "Relationship marketing and airline loyalty schemes", **Tourism Management 17**, No. 8, pp. 575-582.

IATA, (1997), "Cost conscious business travellers will try non frills airlines", **International Air Transport Association, Press release**, No: PS/13/9, 27/1/97.

Jones, L. (1996), "Off to a Head Start", **Airline Business**, September, pp. 60-66.

Mason, K. J. (1995), **A Stakeholder Approach to the Segmentation of the Short Haul Business Air Travel Market**, Unpublished PhD, Faculty of Science, University of Plymouth.

Mason, K. J., and Gray, R. (1995), "Short haul business travel in the European Union: a segmentation profile", **Journal of Air Transport Management 2**, No. 3/4, pp. 197-205.

Nako, S. (1992), "Frequent Flyer Programs and Business Travellers: An Empirical Investigation", **Logistics and Transportation Review 28**, No. 4, pp. 395-414.

Skapinker, M. (1992), "Travel expenditure: Cost-cutting in the air", Contracted Business Services Survey, **Financial Times**, 20/2/92, p. III.

Stephenson, F., and Bender, A., (1996), "Watershed: The Future of U.S. Business Air Travel", **Transportation Journal 35**, No.3., Spring, pp. 14-32.

Whittiker, R. (1998), "Blue Sky faces a storm of protest", **Airline Business**, January, pp. 7-7.

Williams, G. (1993), **The Airline industry and the Impact of Degregulation**, Ashgate, Hants, England.

APPENDIX I

1. CTPs are a good idea
2. CTPs make the whole process of travel more easy
3. CTPs are a constraint which serve no great purpose
4. CTPs benefit those at the top of the hierarchy
5. CTPs take transport decisions away from the individual traveller
6. CTPs allow the company to save money on travel
7. CTPs are a sensible business decision
8. CTPs are a hindrance when planning a business trip
9. CTPs force travellers onto other transport modes for short distance travel (up to 300 miles)
10. CTPs tend to infringe of employment travel benefits
11. CTPs require advance planning of business trips
12. CTPs downgrade the class of travel allowed
13. CTPs have resulted in companies having preferred airlines
14. Frequent flier points should be awarded to the company rather than the traveller
15. CTPs increase the use of video conferencing and e-mail while reducing air travel

APPENDIX II

1. Timing of the outward flight
2. Timing of the return flight
3. Flight frequency
4. Ticket price
5. Ticket discount
6. Ease of reservation
7. Lack of ticket restrictions
8. Direct route
9. Seat allocation at reservation
10. Fast-track check-in
11. Quality of ground service
12. Flight from local airport
13. Return boarding card on departure
14. Business lounge available at airport
15. Automated check-in
16. Exclusive Business Class check-in
17. In-flight service
18. Seat comfort
19. Duty Free available
20. Free daily newspapers
21. Free beverages
22. Frequent flier programme
23. Airline punctuality record
24. Past experience of an airline
25. Airline safety record

Topic Area : A4

59-03
385677
p16

ECONOMETRIC ANALYSIS OF AIRLIFT PASSENGER DEMAND

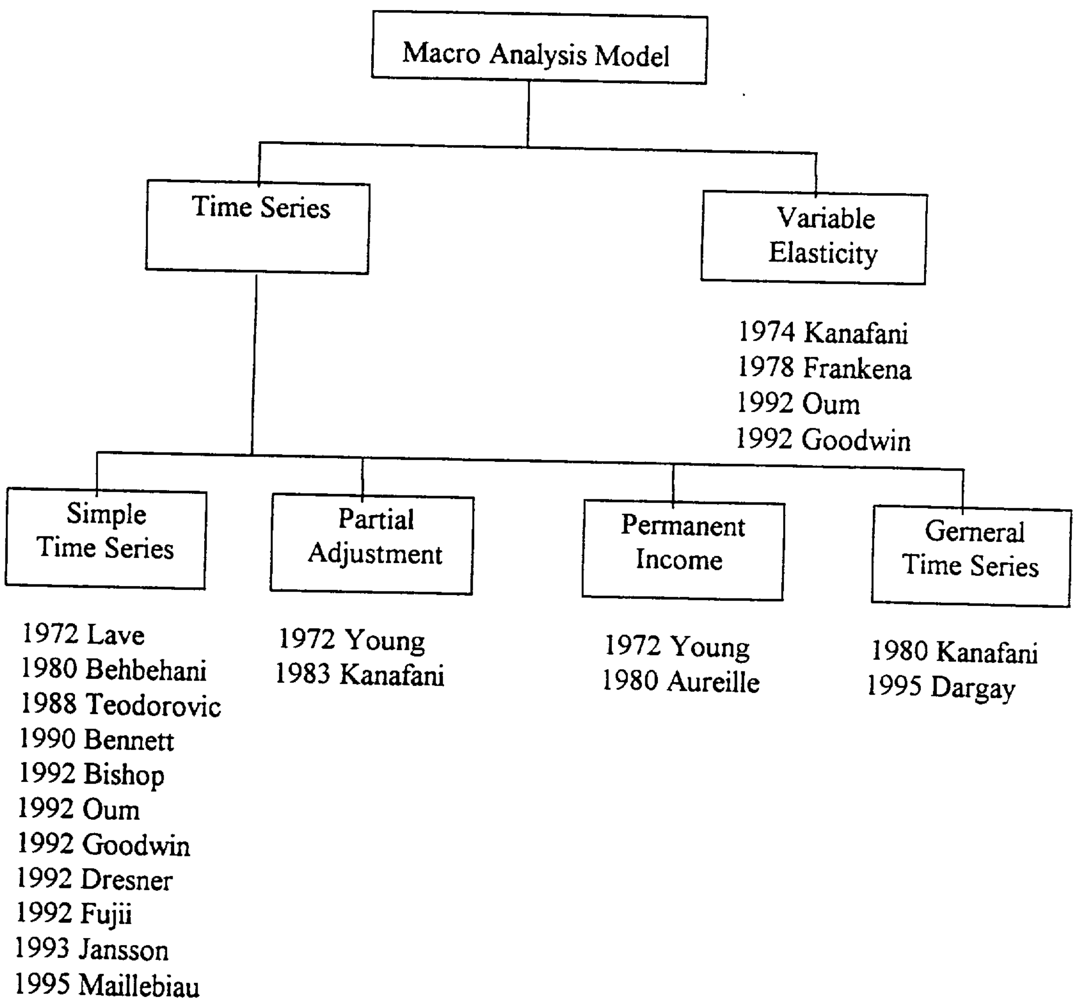
Dr. Suk-Hong Yoon
Professor, Department of
the Aviation Management
Korea Aviation Univ.
Hwa-jon Dong, Go-yang City
Gyong-gi Do, Korea(411-791)
FAX : 82-02-307-5769

1 GENERAL REVIEW OF THE AIRLINE DEMAND FORECAST MODELS

This research is purposed to review current airlift demand forecast models and to refine in accordance with the analysis methods of econometrics.

Kanafani(1983) categorized current models into two ways of macroanalysis and microanalysis models in reference to the dichotomous analysis methods of the economics as macroeconomics and microeconomics respectively. Macroanalysis methods includes both of the time series models and variable elasticity models as shown <Figure 1 and 2>.

< Figure 1 > Macro analysis models



Simple time series model developed by Maillebiau(1995) is as follows.

$$\log(PAX) = \alpha - 0.868 \log(YLD) + 0.618 \log(USENP) + 0.170 \log(ACC) - 0.044 \log(TRD) + 0.062 \log(DOL) - 0.217\, D86 \quad \text{------------------------} (1)$$

(PAX: annual passenger
YLD: average fare per mile
USENP: annual domestic enplanements
ACC: accessibility of service
TRD: annual trades
D86: dummy)

In variable elasticity model, Oum(1992) estimated air fare elasticities of air passenger travel demand as <Table 1>.

<Table 1> Demand Elasticities of Air Passenger Travel

	Time Series	Cross-section	Other
Leisure travel	0.40-1.98,1.92	1.52	1.40-3.30,2.20-4.60
Business travel	0.65	1.15	0.90
Mixed or unknown	0.82,0.91,0.36-1.81	0.76-0.84,1.39,1.63	0.53-1.00,1.80-1.90
	1.12-1.28,1.48	1.85,2.83-4.51	

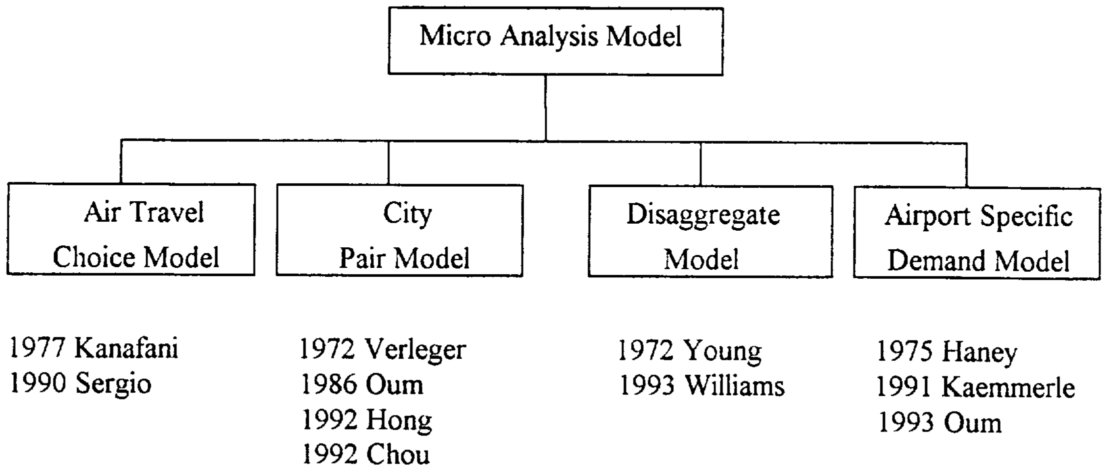
In consideration of time, the statistical observation usually takes as one year, because it is essential that the economic datas are available on an annual basis.

Current demands would be the results of the foregone years as Dargay(1995) model for the U.S. domestic passenger.

$$\ln D_t = a + b\ln P_t + c\ln Y_t + d\ln D_{t-1} \quad \text{--} (2)$$

(D_t : travel demand in period t,
P_t : air fare in period t,
Y_t : Personal income in period t
D_{t-1} : travel demand of the previous year)

< Figure 2 > Micro analysis models



2 ECONOMETRIC MODEL BUILDING

Airlift passenger demands are divided into business and nonbusiness by trip purposes. And nonbusiness demands are subdivided into tourism and visitor (of relatives and friends.)
Kanafani(1983) said that, from the unavailability of trip purpose information, trip purpose analyses are often not taken into consideration in air travel. But Korea authorities concerned immigrations/emmigrations have been gathering informations about the trip purposes of official, business, tourism, and visitors (relatives/friends) strictly in view of national securities.

The objective period of this research is between 1976 and 1990, before ASIANA airline was inaugurated into the transpacific routes. Econometric models will be built for these 3 categories with time series analysis.

Independent variables are final consumption expenditures per capita (Table A-3), Transaction between Korea and U.S.A.(Table A-6), air fare (Table A-5), and GDP per capita (Table A-4) of appendix. And the standard year to change the current value to real values is 1985.

From the decreasing effect air fare and increasing of income, American travelers to Korea were increased 14.2% in average annually.
In due to the absence of intermodal competition between airlift and others on the route of transpacific, these analyses do not include any cross elasticity of demand.
Since the specification test becoming an intergral part of econometric demand model, all

models are passed through one of the statistical inference tests, Kolmogorov-Smirnov evaluation.

In Korea, Since government managed the exchange rate of foreign currency, this research omits any effects from this.

2.1 American Tourists to Korea

$$\ln T_t = 1.321156 \ln d_t - 1.028466 \ln f_{t-1} + 0.536099 \ln T_{t-1} \text{ -----------(3)}$$

(2.403056) (-1.243644) (3.159584)

( ) t statistical value of 95% significance level.

$R^2 = 0.97$, $\bar{R}^2 = 0.96$, D.W. = 1.94

(T_t : American tourists, d_t : final expenditure per capita, f_{t-1} : fare of the previous year)

<Table 2> Kolmogorov-Smirnov Evaluation

Range	Number of Observation (O_i)	Accumulated Frequency ($C\,O_i$)	Expected Frequency (E_i)	Accumulated Frequency ($C\,E_i$)	Difference ($d=C_iC_i-C_iE_i$)
$-\infty \sim -1.0$	0	0	2.6976	0.1587	-0.1587
$-1.0 \sim -0.5$	0	0	2.5463	0.3085	-0.3085
$-0.5 \sim 0$	7	0.41	3.2558	0.5	-0.09
$0 \sim 0.5$	10	1.0	3.2558	0.6915	0.3085
$0.5 \sim 1.0$	0	1.0	2.5463	0.8413	0.1587
$1.0 \sim \infty$	0	1.0	2.6979	1.0	0
total	17		17		

max $|d| = 0.3085 < 0.318$, therefore, null hypothsis is adopted.

There are three findings from this study being different from conventional studies. American tourists demand is elastic to air fare of the previous year of their departures rather than the current year. And this is different from <Table 1>. The reason is that almost of Americans participates in tours organized by travel agencies who begin to promote their sales several years prior to.

American tourists swarm into the trip corridors that the American tourists have been experienced. They prefer of those routes security ascertained to the undeveloped routes . And they are sensitive to their income of the year of their departure.

2.2 American Visitors to Korea

$$\ln B_t = 0.420802 \ln g_t + 0.764301 \ln m_t \quad \text{-----(4)}$$
$$\qquad (3.004489) \qquad (5.491212)$$

$R^2 = 0.9442$, $\bar{R}^2 = 0.9330$, D.W. = 1.97, $\rho = 0.597$ (Cochran - Orcutt)

(B_t : business purpose visitors, g_t : real GDP per capita in America
m_t : transactions between two countries in the period of "t")

<Table 3> Kolmogorov-Smirnov Evaluation

Range	Number of Observation (O_i)	Accumulated Frequency ($C\,O_i$)	Expected Frequency (E_i)	Accumulated Frequency ($C\,E_i$)	Difference ($d=C_iC_i-C_iE_i$)
$-\infty \sim -1.0$	0	0	2.2218	0.1587	-0.1587
$-1.0 \sim -0.5$	2	0.1428	2.0958	0.3085	-0.1657
$-0.5 \sim 0$	2	0.2857	2.681	0.5	-0.0228
$0 \sim 0.5$	6	0.7142	2.681	0.6915	0.0227
$0.5 \sim 1.0$	2	0.8571	2.0958	0.8413	0.0158
$1.0 \sim \infty$	2	1.0	2.2218	1.0	0
total	14		13.9972		

max $|d| = 0.1657 < 0.349$, therefore, null hypothesis is adopted.

Doganis(1991) identified factors as generally affectiong passenger demand for airline services across all markets, i.e., the level of personal diposable income and the level of economic activity.
But the results is that American visitors for the purpose of business and official are sensitive to GDP per capita rather than personal disposable income. The reason is that visitors' organization pays trip expenses for the visitors.

2.3 Korean Ethnics (of America) Visitors

$$\ln V_t = 0.560291 + 0.516563 \ln d_t - 4.168766 \ln f_{t-1} - 3.461288 \ln f_{t-2} \quad \text{-----(5)}$$
$$(0.802) \qquad (7.584) \qquad (-3.180) \qquad (-2.917)$$

$R^2 = 0.8787$, $\overline{R}^2 = 0.8374$, D.W.= 1.26, $\rho = 1.17$.

The reason why statistical values are not so good is that, when Korean ethnics (of America) travel their motherland to visit relatives, they are used to buy any diluted tickets from the normal fare.

3 POLICY IMPLICATIONS

Americans' behavior of travel is rational in view of economy referring statistical values of three models. In tourism purpose travel model, demand elasticities both of income and fare are near unitary (1.32 and -1.03 respectively) mean that they consume travel as an usual goods rather than luxury.

They respond to the fares of the previous year not the current year and also to the tour fashions of the previous year. It means that Americans begin to plan several years prior to their departures and pay tour fees to the organizers two years prior to at least.

American visitors for the purpose of business respond to the real GDP per capita rather than final consumption expenditures per capita, and also to the real transactions between two countries.

Korean ethnics of America desire to visit their relatives in motherland regardless of their level of income (demand elasticity of income, 0.56.). But whether they could materialize their desire depends upon highly to the level of fares.

And they begin to plan several years earlier than American tourists.

Upon these conclusions, policy implications are drawn as follows.

First, to promote foreign tourists to travel to Korea, authorities focus their activities on to the tour organizers of America rather than the individual traveler.

The target is to the middle level income or above group. Public relations activities including advertise should be maintained with the long-term programs.

And, because Americans refer to the tourism pattern that tourists have swarmed into, authorities keep the bondages with the persons who already visited Korea.

Second, to help the Korean ethincs of America to materialize their desire, authorities prepare package program of home-coming tour several years prior to their trips.

REFERENCES

Aureille,Y.G.(1980), The Outlook for the U.S. Airline Industry : An Econometric Approach, **Proceedings of Workshop on Air Transportation Demand and Systems Analysis**, M.I.T.Report ITS-WP-80-5.

Behbehani,R.,et el.(1980), Demand and Supply Models of Air Traffic in International Market, Institute of Transportation Studies, Research Report ITS-WP-80-5, Berkeley.

Bennett,R.W.,et al.(1990), Inverse Price/Quality Tradeoffs in the Regulated Airline Industry, **J. of Transport Economices and Policy** 24,35-47.

Bishop,M.et al.(1992), Peak-load Pricing in Aviation, **J. of Transport Economics and Policy 26**,71-82.

Chou,Y.H.(1992), A Method for Measuring the Spatial Concentration of Airline Travel Demand,**Transportation Research 27B**,267-273.

Dargay, J.M. et. Goodwin, P.B. (1995), Evaluation of Consumer Surplus with Dynamic Demand, **J. of transport Economics and Policy 29**, 179-193.

Doganis, R. (1991), **Flying off Course : the Economics of international Airlines** (2nd. ed), Routeledge, London.

Dresner,M. et al.(1992), Modelling and Testing the Effect of Market Structure on Price, **J. of Transport Economics and Policy 26**,171-184.

Frankena, M.W.(1978),The Demand for Urban Bus Transport in Canada, **J. of Transport Economics and Policy 12**, 280-303.

Fujii,E.et als.(1992), The Economics of Direct Flight, **J. of Transport Economics and Policy 26**,185-195.

Goodwin,P.B.(1992), A Review of New Demand Elasticities with Special Reference to Short and Long Run Effects of Price Changes, **J. of Transport Economics and Policy 26**,155-169.

Haney,D.G.(1975), Review of aviation forecasting methodology, Report DOT-40176-6, USDOT, Washington, DC.

Hong,S.W.et.al.(1992), Air Traffic Network Equilibrium: Toward Frequency, Price and Slot Priority Analysis, **Transportation Research 26B**,307-323.

Jansson,K.(1993), Optimal Public Transport Price and SerVice Frequency, **J. of Transport Economics and Policy** 27,33-50.

Kaemmerle,K.C.(1991), Estimating the Demand for Small Community Air Service, **Transportation Research 25A**,101-112.

Kanafani,A.(1983), **Transportation Demand Analysis**, McGraw-Hill Book Pub.Co.,New York, p.235.

———(1980), Price Elasticity of Nonbusiness Air Travel Demand, **Transport Engineering Journal 106**,217-25.

——— et als.(1974), Demand analysis of north atlantic air travel, Research report, Vol .1,Institute of Transportation Studies,Berkeley.

——— et. al.(1977), The Partitioning of Long Haul Air traffic, A Study in Multinomial Choice, **Transportation Research 11**,1-8.

Lave,L.B.(1972), The Demand for Intercity Passenger Transportation, **J. of Regional Science 12**,71-84.

Maillebiau, E. et. Hansen, M. (1995), Demand and Consumer Welfare Impacts of International Airline Liberalization, **J. of Transport Economics and Policy 29**, 115-136.

Oum, T.H. et. als.(1993), Inter-Firm Rival-yard Firm-Specific Price Elasticites in the Deregulated Airline Markets, **J. of Transportation Economics and Policy 27**, 171-192.

———(1992), Concepts of Price Elasticity of Transport Demand and recent Empirical Estimates, **J. of Transport Economics and Policy 26**,139-154 and 164-169.

———(1986), Demands for Fareclasses and pricing in Airline Markets, **The Logistics and Transportation Review 22**, 195-222.

Sergio,R.et.als.(1990), Welfare Implications of the Omission of Income Effects in Mode Choice Models, **J. of Transport Economics and Policy 24**,83-932.

Teodorovic,D.(1983), **Airline Operations Research**, Gordon & Breach Science Pub., New York.

Verleger,P.K.(1972), Models of the Demand for Air Transportation, **Bell J. of Economics and Management Science 3** (No.2.)

Watkins, W., Taylor, D., and Richard, D. (1972), Forecast of scheduled domestic air travel for the 50 states 1972-1981, USCAB, Washigton, DC.

Williams,H.C.W.L.,et.al.(1993), Public Transport Service Under Market Arrangements, Part I: A Model of Competition between Independent Operators, **Transportation Research 27B**,369-387.

Young,K.H.(1972), A Synthesis of Time Series and Cross Section Analysis:Demand for Air Transportation Service, **J. of American Statitical Association 67**,560-566.

APPENDIX A

<Table A-1> Americans to Korea(Tourism Purpose)

Year	Tourists			Other		Total
	Person	Occupancy(%)	Rate(%)	Person	Rate(%)	
1976	32013	31.32	11.40	70186	2.19	102199
1977	37465	32.95	17.03	76245	8.63	123710
1978	42420	35.94	13.23	75619	-0.82	118039
1979	55937	43.92	31.87	71418	-5.56	127355
1980	53295	43.90	-4.72	68109	-4.63	121404
1981	58475	44.84	9.72	71927	5.61	130402
1982	67089	44.36	14.73	84160	17.01	151249
1983	80776	45.77	20.40	95712	13.73	176488
1984	89893	45.21	11.29	123092	28.61	212986
1985	82388	34.41	-8.35	157035	27.58	239423
1986	112069	39.38	36.03	175502	9.85	284571
1987	136412	41.80	21.72	189918	8.21	326330
1988	122604	35.30	-10.12	224677	18.30	347281
1989	108454	34.20	-11.54	208679	-7.12	317133
1990	104756	32.19	-3.41	220632	5.73	325388

<Source : Korea Tourism Promotion Association, Foreigners to Korea (Monthly Report)>

<Table A-2> **American Travelers to Korea (Visiting Relatives)**

Year	Visiting Relatives	Business		Other	Total
		Commercial	Official		
1976	1682	11785	42303	14416	70186
1977	1262	20860	33269	20854	76245
1978	2698	19158	33450	20313	75619
1979	5575	17505	39830	8508	71418
1980	6779	17262	36400	7668	68109
1981	7538	20761	35593	8035	71927
1982	7895	22913	44401	8951	84160
1983	11762	27750	45593	10607	95712
1984	20385	35390	50373	16944	123092
1985	33517	51376	58060	14082	157035
1986	39112	61721	59849	11820	172502
1987	43877	69975	61185	14881	189918
1988	43714	73149	63911	43903	224677
1989	48707	75304	19194	65474	208679
1990	46429	74408	17033	82762	220632

<Source : Korea Tourism Promotion Association, Foreigners to Korea (Monthly Report)>

<Table A-3> Final Consumption Expenditure Per Capita of U. S. A

Year	Current Expense ($billion)	Real Expense			C.P.I.(%)
		Amount ($billion)	per capita	Rate(%)	
1976	1129.4	2135.0	9791	4.39	52.9
1977	1257.2	2233.0	10138	3.54	56.2
1978	1403.5	2316.0	10404	2.62	60.6
1979	1566.7	2321.0	10312	-0.88	67.5
1980	1732.6	2264.8	9943	-3.52	76.5
1981	1915.1	2266.4	9847	-0.97	84.5
1982	2050.7	2286.2	9832	-0.15	89.7
1983	2234.5	2413.1	10277	4.53	92.6
1984	2426.4	2511.8	10598	3.12	96.6
1985	2629.0	2629.0	10987	3.67	100.0
1986	2807.5	2755.2	11403	3.79	101.9
1987	3012.1	2849.7	11682	2.45	105.7
1988	3235.1	2943.7	11950	2.29	109.9
1989	3471.1	3013.1	12080	1.09	115.2

< Source : IMF, International Financial Statistics Yearbook (1990)>

<Table A-4> **G.D.P . of U.S.A.**

Year	Current GDP ($billion)	Real GDP			GDP Deflator
		Amount ($billion)	(Real GDP) per capita	Rate(%)	
1976	1761.7	3101.6	14225	3.93	56.8
1977	1965.1	3247.7	14746	3.66	60.6
1978	2219.2	3408.9	15315	3.86	65.1
1979	2464.4	3480.8	15466	0.99	70.8
1980	2684.4	3472.7	15247	-1.41	77.3
1981	3005.5	3548.4	15418	0.10	84.7
1982	3114.8	3457.0	14868	-3.57	90.1
1983	3355.9	3585.4	15270	2.70	93.6
1984	3724.8	3828.2	16153	5.78	97.3
1985	3974.2	3974.2	16609	2.82	100.0
1986	4205.4	4094.8	16947	2.04	102.7
1987	4497.2	4238.9	17367	2.53	106.1
1988	4847.3	4434.9	18004	3.61	109.3
1989	5198.4	4568.0	18315	1.73	113.8

<Source : IMF, ibid.>

<Table A-5> **Air Fare (between L.A. and Seoul)**

(unit : $)

Year	Normal One Way Economy Fare (Nominal)	Real Fare	
		Amount	Rate(%)
1976	581	1098	-8.19
1977	581	1033	-5.92
1978	581	958	-7.26
1979	581	860	-10.23
1980	710	928	7.91
1981	756	894	-3.66
1982	794	885	-1.01
1983	842	909	2.71
1984	842	871	-4.18
1985	842	842	-3.33
1986	842	826	-1.90
1987	884	875	5.93
1988	884	842	-3.77
1989	884	804	-4.51
1990	884	767	-4.60

<Source : IATA, Tariff>

<Table A-6> **Transactions between Korea and U.S.A**

Year	Import from Korea	Export to Korea	Total Amount	
			Amount	Rate(%)
1976	4297	3150	7447	27.26
1977	4973	3794	8767	17.73
1978	5994	4410	10404	18.67
1979	5466	5863	11329	8.89
1980	4547	5488	10035	-11.42
1981	5206	6217	11423	13.83
1982	5821	6052	11873	3.94
1983	8063	6312	14375	21.07
1984	10213	6820	17033	18.49
1985	10754	6489	17243	1.23
1986	14368	6480	20848	20.91
1987	17674	8528	26202	25.68
1988	19709	11608	31317	19.52
1989	17285	14105	31390	0.23

<Source : Korea Trade Association, Foreign Trade (Monthly Report) and
IMF, International Finance Statistics>

Topic area: "A4" Airports and Aviation (SIG)

50-03

385678

p. 12

PASSENGER'S CHOICE OF AIR TRANSPORT UNDER ROAD COMPETITION: THE USE OF COINTEGRATION TECHNIQUES

by
Pablo-Coto*
José Baños-Pino¤
Vicente Inglada◆

*Department of Economics. University of Cantabria.
¤Department of Economics. University of Oviedo.
◆Ministerio de Obras Públicas, Transportes, Comunicaciones y Medio Ambiente (Ministry of Public Works, Transport, Communication and Environment).

Topic area:
"A4" Airports and Aviation (SIG).

Authors:
Pablo Coto-Millán, José Baños-Pino and Vicente Inglada.

Title:
"PASSENGER'S CHOICE OF AIR TRANSPORT UNDER ROAD COMPETITION: THE USE OF COINTEGRATION TECHNIQUES"

Abstract:
In this study, we present a theoretical model for passenger air transport demands in Spain. Quarterly data has been used for the 1980.I-1992.IV period.

We have used cointegration techniques, which are subject to a wide range of tests, to obtain short- and long-run equations. Moreover, we have obtained the product, price and cross elasticities of each mode of transport. These estimations may be used to analyze the effects of transport fares on income changes, as well as to predict short- and long-run traffics.

1. INTRODUCTION

The initial models of passenger transport demand were the aggregate "modal split models". In these models, there has been an attempt to determine the number of journeys in a given set of modes of transport for two towns, taking into account the characteristics of the passengers. Studies on modal split, such as Quandt and Baumol (1966), Boyer (1977), and Levin (1978), have been criticized by Oum (1979) and Winston (1985), among others, for the few variables used to account for the motivation in the user's behavior, and for using very simple linear patterns in their estimations.

Several models of aggregate passenger transport demand based on the user's behavior have been carried out in order to improve the previous ones. The user's utility is optimized in these models in line with the classic theory of consumer's behavior and demand. The work by Oum and Guillen (1979) based on the user's behavior is a typical example in which the passenger demand in Canada is analyzed.

Some disaggregate research based on the user's behavior has also been done on passenger transport demand. The most significant work on these models is McFadden (1973, 1974). In these works, the user takes a discrete choice of some of the different modes of transport (railway, air, road transport, etc.) and it is assumed that the mode chosen optimizes the utility for the user.

Spanish interurban passenger transport was first studied in the "Elasticidad de la Demanda del Transporte Público de Viajeros" (Elasticity of the Passenger Public Transport Demand) by the Instituto de Estudios de Transportes y Comunicaciones (Institute of Transport and Communication Studies) (1978). This was analyzed by Vázquez (1985) in a work carried out by the Secretaría General del Ministerio de Transportes (General Secretariat of the Ministry of Transport). In addition, other studies such as that by Inglada (1991), Coto-Millán and Sarabia (1994); and Coto Baños and Inglada (1995) have been carried out on this issue. The elasticities of the modes of transport in the main regions were studied in IETC (1978) and Vázquez (1985). Price elasticities have been studied in Inglada (1992) for monthly data between 1980.01 and 1988.12, with time series in which the residues have been modeled with the Box-Jenkins techniques. Uniequational models have been carried out in Coto-Millán and Sarabia (1994) in order to estimate income elasticities, using the Industrial Production Index (IPI) and the Electric Power Consumption (CENER), for the 1980.01-1988.12 period, and monthly data have been used in the estimations. In these works, the series is also modeled by the Box-Jenkins methodology.

An original model is offered in this paper in order to estimate price income and cross elasticities for the 1980.I-1992.IV period, applying cointegration techniques and using monthly data. Such techniques allow the estimation of short-run elasticities, which add immediate responses to price and income changing, and the estimation of long-run elasticities which allow to see the effects of the price and/or income changing produced later on.

This research offers a model according to the second proposal above, being based on a microeconomic analysis, which can be considered as classic. Its structure is very simple. Point number two presents the theoretical model for Spanish passenger transport demand. In the next point, the data used are described. Point number four presents the estimations of the different demands. Finally, the main conclusions are offered in point number five.

2. THE MODEL

Assume a typical user whose preferred goods verify the weak separability condition. Thus, modeling of the of passenger transport service demand constitutes the second stage of a two-stage budget process. Therefore, the user's income firstly falls into two big spending categories: passenger transport services and the rest of the goods and services; secondly, the user's income is assigned to the goods and services contained in each of these two categories. That is to say, the utility function of the representative user is as follows:

$$U = U\,(X_1, X_2, ...X_k; X_{k+1}, ..., X_n)$$

where vector $X_i= (X_1, X_2, ...X_k)$; with i= 1, 2,..., k represents passenger transport services; vector $X_j= (X_{k+1}, ..., X_n)$; j= k+1,...n represents goods and services except for those corresponding to passenger transport and U represents a utility function which is continuous and differentiable, monotone, increasing, and strictly quasi-concave.

The consumer balance is reduced to:

$$\max U\,(X_i; X_j)$$
$$\text{subject to: } P_i \cdot X_i + P_j \cdot X_j = Y$$

where the prices $P_i= (P_1, P_2, ..., P_k)$ and $P_j= (P_{k+1}, ..., P_n)$, and where Y represents the user's level of income.

First order conditions allow to obtain the following typical user's Marshallian demands:

$$X_i= X_i\,(P_i, P_j, Y) \quad [1]$$
$$X_j= X_j\,(P_i, P_j, Y) \quad [2]$$

Of these individual demand functions, function [1] is interesting for us since it corresponds with passenger transport services.

Equation [1] still presents some problems. Firstly, functions such as [1] should be valid for any income distribution among the different economic agents. If this were not the case, function [1] would provide as many values as income Y distributions among the user were possible and, therefore, such a function would not exist. Another assumption would be that income is distributed under a specific rule. Once this rule has been established, the integrability conditions are checked and the existence of the aggregate Marshallian demand functions is guaranteed, Varian (1992). However, there are no data to go along these lines. In order to solve this problem in this study we can assume that all the users have the same level of income.

Function [1] is general enough to analyze the passenger transport service demands -Talgo and long-distance railway, air and road transport- identifying the different subindexes for the amounts demanded in each service.

From 1980.I to 1992.IV, passenger transport services in Spain have been provided under different regulation conditions. The government company RENFE and Iberia have the monopoly of railway and air national transport in Spain respectively, and road transport is provided by private companies which were given a regular line after a system called "right of testing". It can be said that trump road passenger transport, which has a low incidence in quantitative terms, is the only mode of transport which has not yet been regulated. However, given the impossibility to obtain quarterly statistical data on passenger road transport, and with the aim of adding inter-regional transport on the user's own vehicles, we have used the premium petrol consumption variable. The premium petrol consumption has also been regulated by the government during the period of this study. Under such regulation conditions and with the aim to prevent the problems which may arise from the supply-demand simultaneity, we have assumed that supply is exogenous in relation with prices and income and is determined by the decisions of the government.

3. SPANISH DATA

The data on the series of long distance passenger railway transport (VKF), passenger Talgo railway (VKT), and passenger departures and arrivals in Spanish airports (AERV), have been obtained from the series provided by the Informes de Coyuntura del Ministerio de Transportes, Turismo y Comunicaciones. No data on road transport passengers are available and a "proxy" such as premium petrol consumption has been used in order to approximate the transport on the user's own vehicles. The variable (QGAS) has been obtained from the Dirección General de Previsión y Coyuntura del Ministerio de Economía y Hacienda. The gas-oil consumption variable (QGLEO) has also been used with the aim of approximating the behavior of regular and trump passenger transport on public services. However, the results obtained are significantly anomalous and the reason for this may be that this variable shows the behavior of road transport of goods (much more important in terms of consumption), rather than of passengers.

The data on the series of long distance railway prices (PF) and air transport tariffs (PA) have been obtained from the monthly series worked out from the tariffs of the Boletines Oficiales del Estado (Official State Reports), evaluated within the period in which each tariff is in force.

The data on the prices of premium petrol (PGAS) have been obtained from the Dirección General de Previsión y Coyuntura del Ministerio de Economía y Hacienda as monthly data, also evaluated within the period in which each tariff is in force.

The data on the prices of gas oil (PGLEO) have been obtained from CAMPSA until 1992. From then onwards, the data from the Compañía Logística de Hidrocarburos (Hydrocarbon Logistic Company) have been recorded for further studies.

The data on the income variable have been obtained considering the Spanish quarterly GDP as "proxy". The series used for the 1980.I-1989.IV period is that used by Mauleón (1989) and it was extended until 1992.IV from the series of the Contabilidad Nacional Española (Spanish National Accounting).

4. MARSHALLIAN OR NON COMPENSATED DEMANDS OF INTERURBAN PASSENGER TRANSPORT: AIR AND ROAD TRANSPORT

We have estimated some equations from the specifications in model [1] by adjusting the variables to each mode of transport. All variables headed by letter L are in natural logs and those headed by letter D are in differences, except for the dummy variables D89.I, DS90.I, D81.I, and D89.II, which will be properly defined later on in this paper. The statistical "t" is presented within brackets under each coefficient.

We have applied a cointegration approach, which has provided the most satisfactory results of the various approaches previously attempted (Inglada (1992), Coto-Millán and Sarabia (1994) to obtain the estimations. For more information about the matter, see Engle and Granger (1987), Johansen and Juselius (1990), and Osterwald-Lenum (1992).

4.1 Air transport demand

4.1.1 Long-run

The estimated equation of long-run balance cointegration has provided the following results:

$$LAERV_t = \underset{(-2.13)}{-1.88} \; \underset{(-6.43)}{-1.48} \, LPA_t \; \underset{(21.14)}{+1.48} \, LPIB_t$$

R^2 adjusted = 0.91 ; S.E. = 0.04 ; DW = 1.25 ;

DF = - 4.14 ; DW = 1.79.

In addition, if Johansen methodology is applied to a VAR along with three lags and a restricted constant, it is concluded that there is only one cointegration vector. The test of the number of cointegration vectors results into:

Number of cointegration vectors				
Under H_0	*Under H_1*	*Trace test*	*Critic values 5%*	*(a)*
$r = 0$	$r \geq 1$	41.14	34.91	
$r \leq 1$	$r \geq 2$	19.60	19.96	
$r \leq 2$	$r = 3$	6.83	9.24	

(a) Osterwald - Lenum critic values (1992)

r being the number of cointegration vectors.

After normalization, the following cointegration relationship is obtained:

$$LAERV_t = -1.76 - 1.41\ LPA_t + 1.17\ LPIB_t$$

In both estimated equations, the long-run elasticity of air transport demand with respect to the GDP is close, somewhat higher than the unit and takes 1.16 and 1.47 values as it would correspond to normal goods and particularly to "luxury" goods. The estimated long-run own-price elasticity of goods is negative with values ranging from 1.38 to 1.40, which reflects a significant response of the demand to price changing.

4.1.2 Short-run

The short-run non-linear and joint equation presents the following results:

$$DLAERV_t = \underset{(-3.92)}{-0.51}\ (LAERV_{t-1} \underset{(1.96)}{+\ 2.24} \underset{(2.06)}{+\ 1.24}\ LPA_{t-1} \underset{(-9.8)}{-\ 1.47}\ LPIB_{t-1})$$

$$\underset{(-3.07)}{-\ 0.43}\ DLPAERV_{t-4} \underset{(2.14)}{+\ 0.45}\ DLPGAS_t \underset{(-2.36)}{-\ 0.78}\ DLPA_t$$

R^2 adjusted = 0.95 ; S.E. = 0.048 ;
F = 147.13 ; DW = 2.10 ;
Serial Correlation : Ljung-Box : Q(1)= 0.30
Q(2)= 0.19
Q(3) = 1.36
Q(4) = 2.44

Residual Normality : Bera-Jarque: N(2) = 1.08
Heterocedasticity: ARCH (1-4) = 1.27

D91.I is a dummy variable which accounts for the effects of an Iberia workers' strike in the first term of 1991, and its value is 1 for the first term of this year and 0 for the rest of the year.

The long-run elasticities obtained for this and the previous model do not differ from each other significantly. Then, long-run income elasticity is now 0.80 in comparison with the former values 1.16 and 1.47, as it corresponds to normal goods or services with an average elasticity of 1.143, next to the unit. Air transport is turning into a normal goods of unitary elasticity rather than a luxury goods, as it was stated in Coto-Millán and Sarabia (1994) -with an estimated value of an income elasticity of 1.61 from 1980.01 to 1988.12-.

The negative value of the own-price elasticity of goods is 0.775 in comparison with the former 1.38 and 1.40 values, the variation here is more significant, although the average elasticity is 1.185.

Short and long-run elasticities are once more slightly different. Short-run elasticities clearly present the inelastic feature of the demand, and a substitution effect of road transport, which has never been revealed before, is detected. Gross and net substitution relationships between air and road transport result once more from these estimations.

4.2 Road transport demand

4.2.1. Long-run

In the inter-city passenger road transport demand equation, the dependent variable is the amount of premium petrol, in logs, LQGAS:

$$LQGAS_t = \underset{(-3.21)}{-3.80} \; \underset{(-1.94)}{-0.13}\, LPGAS_t \; \underset{(8.29)}{+1.11}\, LPIB_t$$

R^2 adjusted = 0.94 ;S.E. = 0.03 ; DW = 1.51 ;

DF = - 5.52 ; DW = 2.01.

Applying the Johansen methodology to a VAR with a lag and a restricted constant, it is also concluded that there is only one cointegration vector. The results obtained from the test of cointegration vectors are as follows:

Number of cointegration vectors				
Under H_0	*Under H_1*	*Trace test*	*Critic values 5%*	*(a)*
r = 0	r ≥ 1	41.87	53.12	
r ≤ 1	r ≥ 2	19.19	34.91	
r ≤ 2	r = 3	7.90	19.96	

(a) Osterwald - Lenum critic values (1992)

r being the number of cointegration vectors.

After normalization, the following cointegration relationship is obtained:

$$LQGAS_t = 2.85 - 0.47\ LPGAS_t + 0.3611\ LPIB_t$$

The results obtained from the long-run estimations provide elasticities of 0.361 and 1.11 with respect to the GDP, relationships which characterize these services as basic goods rather than as luxury goods, always within the context of normal goods. The own-price elasticities of the goods take the negative values 0.13 and 0.47, once more referring to essential goods with inelastic demand and slight demand variations as a response to tariff changes (if we consider such changes as proportional to premium petrol price changing).

The gas-oil demand equation QGLEO presents very similar values with respect to its price and to the GDP variable.

4.2.2 Short-run

The non-linear estimation in only one stage of road demand, provided the following results:

$$DLQGAS_t = \underset{(-4.85)}{-0.69}\ (LQGAS_{t-1} \underset{(2.20)}{+ 3.88} \underset{(1.68)}{+ 0.15}\ LPGAS_{t-1} \underset{(-6.19)}{- 1.11}\ DLPIB_{t-1})$$

$$\underset{(-2.73)}{- 0.36}\ DLPGAS_t \underset{(2.23)}{+ 0.34}\ DLPA_t$$

R^2 adjusted = 0.95 ; S.E. = 0.036 ;
F = 212.45 ; DW = 2.13 ;
Serial Correlation : Ljung-Box : Q(1)= 0.28
Q(2)= 1.91
Q(3) = 4.81
Q(4) = 4.82

Residual Normality : Bera-Jarque: N(2) = 4.16

Heterocedasticity: ARCH (1-4) = 1.17

The value of the GDP long-run demand elasticity now obtained of 0.765 confirms the inelasticity of the income "proxy", the services being considered as essential. The same happens with the QGLEO demand, which considers the regular line inter-city passenger transport demand as "proxy". The negative value of the long-run own-price elasticity of goods for this model is 0.10, while the former values were 0.13 and 0.47.

The estimated short-run own-price elasticities of goods have the negative value 0.36 and a cross elasticity of 0.34 with respect to air transport price. In the short-run, it is possible to speak about gross substitution relationships between road and air transport. However, it is not possible to meet any conclusion with respect to the net substitution or complementary relationships of these transport services without any further assumption.

5. CONCLUSIONS

In this paper, we have presented a theoretical model of air passenger transport demand. With quarterly aggregated Spanish data, equations of inter-city passenger air and road transport demand have been specified for 1980.I and 1992.IV.

Moreover, we have carried out different demand function estimations using cointegration techniques, and have been subject to a wide evaluation which allows us to check the adequacy of this method with respect to others used in earlier works by Inglada (1992), and Coto-Millán and Sarabia (1994).

Each specific demand may require more detailed studies, especially road transport. However, having carried out the estimations, it is possible to meet conclusions as regards income, the own-price elasticity of goods and cross price elasticities such as the following:

- Long-run income elasticities are all positive and all the services are normal goods. Income elasticities are very close to the unit for air transport, and slightly below the unit for road transport.
- The own-price elasticities of goods increase parallel to the quality of the service, since they increase with tariffs, and present values close to the unit for air transport. They are clearly inelastic for road transport.
- All cross elasticities present positive values and they are below the unit. Gross and net long-run substitution relationships between air and road transport and gross substitution relationships between road and air transport can be guaranteed, but net substitution relationships between these cannot.

These estimations can be useful for the analysis and predictions of the effects of tariff changing, as well as for traffic and short and long-run income predictions.

ACKNOWLEDGMENTS

This research was partly financed by the PS95-0095 research project from the DGICYT (Dirección General de Investigación Científica y Técnica), a body from the Spanish Ministry of Science and Education.

REFERENCES

Boyer, K.D. (1977): Minimun Rate Regulations, Modal Split Sensitives, and the Railroad Problem. *Journal of Political Economy,* **85(3)**, pp. 493-512.

Coto-Millán, P. and J.M. Sarabia (1994): Intercity Public Transport in Spain 1980-1988: Elasticities, Prices, Income and Time series. Dept. of Economics, mimeo, University of Cantabria, Spain.

Coto-Millán, P., J. Baños-Pino and V. Inglada (1995): Marshallian Demands of Intercity Passenger Transport in Spain: 1980-1992. An Economic Analysis. Dept. of Economics, Working Paper No 95.04, University of Cantabria, Spain.

De Rus, G. (1990): Public Transport Demand Elasticities in Spain. *Journal of Transport Economics and Policy,* **24 (2)**, pp. 189-201.

Goodwin, P.B., T.H. Oum, W.G. Waters II and J.S. Yong (1991): An Annoted Bibliography on Demand Elasticities. Working Paper No 682, Transport Studies Unit, University of Oxford, Oxford.

Goodwin, P.B. (1992): A Review of New Demand Elasticities with Special Reference to Short and Long-Run Effects of price Changes. *Journal of Transport Economics and Policy*, May, pp.155-169.

I.E.T.C. (1978): Elasticidad de la Demanda del Transporte Público de Viajeros. Ministerio de Transporte (Ministry for Transport). Spain.

Inglada, V. (1992): Intermodalidad y Elasticidades Precio en el Transporte Interurbano de Viajeros. *Revista TTC Transportes y Comunicaciones,* **54**, pp. 3-14.

Johansen, S. y K. Juselius (1990): Maximun likelihood estimation and inference on cointegration with applications to the demand for money, *Oxford Bulletin of Economics and Statistics,* **vol. 52**, pp. 169-210.

Levin, R.C.(1978): Allocation in Surface Freight Transportation: Does Rate Regulation Matter?. *Bell Journal of Economics,* **9(1)**, pp.18-45.

Mauleón, I. (1989): La demanda de dinero y los objetivos de ALP. Working paper, Instituto de Estudios Fiscales, Madrid.

McFadden, D. (1973): Conditional Logit Analysis of Qualitative Choice Behavior, *Frontiers in econometrics*. Ed.: P. Zaremka. NY & London: Academic Press, pp. 575-81.

McFadden, D. (1974): The Measurement of Urban Travel Demand. *Journal of Public Economics,* **3**, pp. 303-28.

Ministerio de Transportes (Ministry for Transport): Informes de Coyuntura de los Transportes y Comunicaciones. (1980-1993). Madrid.

Osterwald-Lenum, M (1992), A Note with Fractiles of the Asymptotic Distribution of the Maximun Likelihood Cointegration Rank Test Statistics: Four Cases,. *Oxford Bulletin of Economic and Statistics,* **54**, pp. 461-472.

Oum, T.H. (1979): A warning on the Use Linear of Logits Models in Transport Mode Choice Studies. *Bell Journal of Economics*, **10(1)**, pp.374-387.
Oum, T.H. and D.Gillen (1979): The Structure of intercity Travel Demands in Canada: Theory, Tests and empirical Results. Queen's University. Working Paper No 79-18.
Oum, T.H., W.G. Waters II and J.S. Yong (1990): A survey of recent Estimates of Price Elasticities of Demand for Transport. World Bank. Working Paper No 359, Washington D.C.
Peña, D. (1978): La metodología de Box-Jenkins: Una aplicación a la previsión del consumo de gasolina en España. *Información Comercial Española*, **542**, pp. 135-145.
Quandt, R. and W. Baumol (1966): The demand for Abstract Transport Modes: Theory and Measurement. *Journal of Regional Science*, **6(2)**, pp. 13-26.
Stone, R. (1954) : The Measurement of Consumer's Expenditure and behaviour in the United Kingdom, 1920-1938 .**Vol. I**, Cambridge.
Varian, H. (1992): Microeconomic Analysis. 3rd ed. W.W. Norton & Company, Inc.
Vázquez, P. (1985): Un estudio limitado sobre elasticidades de demanda al precio en el transporte interubano. *Revista del Ministerio de Transportes, Turismo y Comunicaciones*, **15**, pp. 21-33.
Waters II, W.G. (1984): A Bibliography of Articles Relevant to Transportation Appearing in Major Economics Journals: 1960-1981. Centre for Transportation Studies, University of British Columbia.
Waters II, W.G. (1989): A Bibliography of Articles Relevant to Transportation Appearing in Major Economics Journals: 1982-1987. Centre for Transportation Studies, University of British Columbia.
Winston, C. (1983): The Demand for Freight Transportation: Models and Applications. *Transportation Research*, **17a**, pp. 419-27.
Winston, C. (1986): Conceptual Developments in the Economics of Transportation: An interpretative survey. Journal of Economic Literature, **XXIII**, pp.57-94.

A4

Sn-03
385679
p 20

PAPER NO. 74

COMPETITION BETWEEN HUB AIRPORTS IN EUROPE AND A METHODOLOGY FOR FORECASTING CONNECTING TRAFFIC

(revised version)

Nigel P S Dennis
Senior Research Fellow
Transport Studies Group, University of Westminster

1 INTRODUCTION

Hub and spoke networks have become a critical part of air transport operations since deregulation in the United States. This is principally because they enable a carrier to maximise the number of markets served with a given volume of flights. For example, 100 points linked to a common hub enables service to be provided in more than 5000 different city pair markets. In Europe, hub and spoke networks have existed for many years as a consequence of international boundaries and the restrictions they imposed on traffic rights. Nevertheless, many of these were merely a collection of uncoordinated services that happened to share a common terminus. It is only in the last few years that most European airlines have started to operate and market their networks effectively to carry connecting passengers with both origin and destination outside their home country.

Whereas passengers making a direct flight often have little choice as to the airport used and typically only one or two carriers flying on the route, the situation is somewhat different for transfer traffic. The passenger flying from Berlin to Los Angeles, for example, can choose between eight different hubs in Europe and the United States that provide a one-stop connecting service and a multiplicity of possible airlines. Even where direct flights exist, indirect routings can often still provide a worthwhile alternative in terms of fares or schedules and are hence capturing an increasing share of traffic.

For airport operators, connecting traffic offers the only real opportunity to grow beyond the traffic potential of their own local catchment area. In turn this supports a much wider range of services than would otherwise be possible with accompanying economic benefits as shown by Small (1995). Amsterdam Schiphol for example sees it as vital to the Dutch economy to become a 'mainport' (one of Europe's leading hubs) in the 21st century (Butterworth-Hayes, 1993). The 'footloose' nature of this traffic means that it is one of the few areas in which competition between airports can take place.

Whereas traditionally it has been straightforward to forecast air traffic on a route by route basis, transfer passenger demand is very much more difficult to predict. This is because it is driven by the supply of air services and will shift between alternative hubs and airlines dependent on the relative quality of service and price. Data on connecting flows is scarce outside the US hence various models and estimates become necessary to analyse this traffic.

This paper considers the extent to which hub airports in Europe compete for transfer traffic and the performance of the major airlines. The relationship with scheduling issues, airport facilities and geographical constraints is addressed. A method for estimating changes in transfer traffic under changes in service or infrastructure provision is suggested. Some possible future developments of hubbing in Europe are considered, with particular reference to the shortage of runway capacity at many of Europe's major airports.

2 MARKETS SERVED

International boundaries have played a major part in shaping the present European air networks. Most passengers from regional airports have historically had to change planes at the national gateway (ie UK traffic would travel via London, German via Frankfurt etc). Long-haul services have also tended to reflect linguistic and colonial links. For example, many Latin American services are available from Madrid but little in the way of routes to Asia; Montreal is well served from Paris but Canadian flights from other European cities focus on Toronto. Deregulation within Europe has meant that most airports of any size are now linked with several hubs in different European countries and for most journeys the passenger has the option of taking connecting flights through a variety of hubs as well as any direct services.

Despite the advent of long-range twin jets, the coverage of intercontinental services from Europe remains fairly thin. For example, Paris does not have a daily service to Delhi while London is lacking one to Rio; Brussels has no service to Hong Kong and Athens none to Chicago. Only New York is linked with all the major European capitals on a regular basis. This makes the use of hubs necessary even in some relatively large markets. Furthermore, the time taken to change planes is less significant in the context of a 7000 km journey than for one of 700 km.

Table 1 examines the potential range of services from Europe to each of the world regions via the alternative hubs. It is number of flights rather than capacity that is the critical factor as passenger choice is not increased by merely using a larger aircraft. The product of the frequencies available via each hub has been used as the basis for comparison.

For example, considering all European countries to North America, although London Gatwick has more transatlantic flights than Paris Charles De Gaulle, because CDG has twice as many European flights its hub potential in the Europe-North America market is greater:

	European frequency (inc domestic)	x	North American frequency	=	Hub potential
London Gatwick	1099	x	166	=	182 434
Paris CDG	2457	x	146	=	358 722

The hub potential of each airport out of the total sum across all 18 hubs is the key variable used for comparison (a type of theoretical market share). This measure takes no account of waiting times, distance travelled or airlines used. These will be discussed subsequently.

Table 1 shows that Heathrow enjoys a dominant market position in its long-standing role as a hub for services between Europe and North America with 40% of the potential connections; Frankfurt is second with 18%. At the other end of the scale 1% of these connections are via Dusseldorf and less than 0.5% via Barcelona. Heathrow also dominates in the Asia and Middle East markets. To Africa the service is more evenly spread with Paris narrowly behind Heathrow and Rome a significant option. To Latin America, Paris moves into first place closely followed by Madrid, while Heathrow slumps to fifth. The ranking of Heathrow in the African and Latin American markets will have deteriorated further since this time with the recent move of most BA services to Gatwick.

Table 1: Hub service from all European countries
(figures are column percentages)

to	EU	Rest of Europe	North America	Latin America	Africa	Middle East	Asia	Total intercon-tinental
via								
Amsterdam	9	9	10	14	10	10	10	10
Athens	2	2	1	-	3	3	1	1
Barcelona	3	1	-	-	2	-	-	-
Brussels	6	5	2	2	9	1	-	3
Copenhagen	7	12	2	-	-	2	4	2
Dusseldorf	3	2	1	2	1	-	-	1
Frankfurt	9	13	18	17	15	14	22	17
Lisbon	1	-	-	2	1	-	-	-
London LGW	3	1	6	3	2	2	-	3
London LHR	20	18	40	13	22	39	38	35
Madrid	6	2	2	18	3	1	-	3
Manchester	2	1	1	-	-	-	-	-
Milan LIN	3	1	-	-	-	-	-	-
Munich	4	4	1	1	2	1	1	1
Paris CDG	12	12	11	23	17	13	14	14
Rome	4	4	2	3	10	7	3	4
Vienna	2	5	-	-	1	3	1	1
Zurich	4	9	3	2	4	4	5	4

- less than 0.5%

Source: Derived from OAG data for week of 19-25 June 1995

Table 2 considers the level of provision from the five major European markets to long-haul destinations. In each case it is Heathrow together with the national hub that dominates. Paris CDG suffers in the French market from a lack of domestic service (most of the domestic routes being at Orly). Madrid and Rome in contrast have large numbers of domestic flights but poor coverage otherwise. London Heathrow makes a consistently strong showing due to its dominance of intercontinental services. Amsterdam is in its strongest position from the UK (17% of services) but generally falls below 10%. There is a reasonable spread of provision, with at least 3 hubs exceeding 10% of services in each market.

The existence of services is however only part of the equation. To consider how these relate to a passenger's choice in practice a range of other issues have to be considered. The most important of these are the flying time - which is essentially a function of distance travelled - and the transfer time which depends on airport layout, frequencies and the level of schedule co-ordination.

Table 2: Share by hub of potential connecting services from five major European countries to intercontinental destinations
(figures are column percentages)

from	UK	France	Germany	Italy	Spain
via					
Amsterdam	17	9	9	6	7
Athens	-	-	-	-	-
Barcelona	-	-	-	-	3
Brussels	3	3	2	3	3
Copenhagen	1	1	1	1	-
Dusseldorf	-	-	1	-	1
Frankfurt	9	11	26	17	21
Lisbon	-	1	-	-	1
London LGW	5	6	1	3	3
London LHR	43	41	29	22	26
Madrid	1	3	1	2	23
Manchester	1	-	-	-	-
Milan LIN	-	-	-	-	-
Munich	1	1	3	1	1
Paris CDG	15	17	16	20	6
Rome	1	4	2	20	3
Vienna	-	1	2	1	-
Zurich	2	3	5	3	2

- less than 0.5%
Source: Derived from OAG data for week of 19-25 June 1995

3 GEOGRAPHICAL LOCATION

Geographical location is critical for a hub airport. A centrally located hub will minimise travelling distances and hence journey times in a large number of markets.

Table 3 is based on the weighted passenger km required to interlink the 36 busiest airports in Western Europe. Istanbul, Las Palmas, Lanzarote and Tenerife Sur are not considered part of the core network and have been excluded. Only one location in Eastern Europe (Moscow) exceeded this threshold and is also excluded.

This is not simply a distance minimisation exercise; airports are given a 'weight' equivalent to the number of passengers handled. London Heathrow with over 50 million passengers per annum therefore exerts more pull on the outcome than Hanover (4 million), for example. Each airport in turn is considered as the hub and the passenger km required to link all the airports in the system calculated. It is the relative position of the different hubs that is of interest.

Table 3: Increase in weighted passenger km required to interlink 36 major European airports via a hub relative to the optimal location (%)

Hub	Increase in travel distance	Hub	Increase in travel distance	Hub	Increase in travel distance
Brussels	0	Lyon	+21	Dublin	+67
Paris CDG	+2	Hanover	+21	Barcelona	+71
Paris ORY	+2	Munich	+27	Glasgow	+73
Cologne	+3	Birmingham	+27	Rome	+83
Dusseldorf	+4	Milan	+30	Palma	+93
Frankfurt	+6	Hamburg	+30	Madrid	+105
Amsterdam	+7	Manchester	+37	Oslo	+105
Stuttgart	+11	Berlin	+42	Stockholm	+127
London LGW	+12	Nice	+43	Malaga	+161
London LHR	+12	Marseille	+43	Lisbon	+166
Zurich	+14	Copenhagen	+60	Helsinki	+179
Geneva	+16	Vienna	+65	Athens	+196

The optimal location is Brussels. Paris is almost equally good (+2%) and benefits from being a large traffic generator in its own right - these people do not need to take a connecting flight. Northern Germany is then favoured (Cologne +3%, Dusseldorf +4%, Frankfurt +6%). The worst location for a European hub is, not surprisingly, at Athens where travel distances would be trebled compared to using Brussels. In comparison with a previous study based on the EU prior to recent enlargement (Dennis, 1994), the centre of gravity has moved eastwards, as Paris was then the optimal location. This is due mainly to the inclusion of additional airports and also above average growth rates at a number of central European airports in the last few years.

It is worth noting that the result is sensitive to deviations away from a north west - south east axis. Zurich for example represents only a +14% increase in travel distance over Brussels, whereas Lyon is +21% and Hamburg +30%.

In terms of traffic connecting between long-haul and European flights the result will be similar. The southern markets of Africa and Latin America account for only about 24% of intercontinental passengers from Europe as against 41% on the North Atlantic and 35% to Asia, the Middle East and Pacific (IATA, 1997).

Due to the dominance of the North Atlantic a location in NW Europe (UK/Ireland) is favoured as a long-haul hub. Such an airport is also surprisingly well located in relation to the great circle routes from the Far East and Latin America. It is only for Africa that a hub in southern Europe provides a worthwhile advantage. For passengers connecting between Europe and intercontinental flights therefore, the best hub location moves to the north-west of Brussels - ie the London area. There is nevertheless a level playing field between many hubs that extend average travel distance by only 1-2%, not a major problem when travelling thousands of miles. This would include all locations within the region bordered by Manchester-Amsterdam-Frankfurt-Paris.

Other airports can still be optimal for serving more localised flows (eg Copenhagen for Scandinavia-Europe or Madrid for Europe-South America) but to offer a competitive service in the full range of markets necessitates a central location.

The traditional long-haul hubs of London, Paris, Amsterdam and Frankfurt will therefore continue to enjoy a geographical advantage in the years ahead. Brussels could probably support more service than it does at present. Demand for air travel in Europe is likely to become more dispersed over the coming years as the more peripheral countries in the Mediterranean (eg Spain, Italy, Portugal) and Eastern Europe are likely to have the highest growth rates (IATA, 1995; AEA, 1995). This will have the consequence of moving the optimal hub location further south and east, bringing locations such as Munich and Zurich more firmly into the picture.

4 TRANSFER TIMES AND SCHEDULE CO-ORDINATION

If the passenger is prepared to wait an indefinite time at the hub, connections can be achieved between all services operating to and from it. In reality, long delays at the transfer airport are unattractive especially where the actual flying time is short. If alternative routes are available, a considerable drain of traffic may be experienced whilst even in a monopoly position, optional demand will still be suppressed. The typical waiting times incurred differ between the various hubs. This is a result of the physical design of the airport, the frequencies available and the schedule operated by the airlines.

The lower bound for the time required to change between two services is measured by the Minimum Connect Time (MCT). These are co-ordinated through IATA and represent the minimum time required between an arrival and departure for the two flights to be bookable as a connection. The MCT takes into account the time required to relocate a passenger and their baggage between flights. Airports with long walking distances will hence have a higher MCT than more compact facilities, although different MCTs may apply depending on the terminals used. Baggage handling systems are often the constraining factor but customs and immigration or security checks can also pose a bottleneck. At Brussels, for example, more immigration desks have been opened to reduce the MCT on Sabena's connections between European flights inside and outside the Schengen area from 40 to 30 minutes. The speed of unloading passengers is a further consideration - this is generally slower for larger aircraft. Some MCTs are artificially inflated for competitive reasons - to deter passengers from using them as part of a connection. For example, KLM departures at Heathrow (not a KLM hub) have an MCT of 4 hours! Finally, there is a decision to be made as to what is the acceptable level of missed connections. This will be a function of punctuality at the hub airport. The MCT should incorporate a contingency so that a slightly late arrival (eg 10-15 minutes) will not destroy the connection. Increasing congestion and delays in Europe make this the main constraint on any further reduction in the MCTs. British Airways has actually increased certain MCTs at Heathrow and Gatwick in recent years in order to improve reliability.

Table 4 compares a range of examples. At most single terminal locations such as Amsterdam and Brussels transfers can be accomplished in 30-50 minutes (and as little as 25 minutes on Austrian Airlines at Vienna). In contrast, at multi-terminal airports such as Heathrow the MCT rises to 70-90 minutes when a change of terminals is required. In this difference of time, the passenger could have flown an extra 500 km or more! The allocation of airlines to terminals at Heathrow is particularly inefficient as 67% of passengers who change aircraft also have to change terminals (CAA, 1997). In particular, BA short-haul to long-haul passengers have to make the cumbersome move from Terminal 1 to Terminal 4. At Paris CDG in contrast, all of Air France's services are 'under one roof'.

Table 4: Minimum Connect Times for ten major European airports

Airport	Terminals	MCT (minutes)
London Heathrow	(within T1, within T4)	45
	(within T2, within T3)	60
	(between terminals)	70-90
Paris CDG	(within T1)	60
	(within T2)	45
	(between terminals)	75
London Gatwick	(within North term)	45
	(within South term)	40-60
	(between terminals)	75
Rome		45-60
Madrid		45-60
Amsterdam		40-50
Brussels		30-50
Frankfurt		45
Zurich		40
Vienna		25-30

Source: OAG World Airways Guide, July 1998

Although at face value it is the frequencies with which different routes are operated that will also be critical to minimising the waiting time when making a transfer connection, one option that can raise the competitiveness of a hub is to improve the scheduling without actually changing the number of flights. An essential element of any serious attempt to maximise the scope of an airport as a hub involves a concentration of activity into a limited number of peaks or waves during the day. These should see a large number of inbound flights arriving in a short space of time, then departing again as soon as the MCT has elapsed. The transfer time between flights in the same wave will be close to the best attainable. The improvement from grouping flights in this way will be most dramatic at small airports but it can nevertheless offer important advantages to large airlines and airports also. Although the volume of flights at a busy airport such as Heathrow ensures that many connection possibilities will exist by chance, it is only through operating waves of flights that a consistent connecting timetable can be provided, with services in both directions in each city-pair market and a transfer time close to the optimal.

Figures 1-4 compare the distribution of flight activity at Heathrow and at Amsterdam (plotted on the same scales). Heathrow has a flat pattern of activity across the day, the product of the airport being full to capacity and one runway being used for departures and one for landings. Furthermore, British Airways has close to 40% of the slots in each time period. In contrast, Amsterdam's activity is much less smooth with KLM and its partners operating three main connection waves centred on 0930, 1330 and 1830, together with a developing one at 1600. An arrival at Schiphol at 1800 will connect to 80 departures within 2 hours whereas one at 1030 would manage only 20. Heathrow would offer about 30 connections within 2 hours from any given arrival time, which is due also to the high Minimum Connect Times that exist between terminals. Most of the major airports in Northern Europe with the exception of Heathrow now operate some form of wave pattern but in Mediterranean Europe this has yet to be implemented. Even the best European airports compare unfavourably with the concentration achieved at major US hubs however where the peaks are sharper and virtually every flight is constrained to fall within them.

Figure 1: London Heathrow arrivals
Thur 13 Nov 1997 (scheduled services)

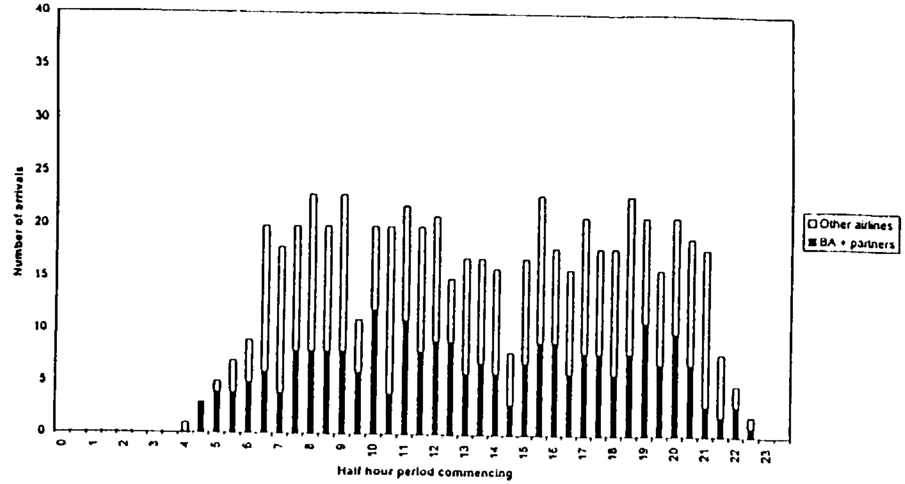


Figure 3: Amsterdam arrivals
Thur 13 Nov 1997 (scheduled services)

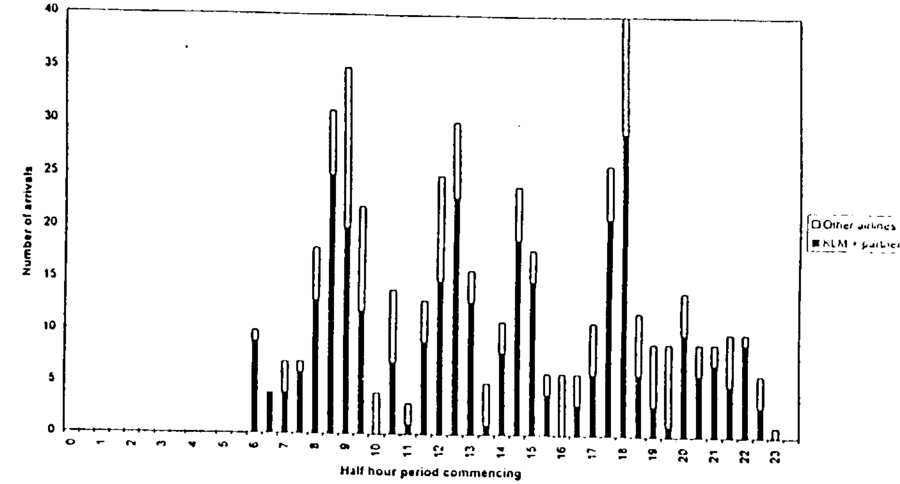


Figure 2: London Heathrow departures
Thur 13 Nov 1997 (scheduled services)

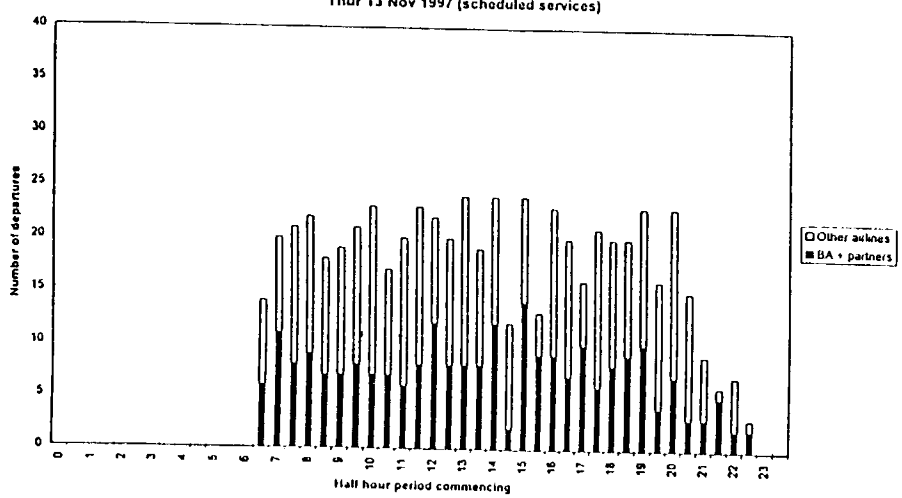
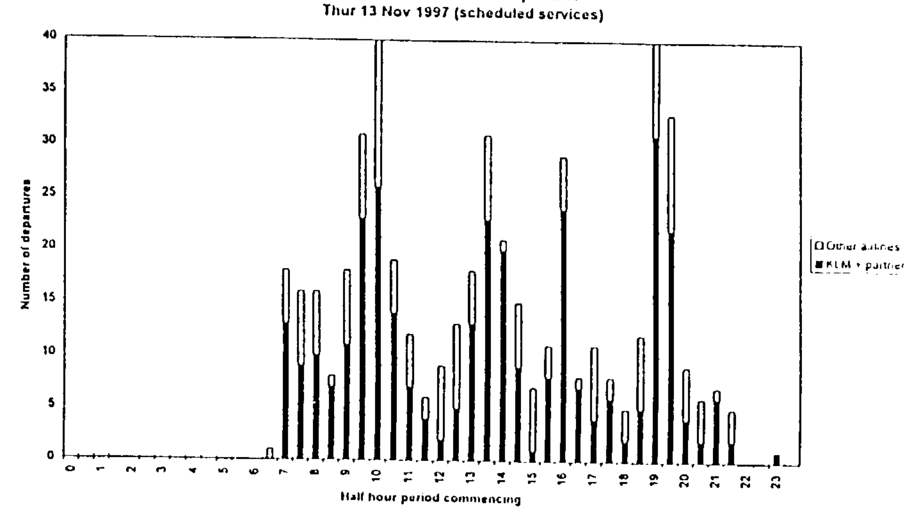


Figure 4: Amsterdam departures
Thur 13 Nov 1997 (scheduled services)



Inevitably it is only the local airline and certain agreeable partners that will conform to this type of schedule. Operators not based at the hub airport have less to gain from the multiplier effects and will be more strongly motivated by requirements of the point to point traffic or their own hub system elsewhere. The grouping of flights into waves also means that the probability of the first outgoing service to any particular destination being by the same airline as the delivering flight is disproportionately high. One of the most important commercial benefits to arise from hub and spoke operations is the extent to which individual airline networks can become self sufficient in meeting demand. Department of Transportation data in the US shows the proportion of on-line connections (passengers who change planes between two flights on the same airline) has risen from 52% prior to deregulation to over 90% today. At Heathrow, with its wide variety of operators, Civil Aviation Authority (CAA) surveys showed that BA-BA connections accounted for only 27% of transfers in 1984. This had risen to 43% in 1991 and is estimated to be nearer 60% today. This means that British Airways' on-line connections at Heathrow generated 4x as many transfer passengers as those involving any other combination of carriers in 1991 and this is likely to be closer to 6x in 1996. It is individual airline networks therefore that increasingly provide the focus for competition between hubs.

A consequence of the move towards on-line feed is the marginalisation of carriers that are not hubbed at one end of the route or the other. In the US this is readily seen in the dominance of the major carriers at their 'fortress' hubs. In Europe, the traditional 50:50 split between the two national carriers is being squeezed as the hub airline, with the benefit of the connecting traffic, can raise frequencies to a level that the other carrier(s) cannot match. This may lead to withdrawal of the non-core operations, as SAS have done on Gothenburg-Amsterdam and Alitalia on Turin-Frankfurt (Table 5).

Table 5: Domination of hub to spoke routes (daily frequencies)

Route	1989	1997
Amsterdam-Gothenburg	1xKL, 1xSK, 1xAY	4xKL
London-Marseille	1xBA, 1xAF	3xBA
Frankfurt-Turin	1xLH, 1xAZ	4xLH

AF-Air France, AY-Finnair, AZ-Alitalia, BA-British Airways, KL-KLM, LH-Lufthansa, SK-SAS

Source: ABC/OAG World Airways Guide

5 AVAILABILITY OF SERVICES AND IMPACT ON JOURNEY TIMES

To assess how these factors come together in practice to influence a passenger's choice of route, schedules in 40 sample markets (Europe-long haul) have been ranked by overall journey time for travel starting on Thursday January 15th 1998. Thursday is the most neutral day of the week for analysis as it generally has average traffic levels and service patterns. The markets were chosen to give a good geographical spread around Europe and the World in relation to the overall patterns of demand (eg more US points were included than African ones). None of the city pairs selected had direct service on the day chosen for study. The aim was to ensure that all hub airlines had a comparable opportunity to compete for this traffic.

Several rules were created for this analysis. Only on-line connections (including code-shares) have been included as these account for the majority of traffic and form the key focus of competition. There is likely to be a close correlation between the ranking of the major airlines and the status of the airport as a whole.

Linkages must satisfy the published IATA Minimum Connect Times but have been compiled with reference to all scheduled flights on each sector, not merely connections published or listed in the OAG. Only connections between non-stop flights are considered as it should often be possible to use the intermediate call as a hub to cut out one stop. It would otherwise also be complicated by US routes where a large number of one-stop through services exist that really involve an additional connection at a US hub. Services requiring a wait of more than 6 hours at the transfer point also have been discarded and this will eliminate any connections requiring a night stop. Connections via hubs outside Europe are treated on the same basis as those within - a passenger from Stockholm to Los Angeles may well find the best connection to be American Airlines via Chicago and it will be identified as such.

A flight cannot be counted more than once in this analysis even it carries multiple codes. If there is more than one on-line connection possibility, it is the European airline that has been taken. (There are relatively few cases where this ambiguity arises).

An airline that provides the fastest routing in every sample market would receive a score of 100%. If an airline has no service in a particular market it scores zero. The score could hence be considered analogous to the position of an airline on the CRS screen.

Table 6 shows the performance of the various airlines at their hub airports and compares the results from a similar exercise carried out for Thursday June 22nd 1995.

Table 6: Performance of European hub airlines: score based on sample of Europe-intercontinental markets (optimal service = 100%)

Hub airline (airport)	Score 1998	Score 1995	Hub airline (airport)	Score 1998	Score 1995
Lufthansa (Frankfurt)	63%	70%	Lufthansa (Munich)	13%	1%
Air France (Paris CDG)	60%	42%	Austrian (Vienna)	9%	-
KLM (Amsterdam)	59%	50%	Continental (Newark)	8%	-
Swissair (Zurich)	50%	29%	SAS (Copenhagen)	6%	6%
British AW (Heathrow)	47%	55%	USAirways (Philadelph)	5%	-
Sabena (Brussels)	15%	5%	American (Chicago)	5%	-
Alitalia (Rome)	14%	11%	Delta (Atlanta)	5%	4%
British AW (Gatwick)	13%	10%	Others <5% in 1998	18 hubs	6 hubs

Lufthansa at Frankfurt comes narrowly ahead of its main rivals, followed by Air France at Paris CDG and KLM at Amsterdam. Swissair at Zurich and BA at London Heathrow are the other two major players in the Europe-intercontinental markets. There is then a 'second division' made up of Sabena, Alitalia, BA at London Gatwick and Lufthansa at Munich. The other hubs are only a realistic option in a few specific markets. Although Iberia, for example, has an attractive Latin American network it scores only 4% overall. This is because Latin America is a relatively unimportant market from Europe as a whole, Iberia's long-haul services are poorly scheduled in relation to its European flights and many secondary European points are not linked directly with Madrid at all.

This demonstrates the importance of scheduling and MCTs as Heathrow's theoretical superiority in number of services is eroded when one considers the fastest viable routings in practice. Similarly, KLM does much better than Amsterdam's level of operations alone would suggest.

It is important to note that the figures in the table above are somewhat subject to variations in the sample of markets chosen. The positioning of the major hubs appears to be robust however and it is only in the range below about 10% that the outcome may be seriously distorted. A number of key principles are nevertheless clear.

Compared with 1995, one of the most notable changes has been the improvement of Air France from being the weakest major hub carrier to one of the strongest. This can be attributed to their conversion to a five wave system in Summer 1996 accompanied by a $22 million investment (in conjunction with Aeroport de Paris) in airport facilities (Beechener, 1996). Swissair is the other dramatic improver and now merits a place alongside the big four. This has been achieved by scrapping the split operation of long-haul services between Zurich and Geneva, in order to concentrate on developing the Zurich hub and boosting European feeder flights and frequencies through the use of smaller Crossair equipment. Aggressive scheduling gives fast connections, especially from the Mediterranean regions - where the local hubs are ineffective and Zurich has a geographical advantage over the gateways in Northern Europe.

The competition has sharpened up since 1995, which accounts for the slight fall in the rankings of Lufthansa at Frankfurt and British Airways at Heathrow. If a faster routing via another hub is now available the position of eg Lufthansa will fall, even though it may be operating the same schedule as before. This is because the scores are relative to the best service available in each market. It is likely that Frankfurt and Heathrow will continue to lose ground as they have little scope for expansion and other hubs will start to catch them up. BA's Heathrow rating may also have suffered from the transfer of thinner routes to Gatwick, eliminating its service altogether in certain connecting markets or requiring a change of airport at London which is not allowed in this analysis.

KLM has improved its score marginally thanks to very competitive European coverage. It is more wedded to the 747 than its main rivals however and in a number of long-haul markets (apart from the US) it fails to achieve a daily frequency, which is becoming something of a handicap.

The secondary hubs have generally also been improving. Lufthansa has now started to develop Munich as a serious additional hub to its Frankfurt base (Jane's Airport Review, 1997), while Sabena has built on its extensive European network to introduce more long-haul flights. Austrian, supported by a range of code-share deals, has moved into intercontinental services and BA has moved more flights to Gatwick - although not in the major markets that tend to be the focus of this analysis. A much greater number of airlines and airports are also able to offer service in at least some markets. 18 other hubs scored 1-5% in the 1998 analysis compared to only 6 in 1995. Newcomers include British Airways at Birmingham where they now have one transatlantic flight and Eastern European carriers such as LOT at Warsaw who are modernising and developing rapidly. A trend towards deregulation globally is opening up additional gateways and services.

Beyond Europe, it is really only the US hubs that have sufficient links to offer a serious alternative and then only for passengers travelling to the Americas. It is interesting to note the relative decline of JFK as more links to US gateways with better domestic connections become available. The compact scale of Europe compared to the other continents means that a back-track in Europe can often prove shorter than using an overseas hub that is not quite en-route. For example, Manchester-Amsterdam-Los Angeles is 9381 km whereas Manchester-Atlanta-Los Angeles is 9652 km. Thus although the US hubs score highly on fast transfer times (except perhaps at JFK) and range of destinations, these are counteracted by the increased flying time in many cases.

There are of course other ways in which hubs can compete besides providing attractive schedules. Leisure passengers can be tempted by heavily discounted fares to consider the most tortuous of routings (eg consider services from Europe to Australia by Air China or by Aeroflot from Europe to the Far East). In Europe, an airline such as British Airways benefits from being based in the UK and can afford to be aggressive on pricing in high cost markets such as Germany. In contrast, Swissair is more dependent on high yields to balance its costs. Business passengers are more sensitive to time than price but frequent flier programmes have added a new dimension. Someone locked in to British Airways' Air Miles or KLM's Flying Dutchman scheme for example is likely to go out of their way to use them for long-haul travel, even if it involves a connection through a hub.

6 INTRA-EUROPEAN CONNECTIONS

The suitability of hubs for intra-European traffic is more difficult to assess at the general level. This is due to geography ruling out many hubs for particular journeys (eg few people are likely to travel Manchester-Helsinki via Frankfurt let alone via Athens!). This narrows the effective competition in each market. Secondly, because most of the larger markets in northern Europe are of short distance (under 1000 km) and have plentiful direct service, hubbing becomes irrelevant in these cases. However, this position is likely to change over time. The peripheral markets in Europe are the more underdeveloped and expected to see the strongest growth in the coming years, which will raise average stage lengths. Also congestion at some of the capital cities will force greater use of regional airports, which will only be able to access the whole of Europe via connections through a hub (eg a passenger from Northampton might travel Birmingham or Luton - Amsterdam - Vienna rather than going to London to fly Heathrow - Vienna non stop).

The number of hubs able to offer intra-European connections is somewhat wider than for long-haul. Table 7 shows the potential split of services between the realistic hubs in several cross-Europe markets. The pattern of services is generally more dispersed than in the long-haul context although there is still an advantage to the national hubs in most cases. Time of day is also a key factor in short-haul markets. Services departing before 0800 or between 1600-1900 can be expected to command a premium traffic, reflecting the importance of minimising lost working hours in this business travel dominated market.

For the reasons outlined above it is difficult to produce a definitive ranking of the hub airlines but some features can be readily identified. Brussels, which comes nowhere as an intercontinental hub, is a key competitor within Europe, reflecting Sabena's strategy of specialising in this market. In contrast, many of the larger hubs are not optimised for short-haul connections (Blacklock, 1990). Swissair at Zurich benefits again from its strength in the southern European markets. Both Sabena and Swissair are also characterised by attractive timings morning and evening. SAS has the Scandinavian market well tied up at Copenhagen and Olympic the Greek market at Athens. London Heathrow is rather peripheral geographically. The main message seems to be that smaller hubs can fulfil a useful regional role but this is still largely dependent on the base airline targeting such traffic.

Table 7: Share by hub of potential connecting services in five contrasting intra-European markets
(figures are column percentages)

Hub	UK-Italy	France-Sweden	Spain-Greece	Germany-Portugal	Norway-Austria
Amsterdam	11	13	na	6	25
Athens	na	na	36	na	na
Barcelona	na	na	23	4	na
Brussels	11	9	na	11	10
Copenhagen	na	25	na	na	42
Dusseldorf	2	1	na	6	3
Frankfurt	6	5	na	26	5
Lisbon	na	na	na	11	na
London LGW	5	3	na	na	na
London LHR	19	26	na	na	na
Madrid	na	na	17	8	na
Manchester	1	-	na	na	na
Milan LIN	8	na	6	3	na
Munich	2	1	na	7	2
Paris CDG	25	14	na	14	na
Rome	8	na	12	na	na
Vienna	na	na	na	na	-
Zurich	3	3	na	5	13

na not applicable
- less than 0.5%
Source: Derived from OAG data for week of 19-25 June 1995

7 TRANSFER PASSENGERS - SCHEDULE AND DEMAND MODELLING

Transfer traffic is one of the most difficult segments of the market to forecast on a disaggregated basis. Data on the demand side is non existent in much of Europe except for surveys at specific airports. In contrast, the US has an overall 10% ticket sales sample. Transfer flows can also be very ephemeral in nature. It is necessary therefore to devise a model based around knowledge of the supply side to imply patterns of passenger demand.

There are a number of reasons why the distribution of connecting flows may alter over time. These include:

Changes to airline service provision (eg launch of new routes or frequencies)
Changes to airline schedules (eg creation of a new or different wave system)
Changes to MCTs (eg through provision of a new terminal facility or baggage system)

Changes to airline commercial strategies (eg pricing incentives or alliances)

This is particularly crucial when aiming to assess the revenue implications of investments in new infrastructure or services. One example of recent interest involved estimating the impact on transfer passengers of possible changes in service at London Heathrow or Gatwick, relative to the other major European airports. These fall into several different categories (MCT changes such as from a possible fifth terminal at Heathrow; creation of some form of wave system; operation of additional flights due to enhanced runway capacity).

The principle is that the composition of the existing transfer traffic over London by carrier and route group is known from the CAA surveys. No comparable data is available for the other European airports however. We also know the existing level of service in the different hub markets at Heathrow and Gatwick compared to the rival hubs (eg Frankfurt, Paris CDG, Amsterdam). This was achieved by inputting the published schedules to a computer database and then writing some special programs to interrogate this in terms of connecting services for selected connection windows (eg MCT up to 2 hours short-haul, MCT up to 4 hours long-haul). Some estimates of airline yields in the different markets enable a monetary value to be put on the resulting traffic.

The assumption is that the existing London transfer traffic is a reflection of the existing availability of connecting services. By improving the level of service at eg Heathrow relative to the other airports we could then imply a benefit in terms of transfer traffic. This is only at a snapshot in time but provides a measure of the benefit of the new facilities - in practice Heathrow may be running to stand-still as other hubs improve faster but the incremental gain will be similar.

One of the major benefits of the proposed fifth terminal at Heathrow (T5) would be to enable British Airways to combine all its existing T1 and T4 operations in one building. This would hence reduce the high 75 minute MCT that currently exists for interchange between T1 and T4 to a figure of around 45 minutes. The impact of this on one of the (unidentified) transfer market groups in the analysis is outlined below.

The base traffic is 697,000 transfers in the year (each of these passengers makes both an arrival and departure at Heathrow). This is achieved on 543 connecting pairs of flights on an average day: 18.1% of the total on-line connecting service in this market (BA v KL v AF v LH etc). The improved MCTs from T5 increase BA's service with an unchanged schedule to 676 connecting flight pairs. This is 21.5% of the new (larger) total on-line connecting service. We therefore expect BA's traffic to rise by a factor of 21.5/18.1 ie to 831,000 passengers an increase of 134,000. Further gains come from passengers switching within Heathrow as the BA-BA connection becomes a better option than their current one (some of these may already be using BA on one leg of the journey). This brings an extra 74,000 passengers. A 'same terminal' benefit is also included based on experience of existing connections available within the same terminal (eg Paris-Intercontinental which is already within T4) against those involving a change of terminals (eg Brussels-Intercontinental which requires T1-T4 interchange) net of MCT factors. An additional 45,000 passengers are anticipated here. This gives an overall gain in transfer passengers of 253,000 in this market group (+36%). The same process is then repeated across each transfer market sector. The fact that Heathrow is better located geographically in some markets than others is reflected in the current base transfer flows from the CAA data. For example, although there are many theoretical Europe-

Europe connections via Heathrow, these generate very few passengers due to the circuitous routings involved.

Applying the appropriate yields gives the estimated revenue to the airline from these extra 253,000 transfer passengers (which then has to be adjusted down slightly as some were already using British Airways on one leg of the journey). The balancing loss comes partly from other carriers at Heathrow but mainly from the foreign hub rivals such as KLM and Air France. Other scenarios can then also be tested, such as placing the Star Alliance together in T1 at an enlarged Heathrow.

To assess schedule changes or additional flights, a mock new schedule needs to be created (with assumptions about how any additional capacity will be used). This then replaces the existing schedule in the competition analysis with the rival hubs.

Although this is a fairly simplistic model it could be developed further - for example, to consider different price levels between the airlines or to give different weightings to faster and slower connections. Complexity does not necessarily guarantee a more reliable outcome however! Further ideas are discussed by Bootsma (1997), working for KLM, who suggests methods for estimating the relative size of city-pair origin & destination (O+D) markets. This can be done either by breaking down published sector flows into the underlying city pair markets or grossing up one airline's O+D data to the total market. An accurate Quality Service Index (QSI) model is shown to be crucial in accomplishing this. This can then be used to estimate the impact of a new schedule on the true O+D flows.

8 SOME IMPLICATIONS FOR FUTURE DEVELOPMENT

8.1 Range of connections and capacity constraints

There are limited ways in which individual airlines and airports can improve their competitiveness as hubs. The most obvious comes from developing a wider range of destinations or increased frequencies. This is only feasible if the airport has spare capacity - which may be possible at Amsterdam or Brussels but not so easy at Heathrow or Frankfurt. Short-haul feeder routes are being squeezed out at Heathrow while Schiphol continues to build its network. It is therefore likely that the smaller hubs will narrow the gap compared to their rivals as the airports with runway capacity constraints can only increase passenger throughput by using larger aircraft, which does nothing to expand the range of services.

Paris CDG has a strong local demand, is well located geographically and new runway infrastructure is planned. After many years of under-performing, Air France is at last realising the potential of this facility and is well placed to become one of the dominant European carriers in the years ahead.

At Heathrow the scope for change is more limited; grandfather rights to slots have been uniformly distributed and one runway is used for take-off and one for landing (for reasons of noise abatement) which makes it impossible to build up a wave pattern of arrivals and departures. The proposed Terminal 5 would benefit British Airways as outlined in the previous section. BA has tried to overcome the lack of a symmetric timetable and the need to depend on random connections by moving to double daily frequencies on many key long-haul routes. This much improves the chance that one of the flights will make a reasonable connection in any given market. The real solution is mixed mode runway operations which would allow airlines to swap arrival and departure slots to create a wave pattern. The capacity gains are however marginal and hence unlikely to offset the environmental concerns accompanying such a change.

To complement Heathrow, British Airways is also undertaking a major expansion at Gatwick where despite the limited capacity (only one runway) waves of flights (perhaps better described as ripples!) are operated to offset the problems of low frequencies that exist there. A similar pattern to Amsterdam sees three sets of arrival and departure waves per day with most short-haul aircraft based in Europe overnight. Amsterdam itself is now actually facing slot restrictions for the first time, although it is environmental pressures rather than capacity shortfalls that are the problem here (Jones, 1998).

Where major capacity enhancements are under way, this could provide the opening for one or more other airports to promote itself to major hub status in the future. Milan Malpensa would at last provide a Mediterranean hub in the major area of business demand and Alitalia's recently announced alliance with KLM is likely to bring the experience of Schiphol to bear upon the new airport. Munich has the capability to become a powerful rival to Frankfurt but there may not be room for all three of Malpensa, Munich and Zurich to flourish in this region. A new airport in Berlin could become an important east-west cross-roads if Berlin recovers its historic importance and the Eastern European markets grow strongly. The new Oslo Gardermoen is something of a long shot as a hub, being too far north but could probably attract more in the way of North Atlantic services. Finally, in the UK, Manchester has a large catchment within 200 km and is well located geographically as a long-haul gateway. With one of the very few new runways being constructed in Europe, it may overtake some of the lesser European capitals as a hub for scheduled services.

8.2 Regional hubs

Although there may be no more than half a dozen major intercontinental gateways in Europe, there is scope to develop a number of regional hubs. These can serve two main functions: to relieve pressure on some of the congested airports by removing short-haul transfer traffic and to facilitate journeys which may be cumbersome by surface transport but possess insufficient demand for dedicated air services. An example of the former is the British Airways Eurohub at Birmingham. An example of the latter is the 'niche' hub operated by the French carrier Regional Airlines at Clermont Ferrand. This is a mini East-West hub linking six cities in western France (eg Nantes, Toulouse) with points in the Mediterranean, Italy and Switzerland.

This technique could well be applied elsewhere as there are relatively few gaps in the market for point to point regional services but a number of airports that are near the threshold for a wider range of flights. If demand is attracted primarily from surface modes or the major hubs this process can continue successfully. The Mediterranean region still appears severely under served for travel within Southern Europe - most routes running north-south to major hubs in Northern Europe. The French regions are still rather under served due to the historical dominance of Paris.

8.3 Networks of hubs

In the US all the major carriers have built up networks of hubs to cover the main traffic flows in the region. In Europe, national boundaries have tended to obstruct this type of arrangement and airlines have ended up dominating several airports in close proximity in their home country. For example, British Airways at Heathrow, Gatwick, Manchester and Birmingham; Lufthansa at Frankfurt, Dusseldorf and Munich. This is less efficient from a competition viewpoint and these operations are often defensive in nature (ie to block another carrier from getting in rather than being viable operations in their own right). However the emphasis may be changing through the creation of alliances which can reach additional markets. For example, Swissair has built links with Sabena and Austrian to extend its influence into northern and eastern Europe plus TAP to the west, giving a very efficient geographic spread.

British Airways has invested in TAT/Air Liberte in France and Deutsche BA in Germany. Such moves have the potential to increase competition by offering an alternative to the entrenched national carriers. They have not been very successful financially however and offer few synergies with BA's existing network. The opportunity to set up a hub in another EU country increased with domestic deregulation in April 1997 (previously thwarted by the inability to provide domestic feed). Whether this freedom is likely to be exercised however remains to be seen. As it remains very unlikely that governments will allow their national carrier to be driven out of business, alliances with other major incumbents continue to be a much lower-risk means of achieving the same goals.

8.4 Low cost carriers

Hubs offer the major airlines one of the stronger defences against low cost new entrants. Contrary to popular opinion, most of the heavily dominated hubs in the US have been left alone by the low cost carriers. For example, Denver has been avoided by Southwest despite lying in the middle of its home territory. Northwest has a virtually clear run at Minneapolis and Detroit. The new entrants tend to focus on either dense local markets, often using a secondary airport (eg Love Field at Dallas, Midway at Chicago) and/or the busier non-hubs eg Kansas City, Omaha.

The scope for new entrants in Europe is more limited: shortages of capacity coupled with high airport charges make opportunities more limited. It is also rare to find the abandoned inner city airports that have been used so successfully in the US. At London, for example low cost airlines have been obliged to use Luton or Stansted which pushes up surface access costs and travel times. Although British Airways is losing some market share in the London originating traffic - not just to low cost carriers but also to growth by British Midland and Virgin Atlantic, it has been able to counteract this with an increase in hub traffic. For the major airlines their strength lies in their networks.

Hubbing tends to increase unit costs and hence has been shunned by most - but not all - low cost airlines. In any case, low yield leisure traffic is more willing to wait for chance connections where necessary if the fare saving is worthwhile. In Europe, Amsterdam, Zurich and Frankfurt will be difficult to break-into. At London and Paris it is likely to be necessary to use secondary airports. Brussels presents an interesting situation, where Virgin Express are operating and marketing a low cost hub network. Brussels also has quite an extensive surface catchment area for medium distance flights enabling poaching of passengers from Amsterdam, Dusseldorf, Paris etc. Sabena has favoured co-operation rather than confrontation with the low cost upstarts (including Citybird on long-haul routes). It appears somewhat uncertain what the final outcome of this will be.

8.5 High speed rail services

The growth of the high speed rail network in Europe is casting a shadow over a number of short-haul air services. Unlike point to point traffic, transfer passengers do not want to go to city centres however and their goal is a hub airport. With few exceptions therefore it will remain faster to travel by air feeders than rail and because airlines retain control over the marketing of these services they can be priced and promoted more attractively. Lufthansa finds it impossible to remove the air services that parallel its 'airport express' trains because these passengers would be more likely to switch to alternative hubs such as Amsterdam than take the train to Frankfurt.

Where rail services can have a complementary role however is to bring people in from relatively nearby cities (up to about 300 km) where air services are being forced out of the congested hubs. It is ironic that Heathrow is the airport that could probably benefit most from rail feeders but has the least planned provision of links to the long distance rail network.

9 CONCLUSION

Hubs will continue to offer major geographic and mathematical advantages to airlines operating in a competitive European environment. All major carriers are becoming more commercially orientated and seeking ways to attract traffic from beyond their own national frontiers. The need to have a sizeable network and frequencies however mean that it is the largest airlines and airports that tend to dominate this traffic. Airports such as Manchester, Madrid or Milan are much less important as hubs than they are for local traffic. Similarly, airlines such as Virgin, Air Liberte, TAP or Olympic are not serious contenders for passengers requiring a connecting journey.

There is vigorous competition between the major hubs for this traffic. Heathrow suffers from poor schedules, congestion and an awkward multi-terminal layout which counterbalance its unrivalled range of intercontinental services. In contrast KLM and Swissair have been adept at maximising the potential of their smaller scale operations in Amsterdam and Zurich while Sabena has been quietly building a useful intra-European hub in Brussels. Air France - for many years the sleeping giant amongst European carriers has finally woken up and probably has some of the best prospects for the future,. with an excellent geographical location, a strong traffic base and good airport facilities. There is therefore a tendency for the competitive position to equalise between the major airports. Capacity constraints may offer opportunities to less congested locations to develop as hubs. Few cities can support long-haul services or an extensive European network on the basis of local demand alone. It is hence necessary to make a strong pitch for the passengers making a myriad of other journeys - for this is the most footloose traffic of all.

IATA AIRPORT CODES

AMS-Amsterdam, ATH-Athens, ATL-Atlanta, BRU-Brussels, CDG-Paris CDG, CPH-Copenhagen, EWR-New York Newark, FCO-Rome, FRA-Frankfurt, IST-Istanbul, JFK-New York JFK, LGW-London Gatwick, LHR-London Heathrow, LIN-Milan Linate, MAD-Madrid, MUC-Munich, ORD- Chicago O'Hare, ORY-Paris Orly, PHL-Philadelphia, PRG-Prague, SOF-Sofia, VIE-Vienna, ZRH-Zurich.

REFERENCES

AEA (1995) **Medium Term Forecast of European Scheduled Passenger Traffic**, Association of European Airlines, Brussels.

Beechener, J. (1996) Short term problems fade with new capacity plans, **Jane's Airport Review**, Vol.8 No.5 pp. 9-11.

Blacklock, M. (1990) Hubbing: European Style, **Airports International**, September 1990 pp. 22-26.

Bootsma, P. (1997) **Airline Flight Schedule Development**, Thesis: University of Twente, Enschede.

Butterworth-Hayes, P. (1993) Schiphol targets prime hub position, **Jane's Airport Review**, Vol.5 No.4 pp. 17-23.

CAA (1997) **Passengers at Birmingham, Gatwick, Heathrow, London City, Luton, Manchester and Stansted Airports in 1996**, CAP 677, Civil Aviation Authority, London.

Dennis, N. (1994) Airline Hub Operations in Europe, **Journal of Transport Geography**, Vol.2 No.4 pp. 219-233.

IATA (1997) **World Air Transport Statistics**, Number 41, International Air Transport Association, Geneva.

IATA (1995) **European Air Transport Forecast 1980-2010**, International Air Transport Association, Geneva.

Jane's Airport Review (1997) Munich wins new hub business, Vol. 9 No 10 p. 14.

Jones, L. (1998) Restrictions put KLM all out at sea, **Airline Business**, January 1998, pp. 22-23.

Small, N. (1995) Airline Deregulation, Hubbing and the Implications of Superior Accessibility for Metropolitan Economic Development, **PTRC 23rd European Transport Forum,** Seminar J pp. 52a.

A4

CYCLES

IN THE AIR TRANSPORTATION INDUSTRY

Nathalie Lenoir

lenoir@recherche.enac.fr

Ecole Nationale de l'Aviation Civile

7 av E. Belin, BP 4005

31 055 TOULOUSE Cedex 4

FRANCE

1. INTRODUCTION

Cycles in the economy are a widely recognized phenomenon (see for example Schumpeter, 1939). Although the existence of long term cycles is not clearly proved, medium term cycles, averaging a 7 to 10 year period, and formerly known as Juglar cycles, are seldom questioned. The phenomena inducing those cycles, however, are complex and still a subject of research.

In air transportation, cycles have been observed and commented upon, especially those concerning the airlines (periodicity of financial results), and the aeronautic industry (cycles of orders). Specialized magazines (Avmark Aviation Economist, Airline Business...) release articles on this subject periodically, and try to prophesy when will the next downturn come and how bad it is going to be.

Those cycles seem to find their origin, at least partially, in the pattern of demand growth, which is itself linked to the evolution of economic activity. It has been indeed repeatedly observed throughout the world that traffic evolution is statistically correlated to economic growth (usually measured by GDP or GNP growth). Traffic forecasts (Yearly passenger traffic growth) released every year by several organizations (ICAO[1], IATA[2], Boeing, Airbus...) are based on the assumption of a linear correlation between GDP growth and traffic growth

Much more, however, can be drawn from the observation of aviation cycles, in relation to economic cycles. The relations between economic growth, traffic growth and aviation cycles are indeed an interesting subject of study : can a whole system a relationship be built between the variables of interest ? How are related traffic, financial results of airlines, aircraft orders and deliveries ? How can minor variations in traffic, result in airline cycles of such magnitude (14 MD USD lost between 1990 et 1994) ? Why is air transportation such a chaotic system ?

As statistical analysis results provided in this paper point out, the answer comes mainly from the behavior of the actors of this industry. In an oligopolistic sector, like the air transportation industry, strategic behavior matters. This leads us to try to understand the dynamic structure of reactions of airlines to fluctuations of traffic and to good and bad fortunes. A game theory framework (D. Fudenberg, J. Tirole, 1991) can be used to analyze the interplay of the airlines decisions in terms of investment. Do they take a long term view, or do they have a myopic strategic behavior ?

This is therefore the aim of this paper to analyze aviation cycles by using statistical methods, and from there to build a model of airline behavior, using a game theory framework, to account for observed reactions in cycles.

The outline of the paper is the following : First the theory of economic cycles is briefly reviewed (part 2). Then, using long time series data on world GDP and traffic, the link between economic cycles and traffic is discussed (part 3), as well as the relevance of other indicators. In a fourth part, relations and time lags between relevant aviation activity

[1] *International Civil Aviation Organization*
[2] *International Air Transport Association*

variables are studied and their relations with economic cycles discussed. Finally (part 5), a game theory framework is used to give an explanation of the airlines behavior, which results in an amplification of economic cycles in the airline industry. We conclude by suggesting ways of smoothing the cycles through a better management of capacity investments.

Can the aviation cycle be broken ?

2. CYCLES AND THE ECONOMY

Historians and economists have observed that fluctuations, more or less important, with different duration, occur in the economy since the advent of the industrial era. Since Adam Smith (1776), numerous theories have been put forward to account for economic growth, and for cycles affecting this growth[3] (for a review of these theories see for example Boyer, 1990). Neglected after world war II, because growth was strong and continuous, with no more important cycles, those theories have been considered with renewed interest in the seventies. In those years, the economic miracle of after war decades has faded away, and been replaced by more troubled times. Important cyclical economic fluctuations reappear, and with them, attempts to find explanations (Zarnovitz, 1985).

Without explaining details of numerous and complex models, it is useful to understand that basically two types of explanations exist for cycles : Some explanations state that the causes of cycles are exogenous events (an oil crisis for example), while at the other end of the spectrum, others consider that cycles are inherent in capitalistic economies (Marx was the first to provide such an explanation), and can therefore be explained in terms of economic mechanisms (adjustment of supply and demand, monetary disequilibrium...). As often when dealing with complex phenomena, the truth certainly lies somewhere in between those extreme conceptions. More recent research concentrate on modeling the dynamics of economic systems, using complex mathematics models (dynamic systems, chaos theory...) and emphasize the fact that previous models of cycles, without being totally mistaken, had only a partial view of the situation. It is now clear that no simple model can account for such complex phenomena, even if certain models had some relevance in their times.

3. ECONOMIC CYCLES AND AVIATION CYCLES

In air transportation, strong cyclical phenomena have been noticed, and the pattern seems to get stronger with time (see for example graph 4.1). Different situations may prevail in different markets (Europe, USA, Asia), but since the industry tends towards globalization, and competition becomes worldwide, what affects one market affects others in several ways. It does not seem, therefore, an oversimplification to speak about global cycles in air

---

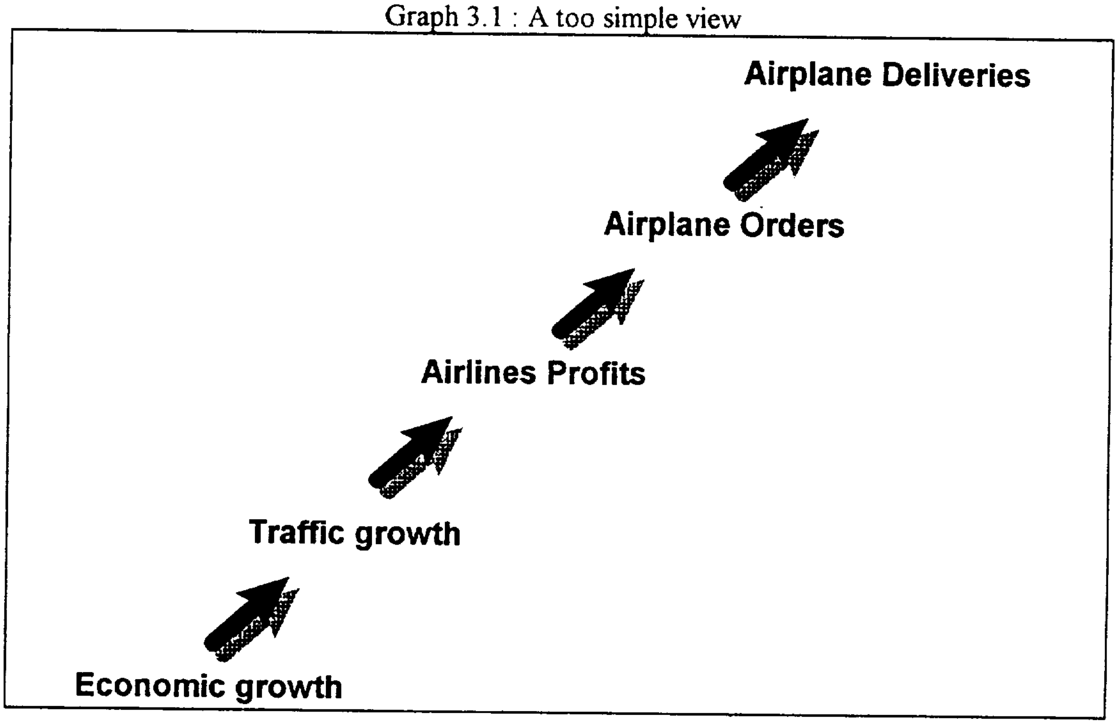
[3] *Most major economists have contributed to the theories of growth : Smith, Ricardo, Malthus, Marx, Von Neumann...*
Some have tried more particularly to explain cycles :Samuelson, Schumpeter, Hayek...

transportation. The growing interaction of markets may also account, at least partly, for the amplification of cycles that seem to appear.

As with economic cycles, two explanations are possible : cycles can have external causes (economic cycles, oil crisis), or can be linked to internal phenomena (behavior of actors :supply, demand, investment...).

External causes are most of the time deemed responsible for cycles in air transportation. It is not rare to see the sequence of events represented in the following way :

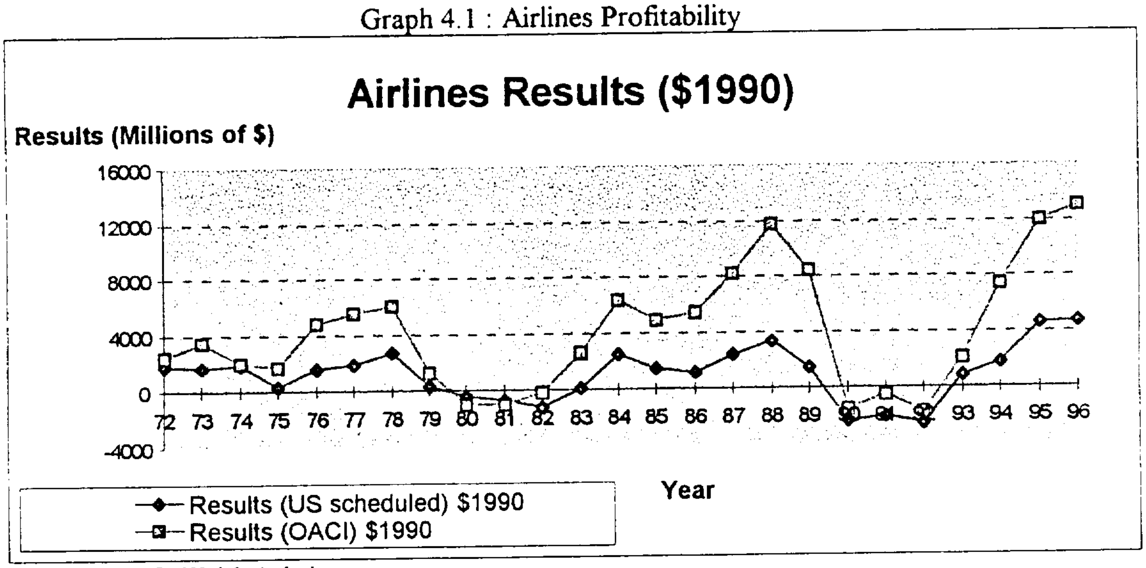
Graph 3.1 : A too simple view



This analysis is only partly relevant, as I shall demonstrate in part 4. It obliterates the role of the airlines in terms of strategies, and makes profits depend only on external factors, which is obviously not true in an oligopolistic industry.

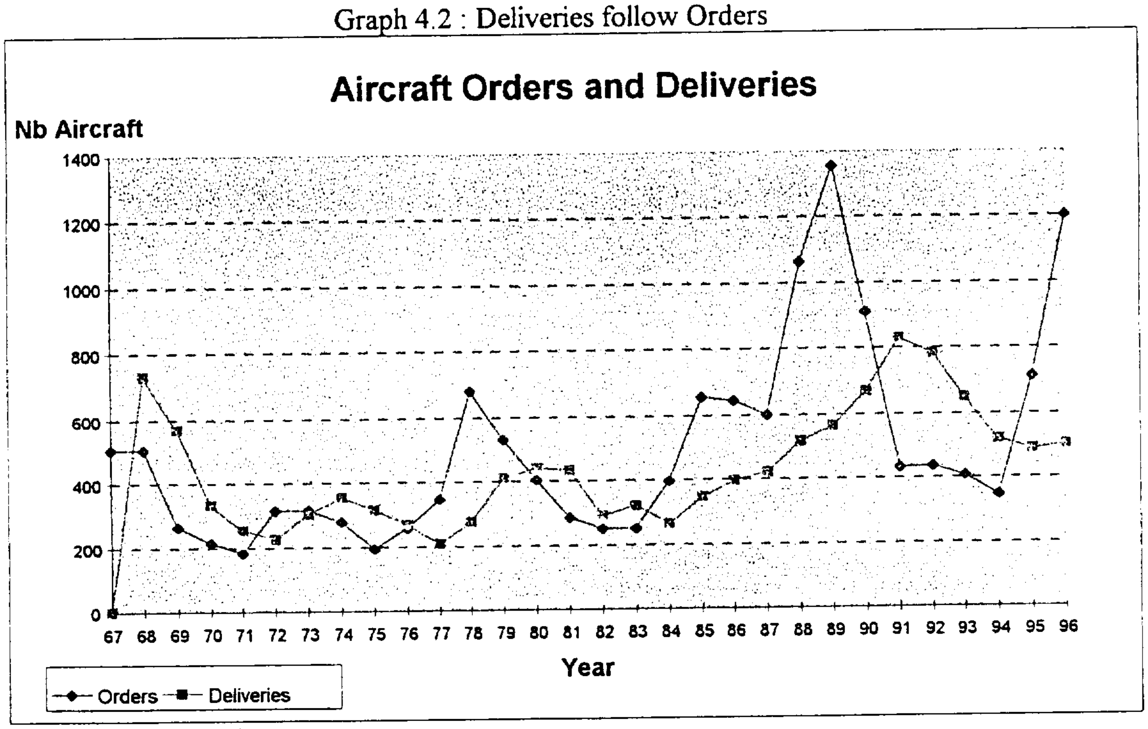
The first part of the sequence, however, linking economic growth to traffic growth, can hardly be disputed.

The correlation between GDP growth and traffic growth has indeed been very often remarked and widely commented upon. GDP growth (or the like) is generally used when traffic forecasts are computed (although GDP growth is in no way easy to forecast itself !). Various organizations compute yearly traffic forecasts, on international level (ICAO, IATA, Graph 4.1 : Airlines Profitability



Sources : ICAO, Walsh Aviation

Graph 4.2 : Deliveries follow Orders



Sources : Walsh Aviation

We computed the correlation between orders and deliveries with different lags, to see how much time there is, on average, between orders (**O_y**) and deliveries(**D_y**).

Table 4.1

Correlation coefficient between Orders and Deliveries			
Lag (years)		**Values**	
0	**$Corr(O_y,D_y)$**	0,347	
1	**$Corr(O_y,D_{y+1})$**	0,643	
2	**$Corr(O_y,D_{y+2})$**	**0,834**	
3	**$Corr(O_y,D_{y+3})$**	**0,824**	
4	**$Corr(O_y,D_{y+4})$**	0,494	

Data Source : Walsh Aviation (Data from 1968 to1996)

The correlation between the variables is high when the lag is two or three years (0.82 and 0.83), indicating that on average, it takes the airlines somewhere between two and three years to have airplanes delivered, once ordered.

More interesting and less obvious is the link between results (**P_y**) and orders (**O_y**). The peaks and troughs in orders follow by one year the peaks and troughs in results. The correlation is very high (0.89) and there is a causality easy to understand : most airlines, after a good year, choose to invest in renewing and increasing their fleet.

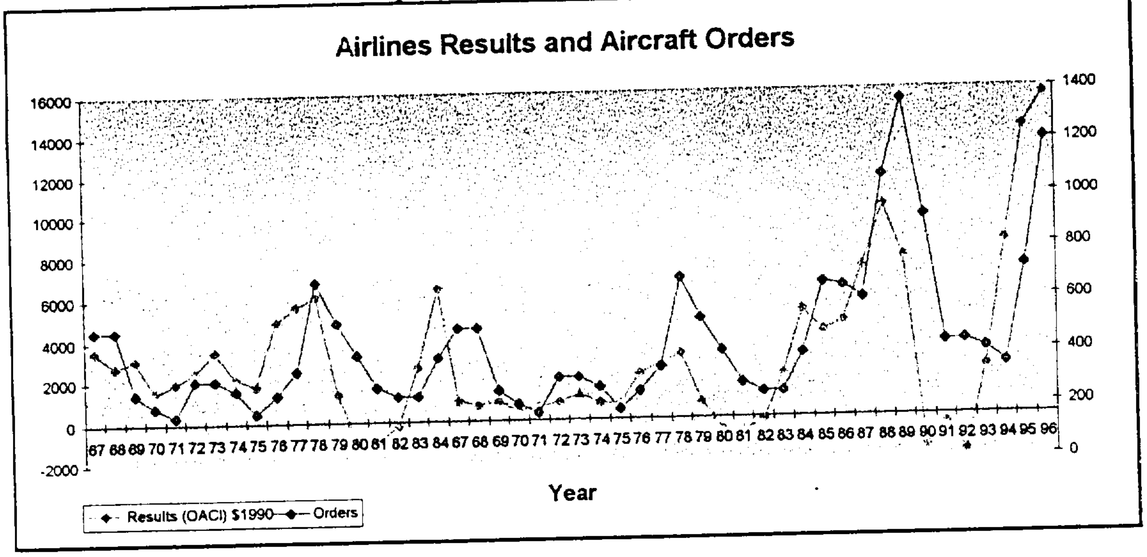
Table 4.2

Correlation between Results and Orders		
Lag		values
0	**$Corr(P_y,O_y)$**	0,632
1	**$Corr(P_y,O_{y+1})$**	**0,887**
2	**$Corr(P_y,O_{y+2})$**	0,754

Data Source : Walsh Aviation, ICAO (Data from 1968 to1996)

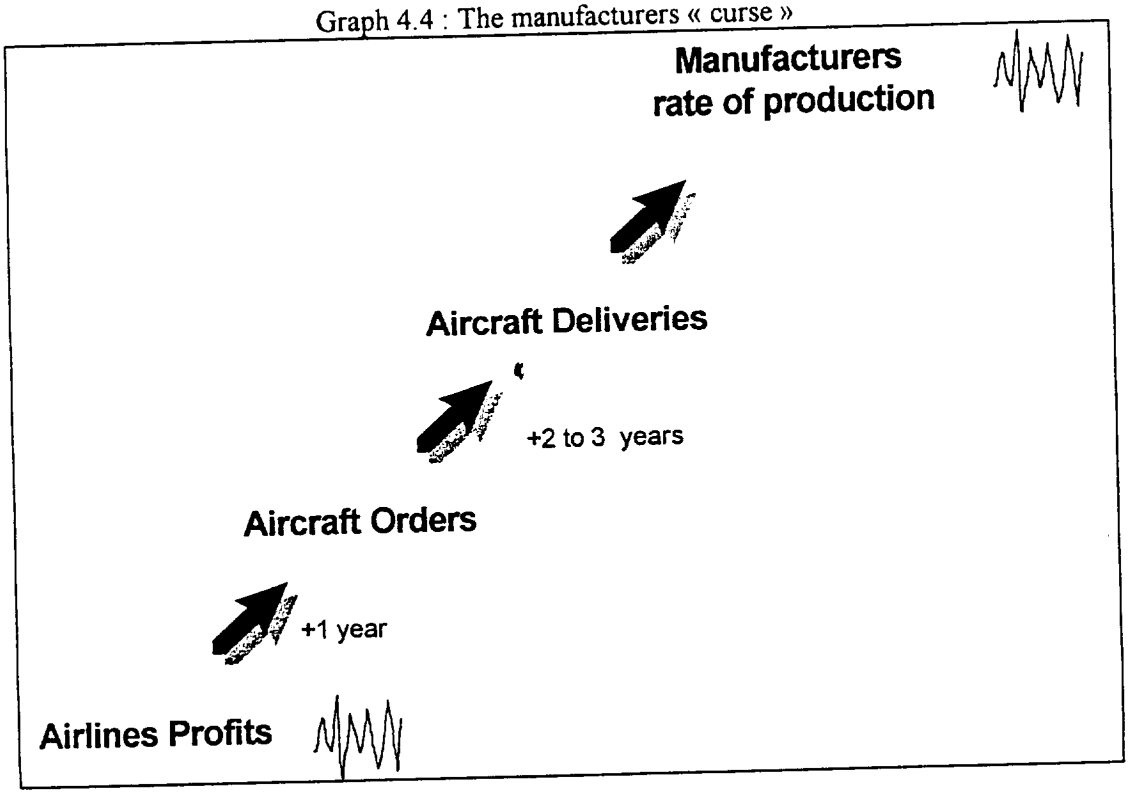
This does not give much time to manufacturers to think ahead and plan their production rhythm, since financial results are only know with certainty towards the end of the year (some years can have good starts but bad endings !). All this explain why manufacturers are mostly forced to follow cycles and have very little influence on their own production rhythm.

Graph 4.3 : Orders follow Profits



These results enable us to draw the first part of the aviation cycle, the one that manufacturers are most interested about, linking airline profits, aircraft orders and deliveries :

Graph 4.4 : The manufacturers « curse »

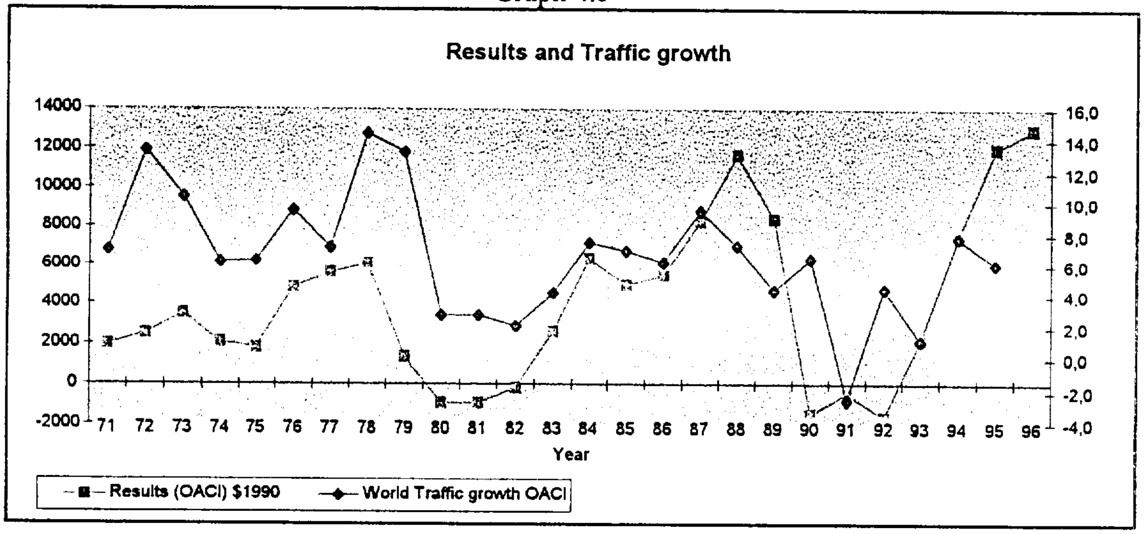


4.3 Airlines profitability cycles

If cycles in airline profits enable us to explain the peaks and trough in orders and deliveries, how can we explain cycles in airlines results ? Where do these cycles come from ?

Contrary to conventional wisdom (see graph 3.1), it is not at all clear that cycles in airlines results originate from cycles in traffic growth. The correlation between results and traffic or traffic growth is weak ($\text{Corr}(P_{y},,\Delta\text{Traffic}_{y})=0.34$), and if downturns in traffic are not generally good news in terms of results, high traffic growth does not necessarily mean good results : in 1990 for example, traffic growth is 6.4 percent, and heavy losses (-1500 millions $) are incurred.

Graph 4.5



Therefore, traffic growth is not, by far, the only relevant element in explaining airlines results. Traffic growth is, moreover, not independent on the strategies of the airlines in terms of pricing. If there is over-capacity at one given point, airlines will lower prices in order to regain market shares, and traffic growth will be boosted. In order to look at external determinants of airline results, indicators of economic activity should rather be used.

Internal factors, like investment pattern or pricing patterns, will also affect profitability. Among other variables we could analyze, we found that results are somehow correlated with load factors and deliveries. A high load factor means full planes, indicating that there is no over-capacity. On the other hand, many deliveries in one year create over-capacity and mean low prices and low yields, and therefore poor results.

We estimated a regression model explaining airlines results, and came up with three main statistically significant variables : Economic activity, its variations (GDP and GDP Growth) and Deliveries.

The estimation was made with data from 1979 to 1996. As previous data were available, this is a deliberate choice : modern air transportation began after deregulation occurred and market forces could interact more freely. Before that date, price and route regulation prevented airlines from competing, both on domestic and international level, and therefore, explaining the workings of the industry during that period is a different business.

Table 4.3 : Results as a function of GDP and Deliveries

$$Results = \alpha + \beta \ \Delta GDP^2 + \gamma \ \ GDP + \delta \ \ Deliveries$$

Data sources :

Results	ICAO (World Civil Aviation Statistics), Millions USD
GDP[8], ΔGDP	IMF (World Economy Outlook)
Deliveries	Walsh Aviation

Multiple Regression Analysis :

Dependent variable : Results

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	-14886,6	3249,82	-4,58074	0,0004
ΔGDP^2	353,966	90,1992	3,92427	0,0015
GDP	10,4859	1,90444	5,50602	0,0001
Deliveries	-17,8026	4,76903	-3,73296	0,0022

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	3,59273E8	3	1,19758E8	26,18	0,0000
Residual	6,40402E7	14	4,5743E6		
Total (Corr.)	4,23313E8	17			

R-squared = 84,8717 percent
R-squared (adjusted for d.f.) = 81,6299 percent
Standard Error of Est. = 2138,76
Mean absolute error = 1591,5
Durbin-Watson statistic = 1,94988

Sources : ICAO, IMF, Walsh Aviation

[8] Index 1000 in 1965

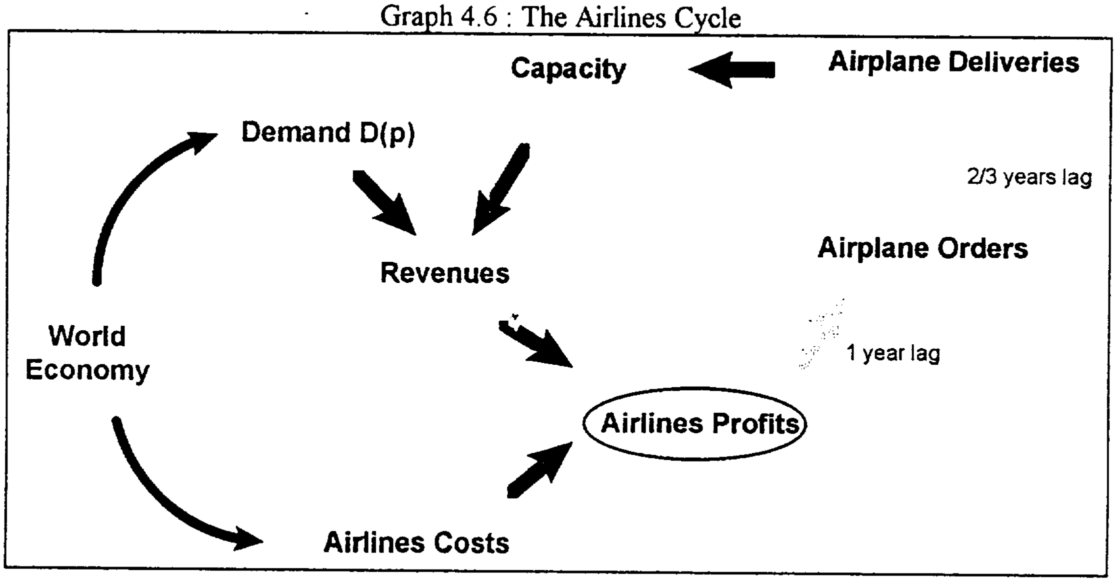
This model yields good results. All estimated parameters are statistically significant, and the adjusted R-squared is 81.6 percent. When the model is re-estimated using only the 16 first years, the result of the 17^{th} year (1996) is predicted within 10 percent, showing that the model is stable and could be used for forecasting.

The model confirms what could be suspected, i.e. that factors internal to air transportation are important in explaining the airlines profitability. The number of deliveries in one given year is a good indicator of the amount of new capacity that has to be absorbed by the market : is has a negative coefficient, indicating that more capacity means lower prices and lower profitability.

The external factors, summarized by DGP and GDP growth, are also important. The economic conditions are driving demand and have also an influence on costs.

The model, combining internal and external factors, succeeds in explaining the profitability of airlines. It gives us the final clue to the understanding of the airline cycle : Although economic conditions do matter, economic cycles are amplified in the air transportation industry, by the pattern of investment. Good financial results mean orders, resulting in deliveries, very often occurring at odd times, in opposition with the economic conditions. This leads to over-capacity, lower prices in order to maintain market shares, and bad results. As the economy gets better (even in bad years, world GDP growth is always positive, so far !), growing demand gradually absorbs the redundant capacity, and airlines get better. They start investing again....

Graph 4.6 : The Airlines Cycle



Although this description is somehow a simplified presentation of what really happens, it gives a fairly good notion of the causes of cycles, explaining why they are so much more serious in the air transportation industry than in other sectors of the economy.

4.4 Forecasting profitability

Table 4.4 : Profitability forecasting model

$$Results(t) = \alpha + \beta \quad \Delta GDP(t)^2 + \gamma \quad GDP(t) + \delta \quad Orders(t-2)$$

Data sources :

Results	OACI (World Civil Aviation Statistics), Millions USD
GDP, ΔGDP	FMI (Perspectives de l'Economie Mondiale)
Orders	Walsh Aviation

Multiple Regression Analysis :

Dependent variable : Results

Parameter	Estimate	Standard Error	T Statistic	P-Value
CONSTANT	-12745,9	3980,72	-3,2019	0,0064
Orders(t-2)	-5,41081	2,43044	-2,22627	0,0429
ΔGDP^2	415,601	106,154	3,9151	0,0016
GDP	6,77481	1,7535	3,86359	0,0017

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	P-Value
Model	3,28936E8	3	1,09645E8	16,27	0,0001
Residual	9,43719E7	14	6,74085E6		
Total (Corr.)	4,23308E8	17			

R-squared = 77,7061 percent
R-squared (adjusted for d.f.) = 72,9288 percent
Standard Error of Est. = 2596,31
Mean absolute error = 2079,85
Durbin-Watson statistic = 1,40952

Sources : ICAO, IMF, Walsh Aviation

In terms of forecasting, more can be done, since we know that the pattern of deliveries is strongly dependent on the pattern of orders. A model can be constructed linking results with economic conditions and previous orders. It gives satisfying results (adjusted R-squared of 72.9 percent), considering that previous orders are a rough estimation of the capacity on the market at a given time.

It enables to make forecasts of airline results depending on one known parameter, the number of orders made two years before (as long as you restrict your forecast to two years ahead, which seems a reasonable thing to do, considering the uncertainty on the economic environment), and one unknown, the economic growth. Depending on hypotheses of economic growth, scenarios can then be elaborated concerning the financial situation of airlines.

5. INVESTMENT AND AIRLINES BEHAVIOR

The airline industry is an oligopoly, which means that there is a limited number of actors in the industry. The behavior of one of them has therefore consequences in terms of pricing and total capacity on the market. The economic analysis of oligopoly (Varian, 1992) points out that behavior of such markets is fairly different from perfectly competitive markets. More specifically, the outcome of competition can lead to non (pareto) optimal situations. Such situations can be explained using models derived from game theory.

Let us imagine a situation where two airlines compete on one market (a route or a set of routes). They have a given market share. Even with correct anticipation of the traffic growth expected on this market (at current prices), it can be shown that the capacity chosen by the airlines will almost surely be superior to the expected traffic growth.

In terms of capacity (seats), each airline can have three strategies :

- increase its capacity on the market by less than the expected growth
- increase its capacity on the market by the same amount as the expected growth
- increase its capacity on the market by more than the expected growth

The first strategy will never be chosen, since it enables your competitor to gain market share over you[9].

The second strategy is a non aggressive one, reasonable as long as your opponent does the same. If he chooses the second strategy, you will loose market share, which is never a good thing.

This can be summarized in a table, choosing simple figures to represent the gains of the airlines.

[9] *We assume that there was no over-capacity in the first place.*

Table 5.1 : A strategic behavior

Airline A / Airline B	**non aggressive strategy (follow market growth)**	**aggressive strategy (invest beyond market growth)**
non aggressive strategy (follow market growth)	g(A) = 2 g(B) = 2	g(A) = -1 g(B) = 3
aggressive strategy (invest beyond market growth)	g(A) = 3 g(B) = -1	g(A) = 1 g(B) = 1

where g(A) and g(B) represent the respective gains of airlines A and B.

In terms of collective welfare, the optimal outcome is {g(A)=2, g(B)=2} since it yield a total gain of 4[10]. It corresponds to each airline matching its capacity increase with traffic growth. They split equally the benefits of increasing demand.

The outcome of both airlines being aggressive is an over-capacity on the market, leading to price cuts, in order to boost demand. Profits go down for each airline : {g(A)=1, g(B)=1}

The outcome of one airline being aggressive while the other is not, is for the aggressive one a large gain, while the other gets less than in any other situation : {g(A)=3, g(B)=-1} or {g(A)=-1, g(B)=3}. It could even be the case that being aggressive when your opponent is not, leads to bigger gains, since with a bigger market share you may be able to raise your prices[11]

In any case, being aggressive is a dominant strategy, since whatever your opponent does, you get more than in the other case (3 or 1, instead of 2 or -1).

This model, known as the « prisoner's dilemma », is very often used to characterize this kind of situations. However simple it may seem, it has a very wide scope, and represents in an adequate way many real situations. We represented a simple case where only two airlines are competing, but it can be successfully generalized to several competitors (Tirole, 1988).

How can the airlines get out of this situation where profits are more or less exhausted by competition ? Again, game theory offers us a way out : if the situation is repeated, then getting along becomes possible. Long term relationships (represented by an infinitely repeated game) enable cooperation. By cooperating, airlines could share the gains from a non aggressive behavior.

This kind of reasoning, however, is only valid in a very stable relationship : competitors have to remain the same all along the game. In the air transportation industry, this is far from the case : existing airlines can disappear (or exit a market) and new airlines can enter a

[10] *We assume that the consumers' welfare is more or less unchanged in this case*

[11] *In this case the consumers' welfare goes down*

market. If an airline thinks one of its competitors may exit a market as a result of an aggressive behavior, it may have as a goal to provoke the exit, and then the framework of repeated games does not hold.

It may not be possible, in this case, to get out of the dilemma. Being aggressive and over-investing may make sense in the long term, in order to eliminate rivals. It may even be in the (short term) interest of consumers, who may benefit from lower prices. In the long term however, exits from markets may lead to monopoly power and need to be watched by regulatory authorities.

6. CONCLUSION : HOW TO SMOOTHE CYCLES

If a tendency to over-capacity, explained by the oligopolistic structure of the airline industry, is worsened by economic conditions, it leads exactly to what we observe : investments timed in good economic periods (when airlines can afford to act aggressively) materialize in the shape of delivered planes (and thus available capacity), a few years later, usually when the economic context is not so favorable (to say the least !). This leads to huge losses (due to a large disequilibrium between supply and demand) and airlines slowly get better when this unbalance is reduced by the growth in demand. Then they start investing again.

To correct this cyclical imbalance between supply and demand, airlines need to adjust in two ways :

First, they should improve their forecasting abilities : although no model can ever predict a demand shock, like the gulf war, a model, like the one we estimated, can be used to build scenarios, and predict how much capacity airlines would want to have in different economic situations and at different points of the economic cycle. This would give airlines boundaries of desirable capacity considering economic conditions and competition. This would help airlines to take advantage of the economic cycles instead of being hit by them, by leading to a better management of capacity.

Since capacity, even managed in a better way, is not as adjustable as airlines would like in order to « ride » the cycles, another important adjustment is to build more flexible capacity. If a fraction of capacity is made flexible, even a marginal one (5 to 10 percent), it may be enough to cope with unexpected changes in demand, since demand can be predicted with reasonable accuracy. For example, capacity can be gained in high demand periods by deferring retirements, or by using short term leases. It can be reduced in low demand periods by returning leased aircraft or retiring old aircraft.

There are important benefits to be gained, for the individual carrier, but also for the industry as a whole, if global capacity matches demand better. This may not be easy to achieve, because it means changing the behavior of all airlines. It will make sense, in order to influence the whole industry, for airlines or groups of airlines to share insights and information concerning the evolution of demand. This may prove a difficult evolution in a very competitive industry, used to the kind of behavior described above, but efforts should be made towards that goal.

ACKNOWLEDGMENTS

The author wishes to thank Michaël Benhamed for his data collection work and preliminary analyses, which have been indispensable prerequisites for this work.

REFERENCES

Airbus (1997) Global Market Forecast, 1997 - 2016. Airbus Industrie

Boeing (1997) The Boeing Company 1997 Current Market Outlook. Boeing

Boyer, R. (1990) Fluctuations et Croissance. in *Encyclopédie Economique*, Ed. Economica

Department of the Environment, Transport and the Regions (1997) Air Traffic Forecasts for the United Kingdom 1997. London

Fudenberg, D. and Tirole, J. (1991) **Game Theory**. MIT Press

Hamilton, J. (1994) **Time Series Analysis**. Princeton University Press, USA.

Harvey, A. (1990) **The Econometric Analysis of Time Series.** 2nd edition. The MIT Press, Cambridge, Massachusetts.

International Air Transport Association (1997) : Air Transport Outlook: Annual Conference

International Civil Aviation Organization (1976-96) World Civil Aviation Statistics

International Monetary Fund (1980-97) World Economy Outlook

Schumpeter, (1939) **Business Cycles : Theoretical, Historical and Statistical Analysis of the Capitalist Process**. New York, McGraw-Hill.

Smith, A. (1776) **An Inquiry into the Nature and Causes of the Wealth of Nations.** New York, Modern Library, 1937.

Tirole, J. (1988) **The Theory of Industrial Organization**. The MIT Press, Cambridge, Massachusetts.

Varian, H. (1992) **Microeconomic Analysis**. 3rd edition. W. W. Norton and Company Inc, Michigan, USA.

Zarnovitz, V. (1985) Recent Work on Business Cycles in Historical Perspectives. *Journal of Economic Literature*, **23**, 523-580.

THE 8th WORLD CONFERENCE ON TRANSPORT RESEARCH

A model for the forecast of demand in major touristic airports - The case of the airport of Rhodes

V. Profillidis
Associate Professor
Section of Transportation
Democritus University of Thrace, Greece

Antwerp
July 1998

A model for the forecast of demand in major touristic airports - The case of the airport of Rhodes

V. Profillidis
Associate Professor
Section of Transportation
Democritus University of Thrace, Greece

Abstract: Models of forecast of demand of airports have focused for years on busy central airports. However, touristic airports with high seasonalities present an increasing interest. The appropriate models for demand forecast for such touristic airports are analyzed in this paper: statistical, time-series, econometric, gravity and fuzzy models. Application of the models are presented for the case of a major airport of Easter Mediterranean, the airport of Rhodes. The impact of the method of forecast in the airport master planning is also discussed.

1. Transport and economic development: a close link

It is established that transport is closely related to the economic activity (Fig. 1). Both passenger and freight transport follow generally the rate of economic development.

However, each transport mode has a more or less predominant position related to the distance traveled (Fig. 2). It can be easily seen that for distances more than 800kms, air transport is by far the principal transport mode.

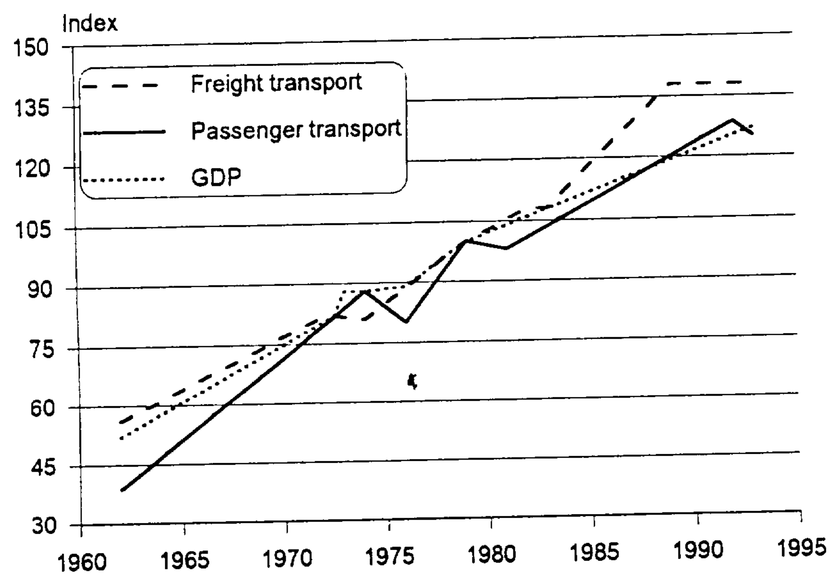


Fig. 1: Rates of development of GDP (Gross Domestic Product), passenger and freight transport for OECD countries.

At the era of the third technological revolution of telematics, biotechnology and airplanes (Fig. 3), air transport has increased during the last 25 years with rates higher than the increase of GDP (Fig. 4), [1].

Concerning elasticities, air transport is highly influenced by the level of income, as it has been established for many countries all over the world (Fig. 5), [2].

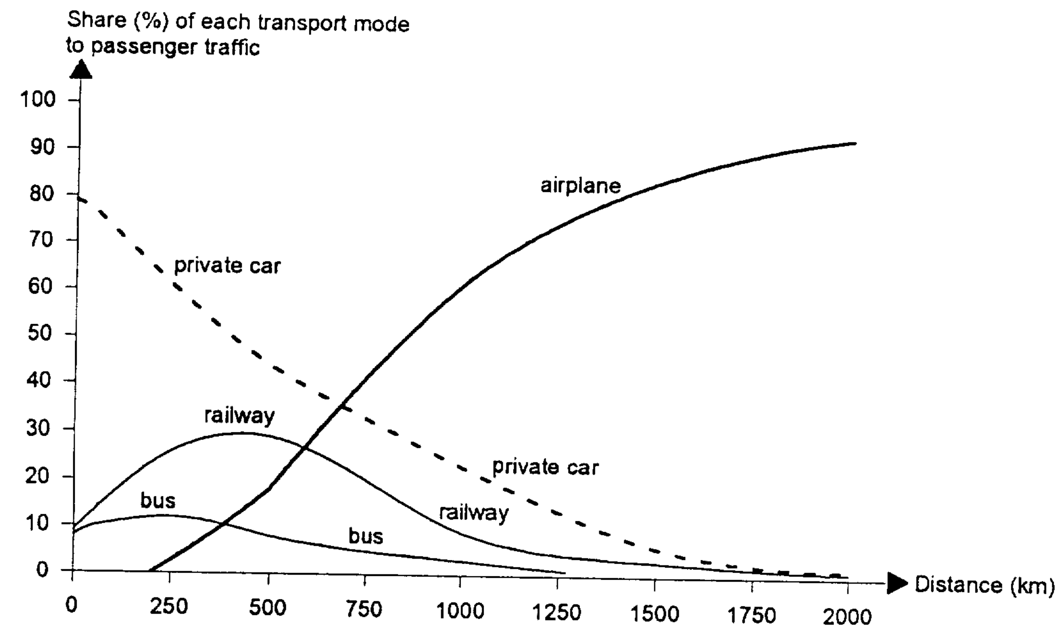


Fig. 2: Share of each transport mode to passenger traffic in relation to distance.

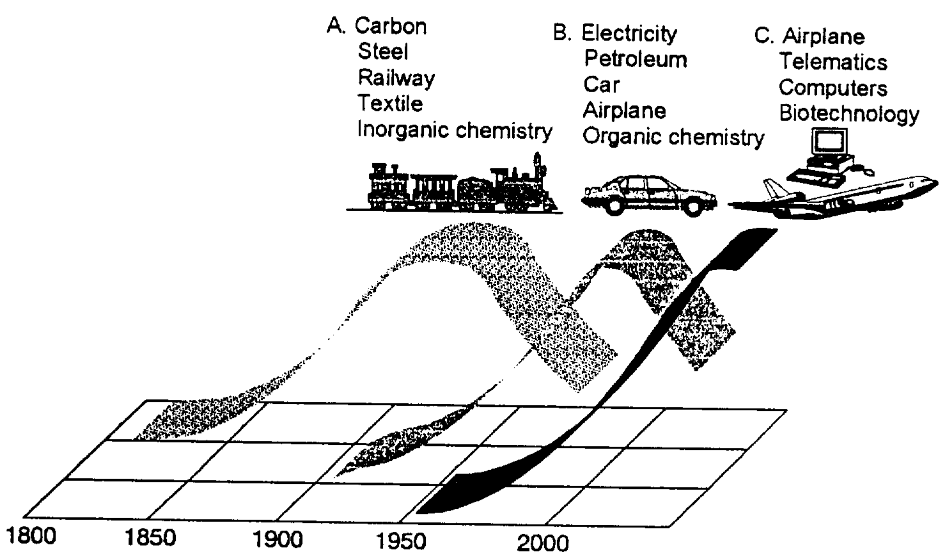


Fig. 3: Economic cycles and transport technologies.

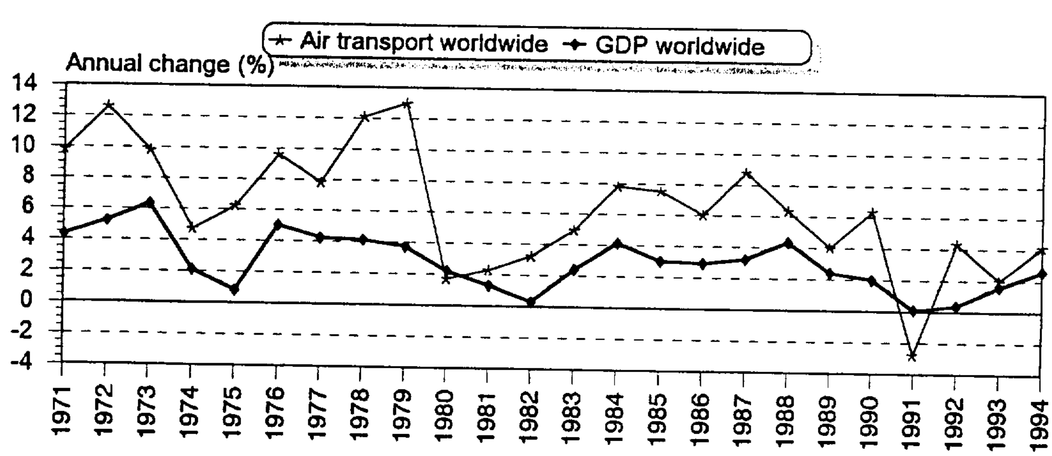


Fig. 4: Rates of development of air transport and GDP worldwide.

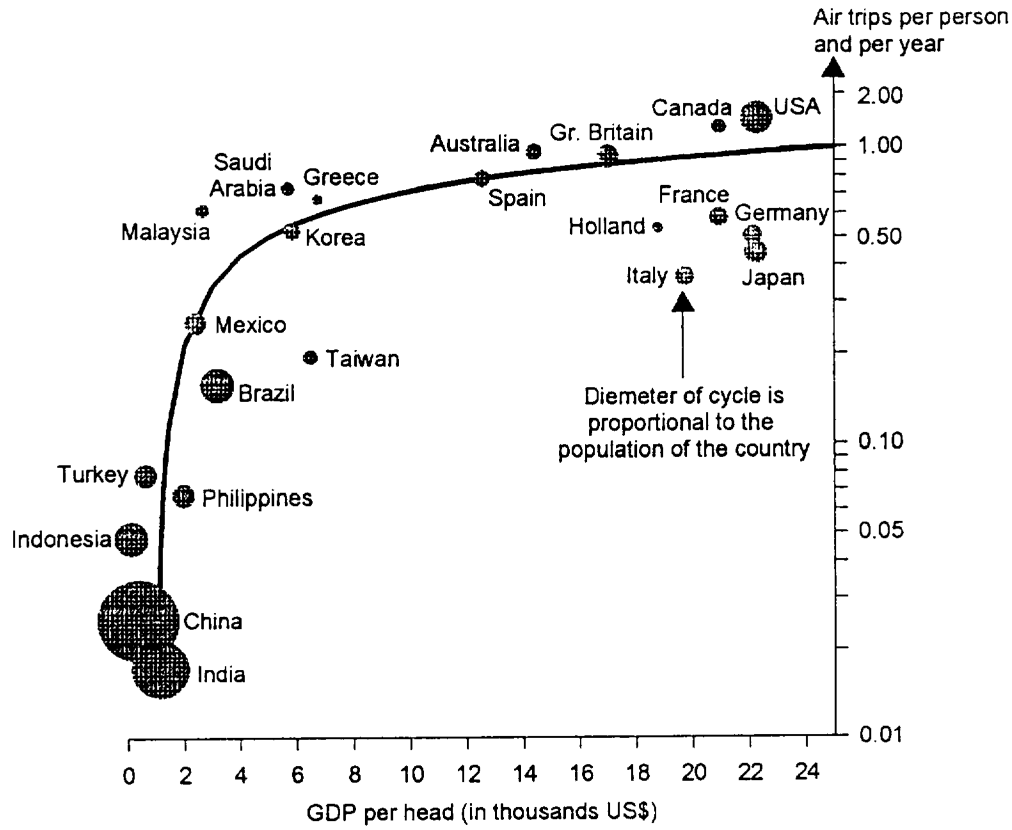


Fig. 5: Relationship between revenue and air transport for various countries.

2. Tourism and air transport

Tourism has become a highly expanding economic activity (Fig. 6, 7), with a great impact to the economy of countries like France, Italy, Greece, etc (Table 1), [3].

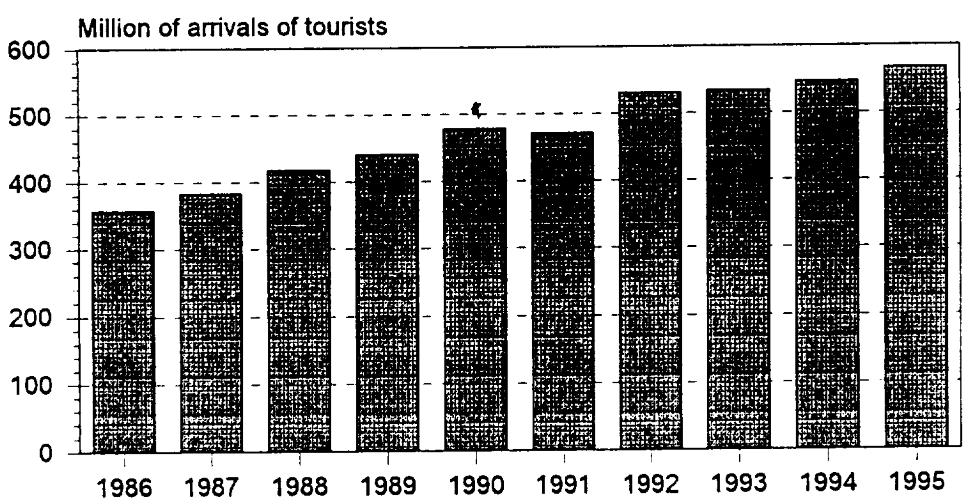


Fig. 6: Evolution of number of tourists worldwide.

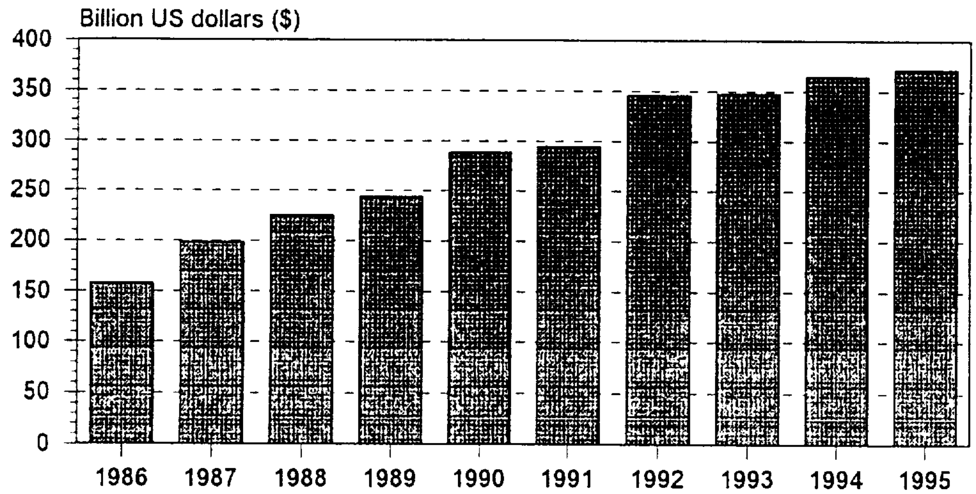


Fig. 7: Revenues from tourism worldwide.

Country	Number of tourists (in million)		Range in 1990	Range in 1995
	1990	1995		
France	52.497	60.584	1	1
Spain	37.441	45.125	3	2
USA	39.539	44.730	2	3
Italy	26.679	29.184	4	4
China	10.484	23.368	12	5
Gr. Britain	18.013	22.700	7	6
Hungary	20.510	22.087	5	7
Mexico	17.176	19.870	8	8
Poland	3.400	19.225	27	9
Austria	19.011	17.750	6	10
Canada	15.209	16.854	10	11
Czech Republic	7.278	16.600	16	12
Germany	17.045	14.535	9	13
Switzerland	13.200	11.835	11	14
Greece	8.873	10.600	13	15
Hong-Kong	6.581	9.598	19	16
Portugal	8.020	9.513	14	17
Malaysia	7.446	7.936	15	18
Singapore	4.842	6.595	22	19
Thailand	5.299	6.532	21	20
Sum of 20 first	338.543	415.221		
Sum worldwide	459.233	566.538		

Table 1: The 20 most important touristic destinations worldwide.

The evolution of tourism is also closely related to the economic activity (Fig. 8). The great part of tourist trips (particularly of long distance) is realized by air transport (Fig. 9), which is closely related to the number of tourist trips (Fig. 10), [3].

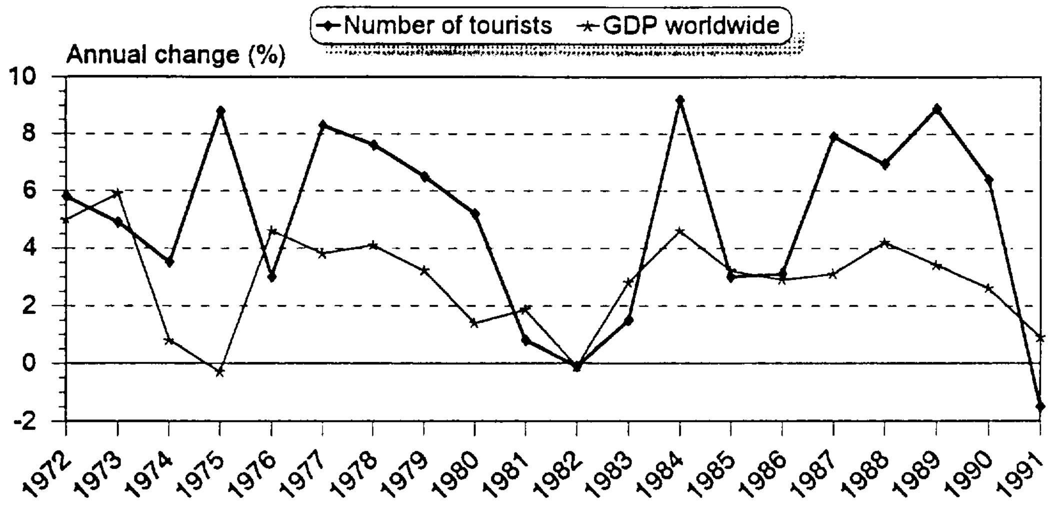


Fig. 8: Tourist arrivals and Gross Domestic Product worldwide.

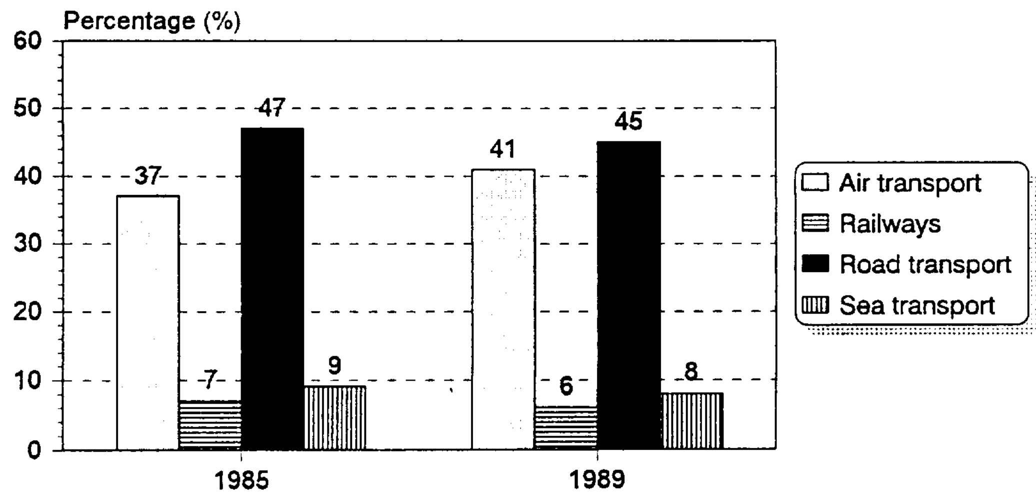


Fig. 9: Share of each transport mode to the total number of tourist trips.

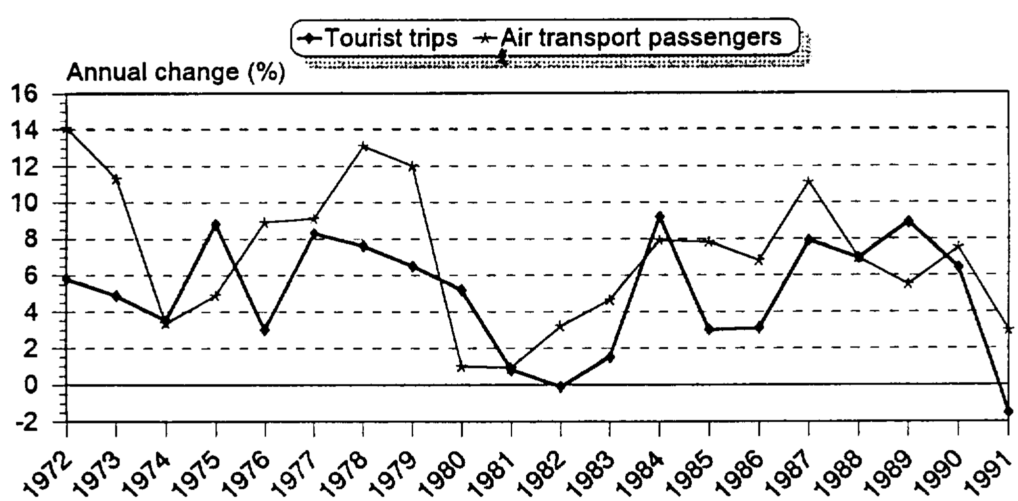


Fig. 10: Relationship between air transport and tourist trips worldwide.

The prospects, however, for Europe in the development of tourism are less promising than in the past. Europe will have lower rates of development of the touristic industry and will absorb 50,8% of the total world touristic market, compared to 63,6% for 1990 and 56,3% for 2000 (Table 2), [2].

	1990 (%)	2000 (%)	2010 (%)
Europe	62,6	56,3	50,8
America	20,4	22,2	22,1
Asia and Pacific	11,5	15,3	20,3
Africa	3,3	3,6	3,8
Middle East	1,5	1,7	1,9
South - East Asia	0,7	0,9	1,1

Table 2: Share of the various continents to the tourist market worldwide.

Receiving increased numbers of tourists is one part of the matter. The second one has to do with the medium expenditure per tourist (Fig. 11), which is related both to the cost of life but to the number of days spent, [4].

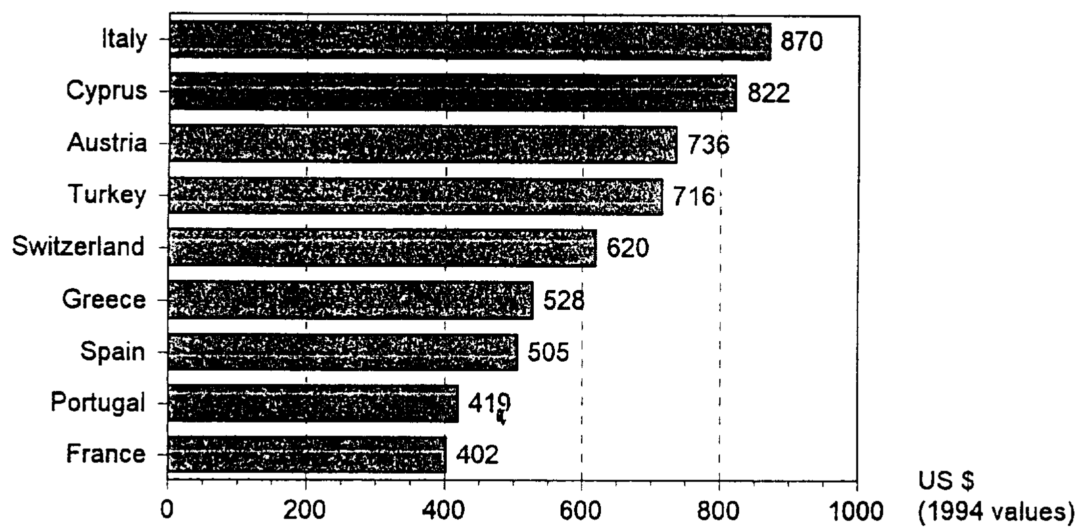


Fig. 11: Revenues per tourist for various countries.

3. The airport of Rhodes and its impact to the economic development of the island

The island of Rhodes (Fig. 12) is situated in the south - east of Greece and its the greatest one of the complex of Dodecanese. Tourism is the principal factor of the economic activities of the island (Table 3) , [4]. The number of tourists has spectacularly increased during the last 40 years (Table 4), [4].

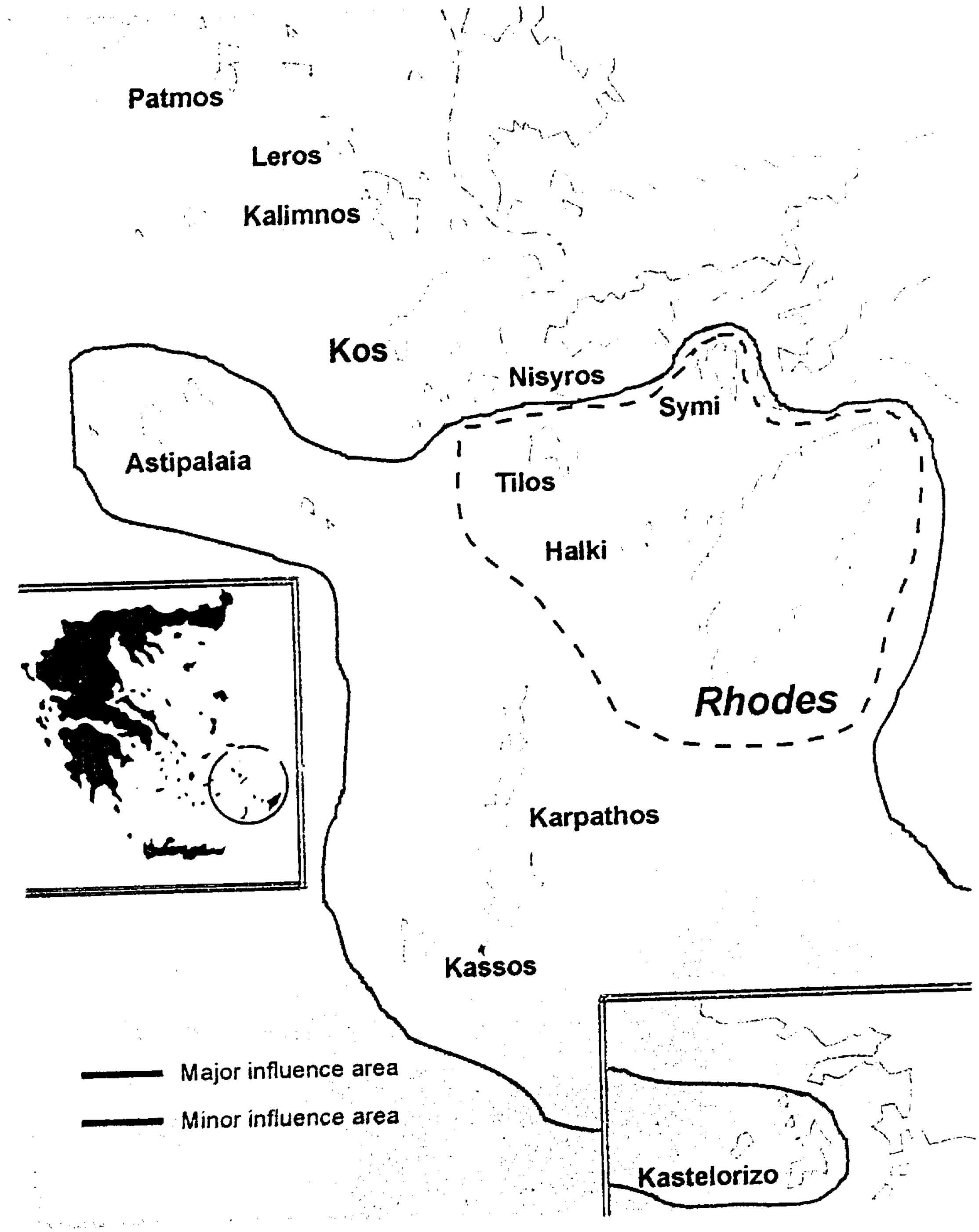


Fig. 12: Island of Rhodes and influence area of the airport of Rhodes.

Activities	Percentage (%) in 1978	Percentage (%) in 1988
Agriculture	21,9	14,9
Forest and Fishing activities	13,2	8,9
Commerce	14,4	14,5
Hotels, Restaurant	26,3	36,9
Construction	9,3	8,8
Public services	12,0	12,4
Education, Health, Justice	2,9	3,6

Table 3: Impact of the various activities in the total economic development of Dodecanese.

Year	Number of tourists arrivals	Medium duration of staying (days)
1952	61.148	6,6
1965	130.380	8,0
1970	213.657	8,1
1976	466.588	9,5
1980	610.827	9,5
1985	780.211	9,4
1990	844.477	9,6
1992	935.067	9,6

Table 4: Evolution of number of tourists at the island of Rhodes and medium duration of staying per tourist.

The contribution of the airport has been crucial for this development. The airport (Fig. 13) has a runway of 3.260m long, to which the great majority of aircraft can land. The terminal is saturated and important extension works are in progress. The airport is equipped with high technology air navigation systems, which make it one of the more important in East Mediterranean. Until 1977 the airport was located in Maritsa. Operation in the airport in Paradissi (Fig. 13) began in 1977. In a period of 20 years the total number of passengers (Fig. 14) has increased by 2,7. This increase principally comes from the increase of international traffic (Fig. 15), whereas domestic traffic is greatly impaired from the level of tariffs (Fig. 16).

Germany and England constitute 49,2% of the international passengers of the airport, and Scandinavians countries 18,3% for the year 1997 (Table 5).

As revenues are 6 times higher compared to the expenses of the airport, the Airport Authority could have the possibility of self-financing the necessary investment.

4. A Survey for the Evaluation of the characteristics of traffic at the airport of Rhodes

4.1. Scope of the Survey

In order to investigate the characteristics of traffic at the airport of Rhodes, a Survey has been conducted during the summer of 1997. 1166 questionnaires have been completed by both international and domestic passengers. The questionnaire and analysis of results are given in next pages. We can conclude the following:

- international passengers have arranged their trip to Rhodes some months ago, with the help of an agency; in contrary, domestic passengers arrange their travel by themselves and only some weeks ago
- whereas international passengers come in Rhodes exclusively for touristic reasons, 16,1% of domestic passengers have a professional motivation for their trip
- the first impression at the moment of entrance in the airport is more or less satisfactory for the 97,2% of international passengers and for the 93,7% of the domestic passengers
- most of the services of the airport are evaluated as satisfactory with the exception of the check-in and waiting areas, the information level and the bar services which must be improved.

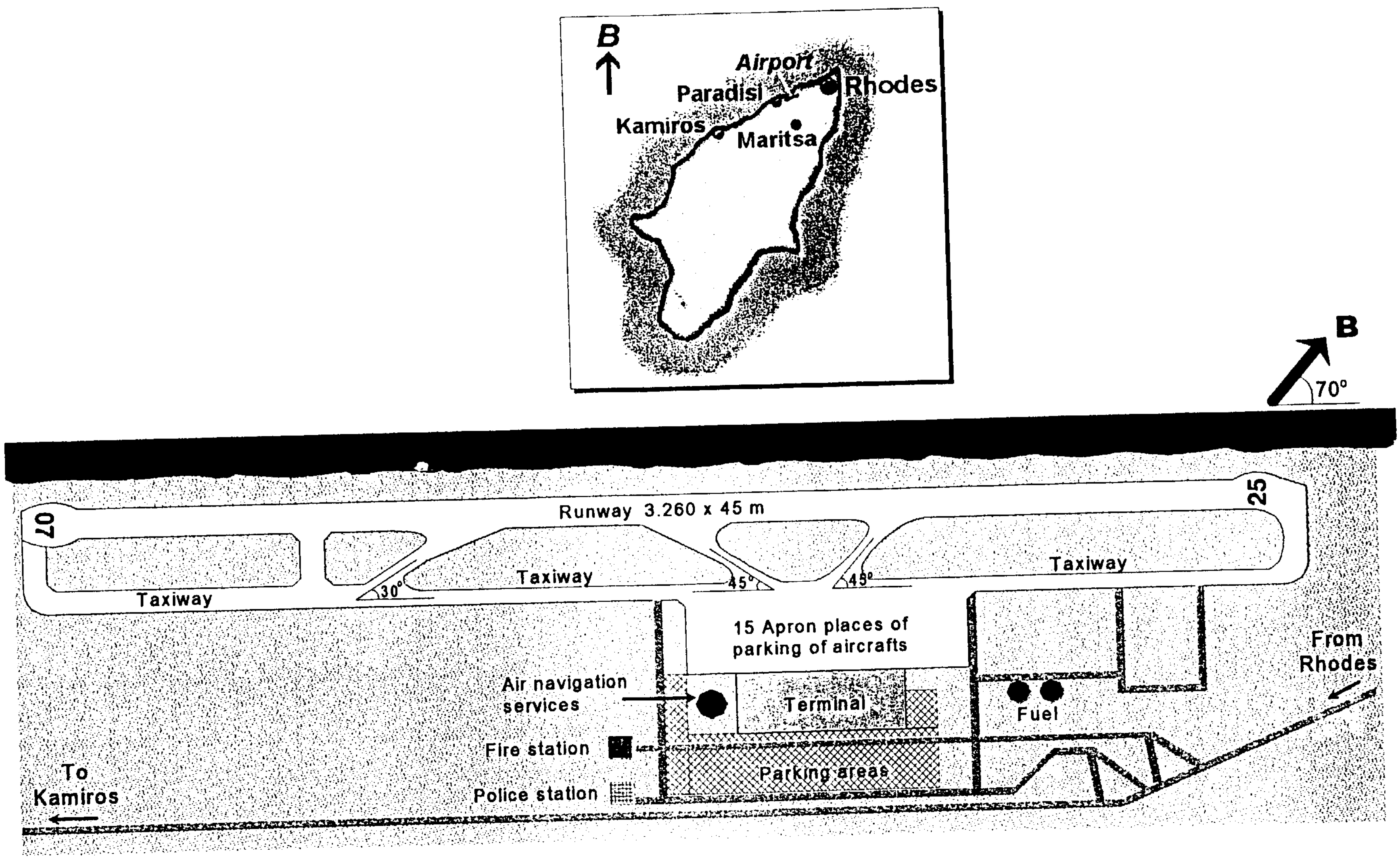


Fig. 13: Components of the airport of Rhodes.

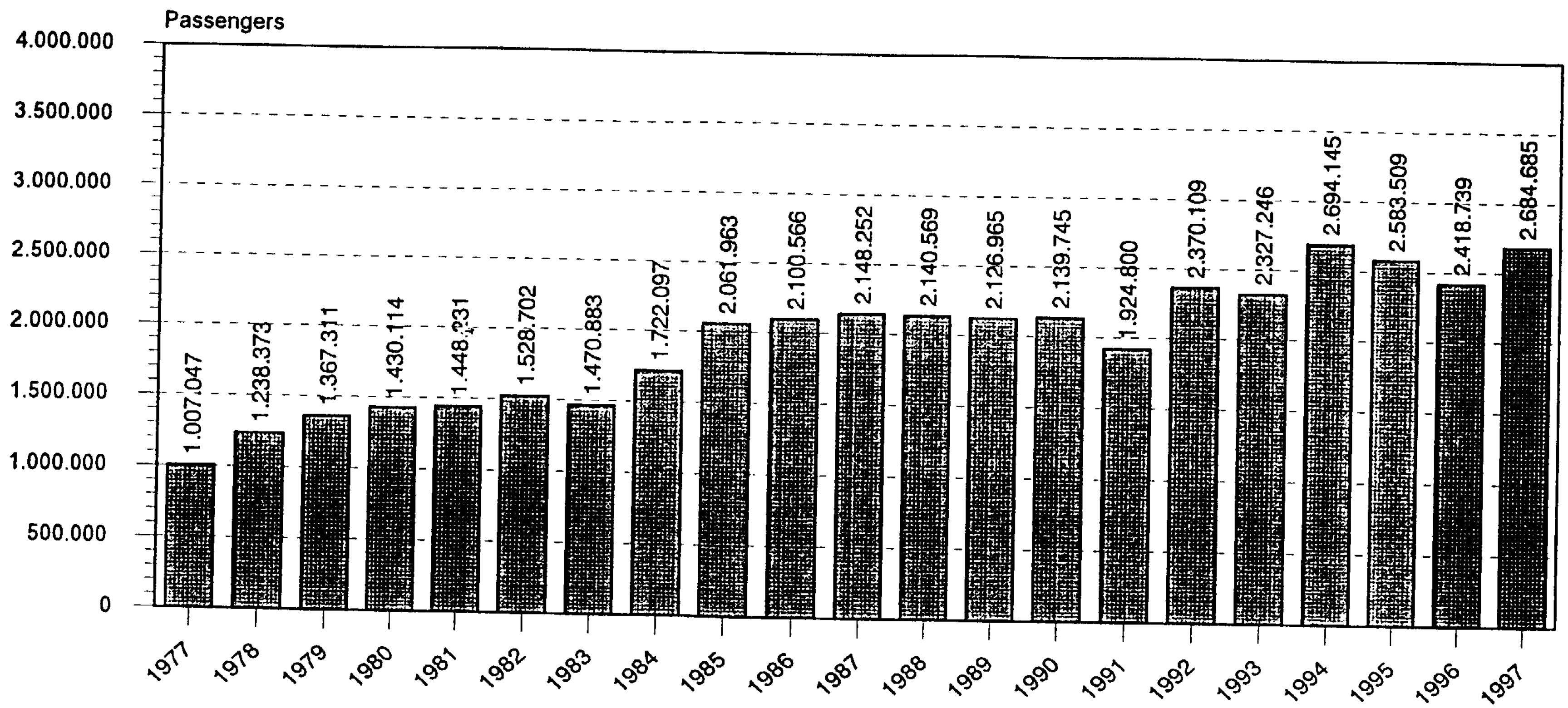


Fig. 14: Total number of passengers of the airport of Rhodes.

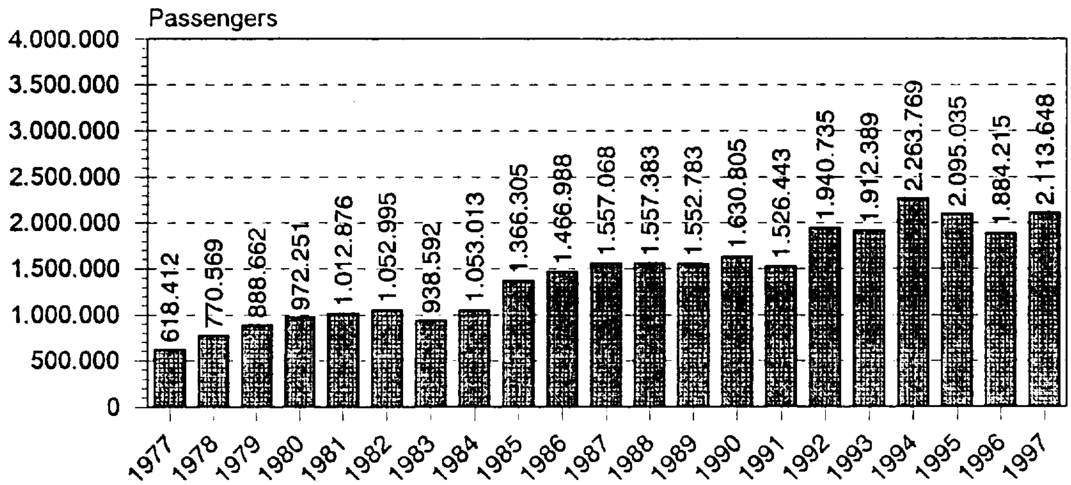


Fig. 15: International passengers at the airport of Rhodes.

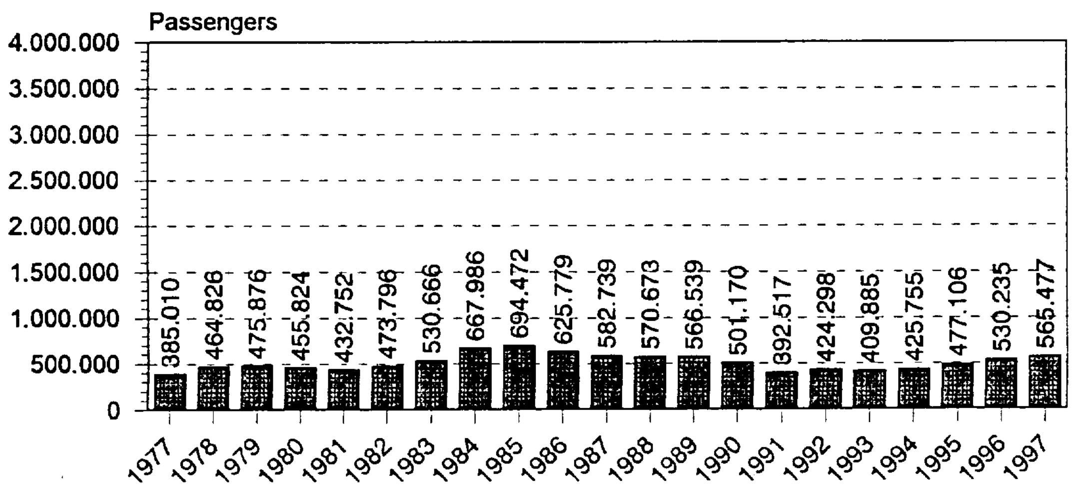


Fig. 16: Domestic passengers at the airport of Rhodes.

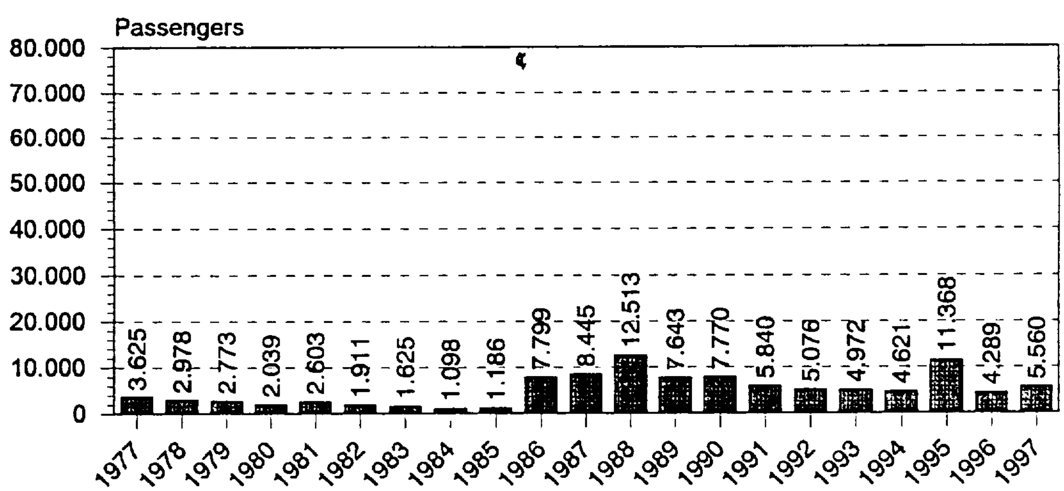


Fig. 17: Passengers of private and military aircrafts at the airport of Rhodes.

Origin country / Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Germany	18,51	17,09	19,07	21,49	23,59	25,38	25,70	29,43	31,47	29,86	28,40	28,15
England	33,29	35,00	33,56	31,66	30,86	31,53	34,57	33,07	31,01	28,17	21,79	21,70
Sweden	9,77	9,57	9,35	8,84	7,57	6,99	5,81	5,10	5,07	6,32	7,41	6,47
Italy	0,22	0,74	1,25	1,74	2,51	3,55	4,36	5,01	5,88	5,87	5,86	5,40
Denmark	6,86	7,38	6,18	6,27	5,65	3,94	4,45	4,04	4,83	4,15	5,71	5,48
Austria	3,77	3,36	6,05	4,20	5,20	5,76	5,32	4,88	3,97	4,53	5,28	5,33
Holland	6,72	6,12	6,19	7,36	7,16	6,80	5,69	5,31	4,62	4,43	4,15	4,06
Finland	9,23	10,29	9,73	11,68	8,63	7,73	5,05	3,52	3,28	3,78	5,29	4,62
Switzerland	2,49	1,92	2,00	1,84	1,45	0,95	1,49	1,84	2,38	3,17	2,96	3,10
Belgium	1,27	1,51	1,64	1,92	2,52	2,01	2,39	2,32	2,29	2,19	2,34	2,36
Norway	6,19	5,63	3,48	1,50	1,79	1,83	1,77	0,88	1,67	2,21	2,58	1,92
Israel	0,14	0,37	0,15	0,15	0,26	0,43	0,48	1,11	0,54	0,80	2,32	3,57
France	0,14	0,14	0,17	0,29	0,88	0,69	0,49	1,12	0,77	0,57	0,42	0,64
Czech Republic	-	-	-	-	-	-	0,12	0,06	0,47	0,84	1,25	2,04
Luxembourg	0,43	0,33	0,42	0,42	0,42	0,42	0,44	0,49	0,39	0,60	0,83	0,75
Ireland	0,12	0,08	0,15	0,25	-	0,35	0,33	0,47	0,43	0,49	0,34	0,31
Hungary	-	-	-	-	0,20	-	0,24	0,08	0,17	0,65	0,75	1,11
Cyprus	0,02	0,01	0,03	0,02	0,49	0,49	0,70	0,53	0,28	0,31	0,32	0,30
Yugoslavia	0,53	0,37	0,35	0,32	0,75	0,69	0,23	0,17	0,18	0,49	0,23	0,21
Egypt	0,11	0,06	0,06	-	-	0,13	0,13	0,26	0,09	0,08	0,01	0,10
Slovakia	-	-	-	-	-	-	-	-	-	-	0,33	0,72
Slovenia	-	-	-	-	-	-	-	-	-	-	0,28	0,24
Jordan	0,20	0,03	0,12	0,03	0,02	0,13	0,10	0,08	0,06	0,02	0,06	0,06
Croatia	-	-	-	-	-	-	-	-	-	-	0,07	-
Estonia	-	-	-	-	-	-	-	-	-	0,04	-	-
Portugal	-	-	0,00	-	-	0,01	-	0,02	-	-	-	-
Turkey	-	-	-	-	-	0,01	-	0,02	-	-	-	0,02
Romania	-	-	-	-	-	-	-	-	-	0,01	-	0,00
Canada	-	-	-	-	-	-	-	0,01	-	-	-	-
Suedi Arabia	-	-	-	-	-	-	-	0,00	-	-	-	-
Arabic Emirates	-	-	-	-	-	-	-	-	-	-	-	0,01
Spain	-	-	0,01	0,01	-	-	-	-	-	-	-	0,01
Other countries	-	-	0,06	-	0,08	0,16	0,14	0,18	0,13	0,44	1,02	1,32

Table 5: Origin (%) of international passengers at the airport of Rhodes.

REPUBLIC OF GREECE

CIVIL AVIATION AUTHORITY

Survey of the Characteristics and the Quality of Service at the Airport of Rhodes

Responsible: Assoc. Professor V. Profillidis

Date: [ ] [8] [1997] Hour: [ ] [ ]

1. Nationality: ____ **2. Age:** __ **3. City in which you are living:** ______ **4. Sex:** Male [ ] Female [ ]

5. To which airport are you traveling? _______ **6. What is your final destination:** ________

7. With which air company are you traveling? ______________________________

8. When did you book your place? ______________________________

9. Reason of your trip:

Professional		*Non professional*	
Related to tourism	[ ]	Family - Personal	[ ]
Public sector servant	[ ]	Medical	[ ]
Private sector employee	[ ]		
Liberal profession	[ ]	Tourism - Vacations	[ ]
Military	[ ]		
Congress participant	[ ]	Organised by a tourist office	[ ]
Studies	[ ]	Non organised by a tourist office	[ ]
Other (clarify) ______________			

10. Do you visit Rhodes by air for the first time? Yes [ ] No [ ]

If no, how many times have you visited Rhodes by air? [ ] times

How many days did you spend in Rhodes? [ ] days

11. Which tourist office, travel agency or air company has organised your trip?

Tourist office__________ Travel agency: ____________ Air company: __________

12. Is your first trip by air? Yes [ ] ⁴No [ ]

If no, approximately how many times have you traveled by air? [ ] times

13. You have chosen air transport instead of sea transport for the following reasons:

Great distance	[ ]	Total cost of trip	[ ]
Travel time	[ ]	Other	[ ]
Risk of sea sickness	[ ]	(please clarify) ____________	

14. How many airports have you visited? [ ] airports

Which ones? ______________________________________

15. How did you travel to the airport?

Tourist bus	[ ]	Rented car	[ ]
Taxi	[ ]	Car of relatives	[ ]
Private car	[ ]		

16. **How many people accompanied you till the airport?** ☐

17. **What is your impression at the moment of entrance at the airport?**

Very good ☐ Good ☐ Medium ☐ Bad ☐

18. **How do you evaluate the quality of service at the check in?**

Personnel behavior: Good ☐ Medium ☐ Bad ☐

Areas: Sufficient ☐ Tolerable ☐ Insufficient ☐

19. **How do you evaluate the information from the personnel of the airport?**

Good ☐ Medium ☐ Bad ☐

20. **How do you evaluate the waiting area of the airport?**

Areas		*Seats*		*Aesthetics*	
Sufficient	☐	Comfortable	☐	Good	☐
Tolerable	☐	Medium	☐	Medium	☐
Insufficient	☐	Non comfortable	☐	Bad	☐

21. **How do you evaluate the bar services of the airport?**

Quality		*Cost*		*Service*	
Good	☐	Low	☐	Good	☐
Medium	☐	Normal	☐	Medium	☐
Bad	☐	High	☐	Bad	☐

22. **How do you evaluate the cleanliness of the airport?**

Waiting areas, Ckeck in		*WC*	
Good	☐	Good	☐
Medium	☐	Medium	☐
Bad	☐	Bad	☐

23. **How do you evaluate the shops of the airport?**

Sufficient ☐ More of them are required ☐

Which ones ______________________

24. **What additional services would you expect at the airport of Rhodes?**

____

25. **What is your profession?**

- Public sector servant ☐
- Private sector employee ☐
- Liberal profession ☐
- Student / Pupil ☐
- Military ☐
- Worker - industry ☐
- Farmer ☐
- Pensioner ☐
- Household ☐

26. **Education level:**

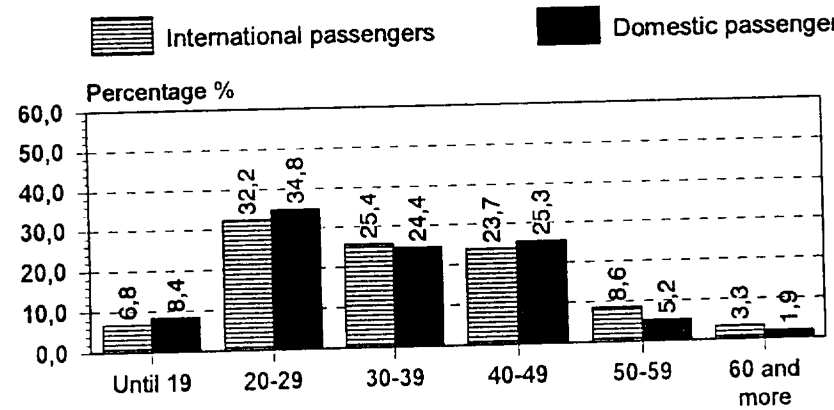
- University ☐
- Technical or Professional school ☐
- High school ☐
- Elementary school ☐

27. **How many members has your family?** ☐ members

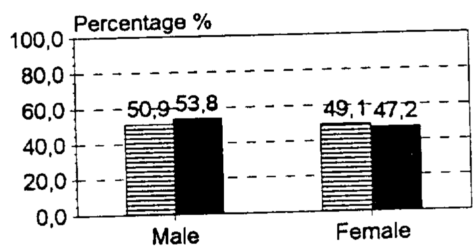
We thank you for your cooperation and we wish you a pleasant trip

4.2 Results of Survey to international and domestic passengers at the airport of Rhodes

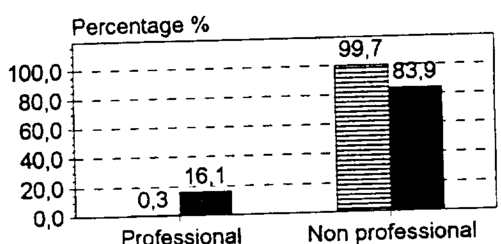
Age of passenger:

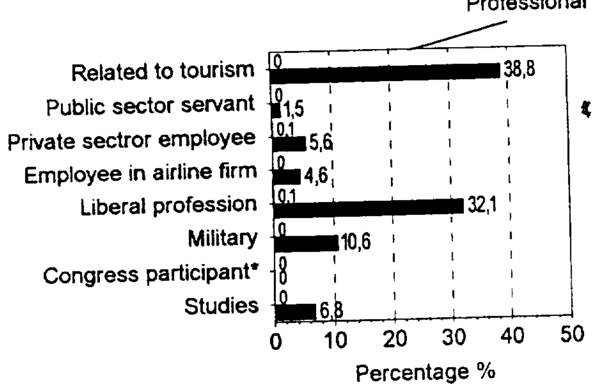


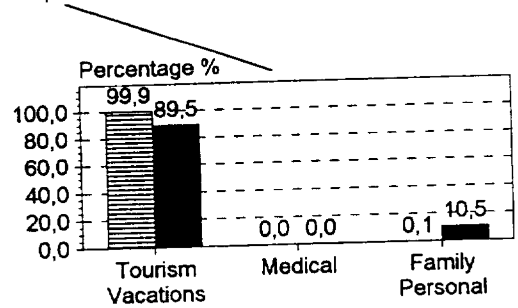
Sex of passenger:



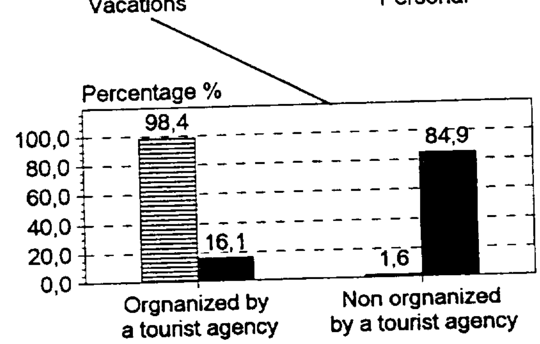
Reason of trip:



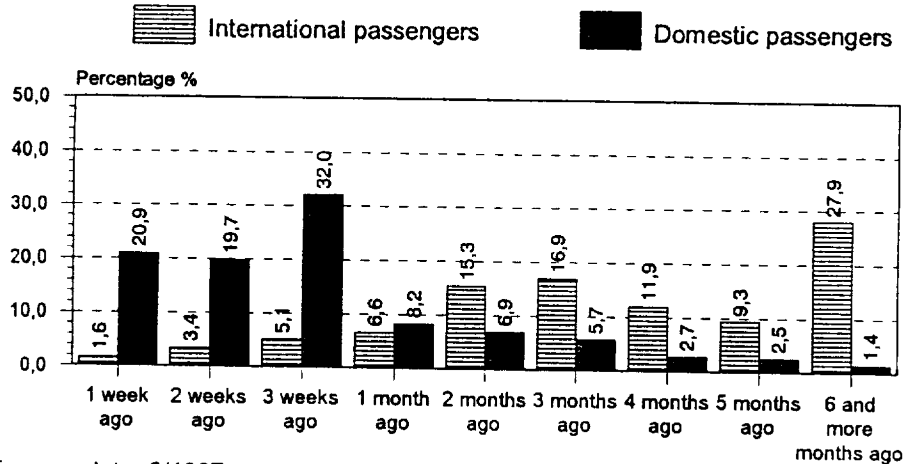




* Because of the period of survey (summer period).
We estimate the real percentage higher.

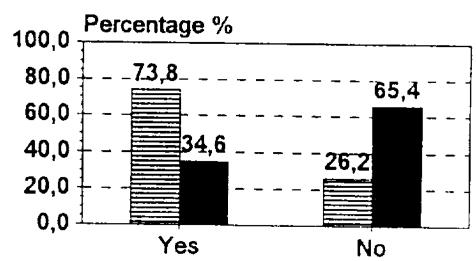


When did you book your place*?

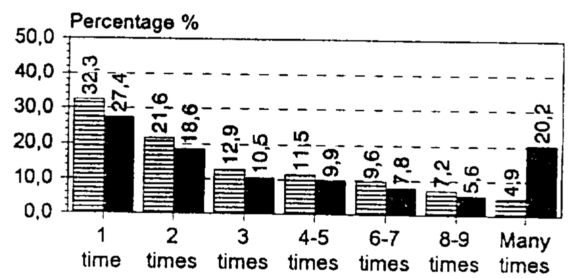


* Reference date: 8/1997

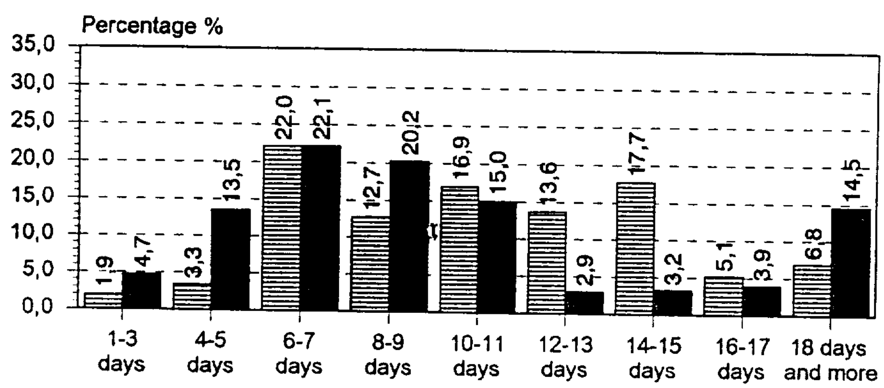
Do you visit Rhodes by air for the first time?



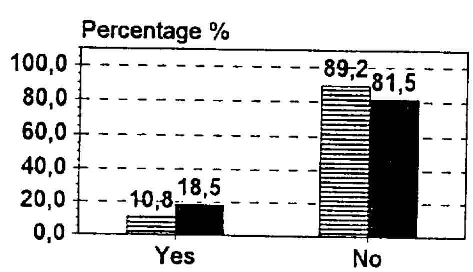
If no, how many times have you visited Rhodes by air?



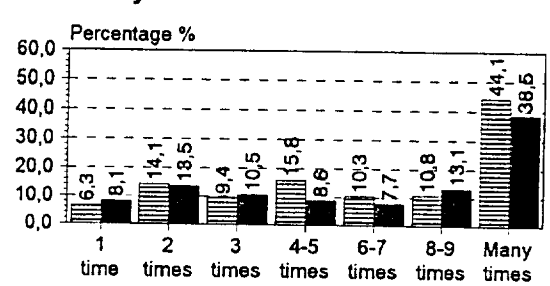
How many days did you spend in Rhodes?



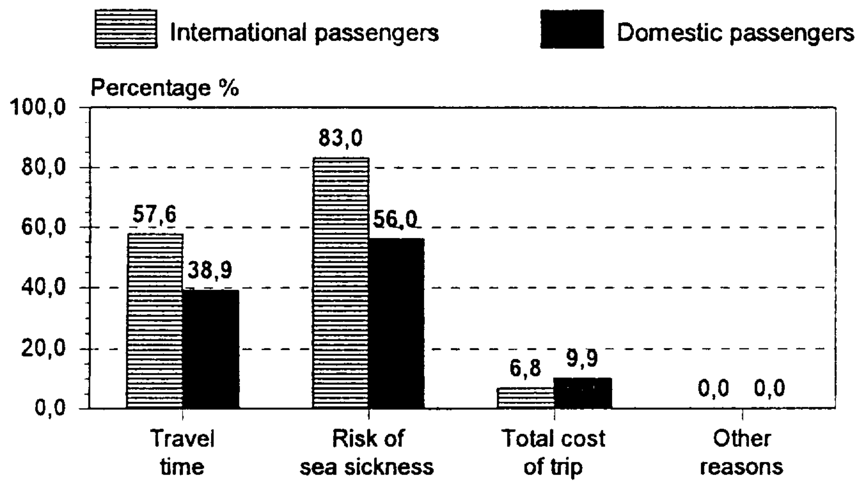
Is your first trip by air?



If no, approximately hay many times have you traveled by air?

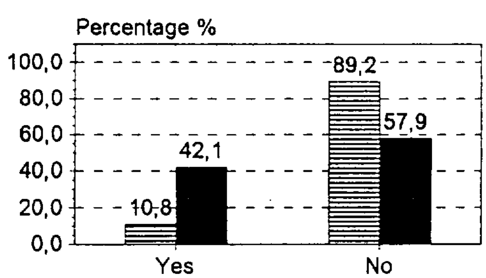


You have chosen air transport instead of sea transport for the following reasons:

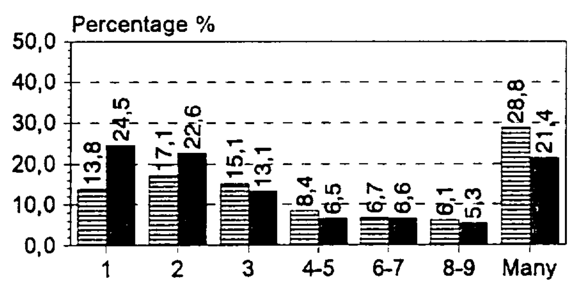


Note. The passenger could choose more than one reasons

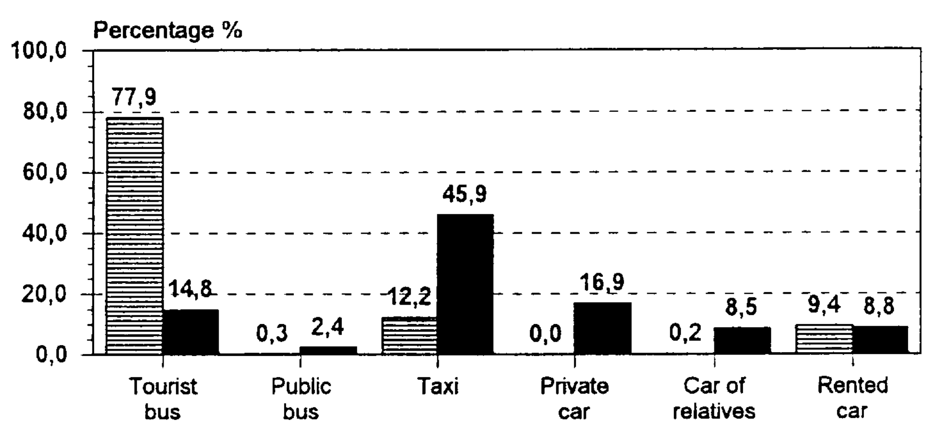
Have you visited other airports?



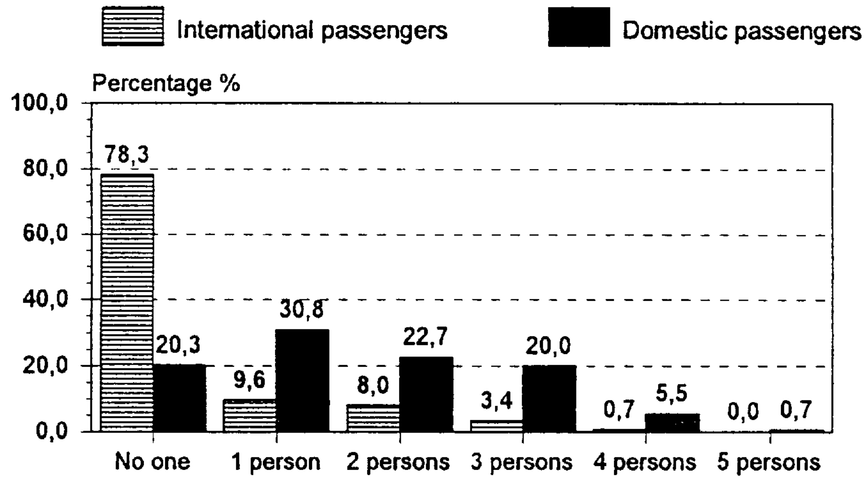
If yes, how many airports have you visited?



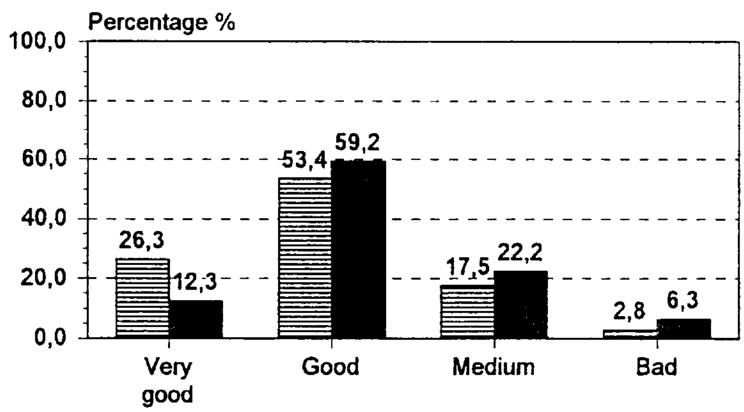
How did you travel to the airport?



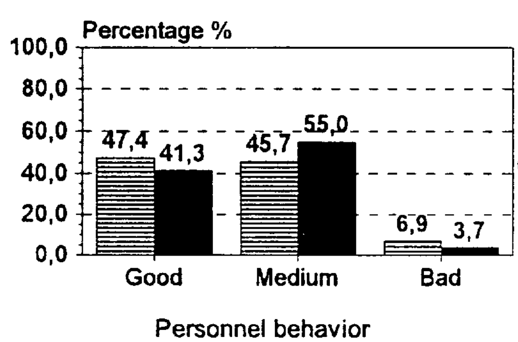
How many people accompanied you till the airport?

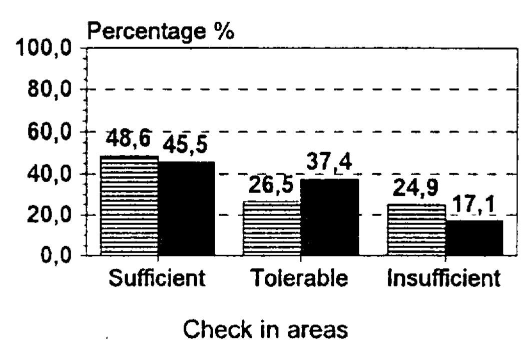


What is your impression at the moment of entrance at the airport?

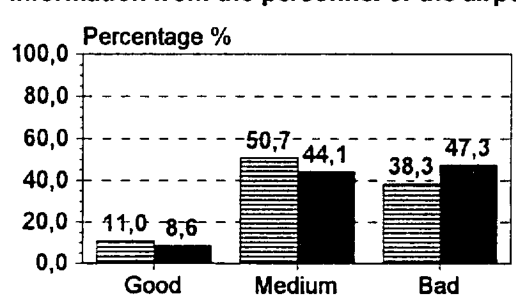


How do you evaluate the quality of service at the check in?

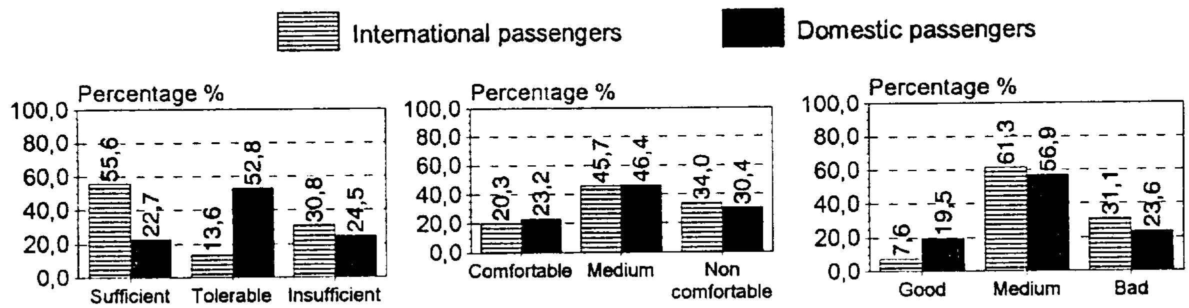




How do you evaluate the information from the personnel of the airport?

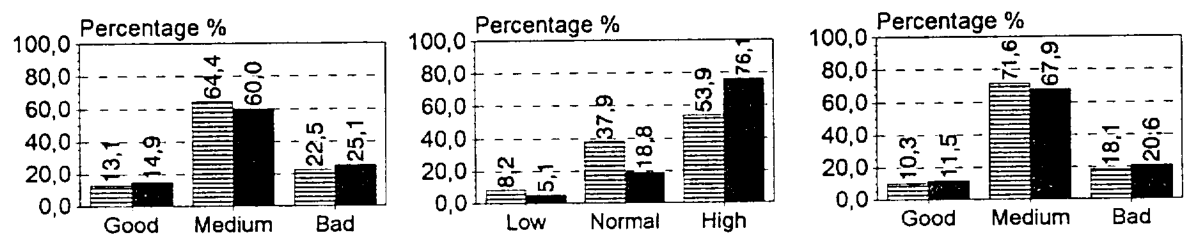


How do you evaluate the waiting area of the airport?



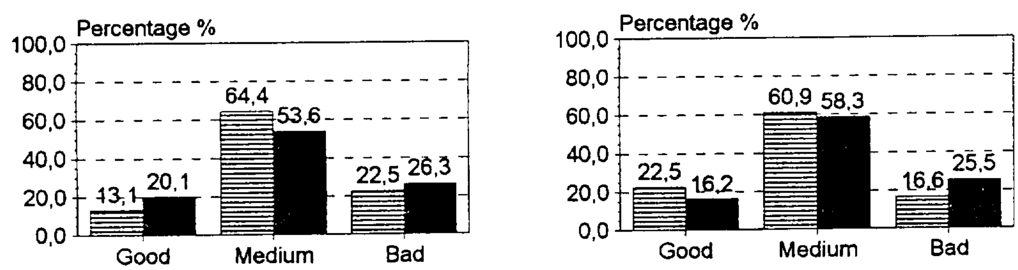
Area Seats Aesthetics

How do you evaluate the bar services of the airport?



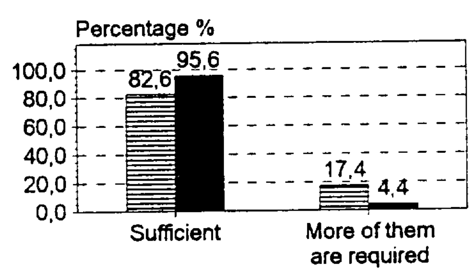
Quality Cost Service

How do you evaluate the cleanliness of the airport?



Waiting areas, Check in WC

How do you evaluate the shops of the airport?

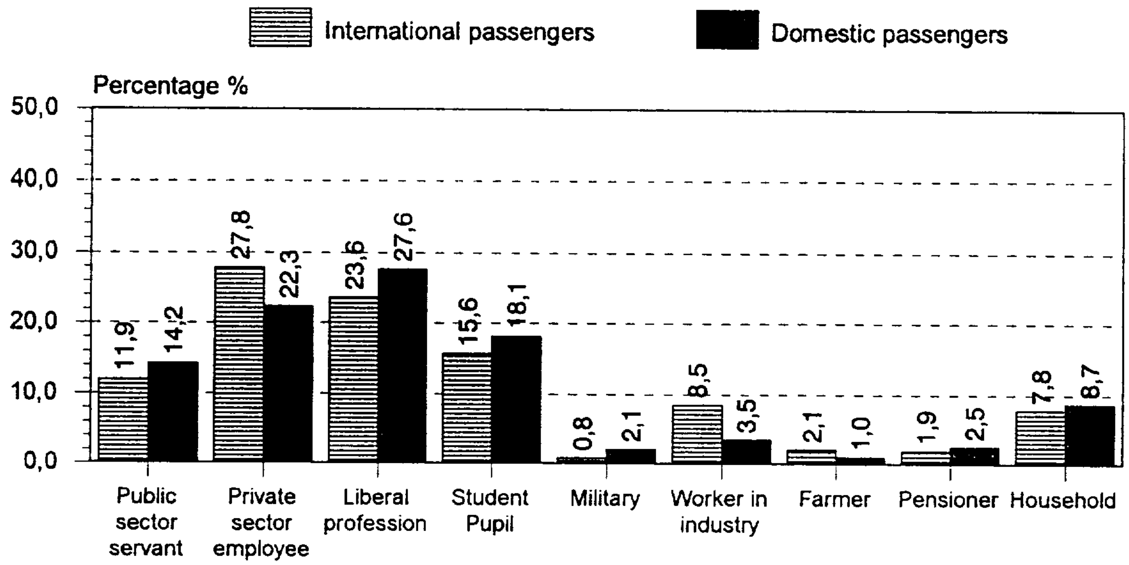


More shops required: Electrical and electronical microsets, Jewels, Pharmacy, Books, Newspapers, Cigarettes, Clothes

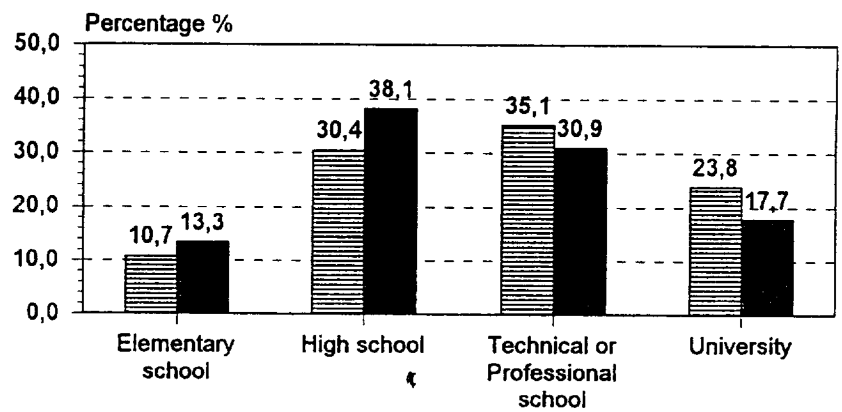
What additional services would you expect at the airport of Rhodes?

Information about flights on screens, Touristic Information about Rhodes, Post office, Non smoking waiting areas, Foreign exchanges services.

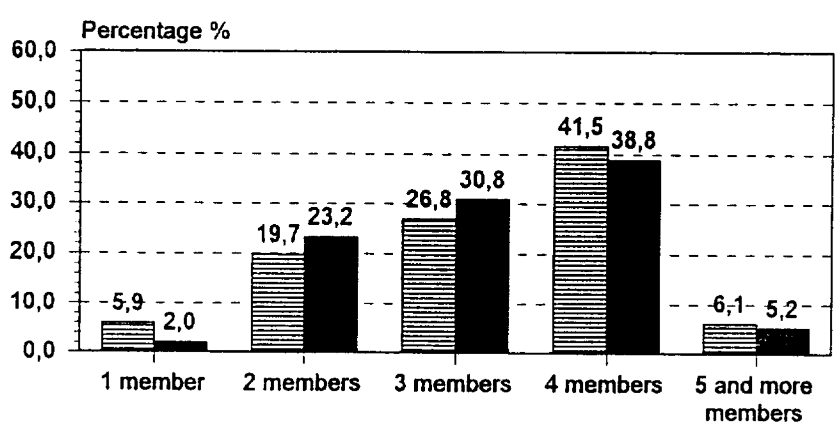
What is your profession?



Education level:



How many members has your family?



5. Forecasting the demand of the airport of Rhodes

5.1 Need and methods of forecast

A civil aviation authority requires demand forecasts at many levels of planing and for many purposes. At the strategic level, forecasts are required for long term planning over a time of 15 to 20 years. More detailed forecasts, but over a similar time span, are required for major investment projects such as the expansions of terminal and runway etc. By contrast, the medium range analysis, 5 to 10 years ahead, is the element for the annual planning of the aviation authority, [5].

There are three main methods of forecasting civil aviation traffic: market surveys, trend projections and econometric relationships (models), [1], [6]. During last years, a new methodology of forecasting has been developed; the fuzzy linear or non-linear regression models, [7].

5.2. Forecasting based on market studies

Traffic forecasting through market surveys aims at analyzing the characteristics of the air transport market in order to examine empirically how the use of an airport varies between different sectors of the population of different countries. The results of a survey must be combined with estimations about social-economic changes and may indicate the possible future development of demand of an airport, [5].

The questionnaire which has been presented in this paper, includes questions which aim to estimate the likely future development of demand of the airport (questions No 9, 10, 13 and 24), [4].

5.3. Forecasting by statistical methods

A first step for forecasting airport demand is to collect and study the historical data and determine the trend curve of demand. When deriving a forecast by projection from the demand trend, we assume that all the factors which determined the development of demand at the past, will continue to operate in the future in the same way as in the past. A trend may be stable in absolute terms (linear) or in percentage terms (exponential or polynomial). The type of trend curve which best fits the given historical data may be determined by using different types of curves. In any case, the period of forecast can not exceed half of the period where historical data are available. The coefficient which evaluates the degree of approach curve - phenomenon studied is the Coefficient of Correlation (R^2, $0 \leq R^2 \leq 1$). Best correlation succeed when R^2 is close to 1, [1].

Fig. 18 gives a medium-term forecasting for the total passenger demand of the airport of Rhodes, based on the data of Fig. 14. We used the polynomial trend and the Coefficient of Determination is very close to 1 (R^2 =0,92).

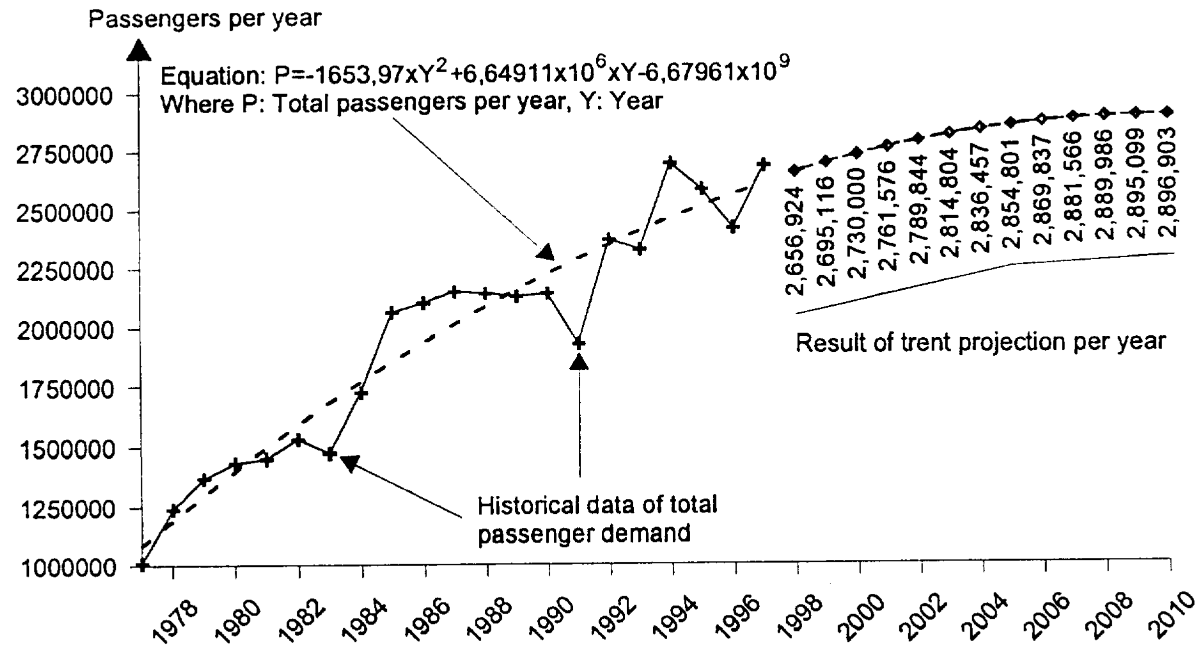


Fig. 18: Forecasting by trend projection for the total passenger demand of the airport of Rhodes.

5.4. Forecasting by econometric method

A future airport traffic demand deduced by projection of historical data does not take into account the way in which the various socio-economic and other external conditions affect the development of demand. Econometric forecasting takes into account a quantitative relationship between the airport demand and one or more variables which influence the development of demand. The most difficult part of an econometric forecasting is the selection of the relevant causal variables to be taken into account in forecasting and the specification of the type of functional relationship existing between the dependent (demand) and independent variables. Forecast of future development of the independent variables is crucial too.

In the case of the airport of Rhodes, aftcr many trials and error efforts, we concluded that the critical variable which influence the development of the international passenger demand is the rate of exchange equivalence of the Greek currency (drachma) to the currency of origin country of passengers. For calculating an Equivalence Indicator which represents this evolution of foreign exchange equivalence of drachma, we accept the index of 100 for the year 1986 (Table 6). All countries participate in the composition of this indicator at the percentages of Table 5.

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Rate of exchange of drachma to currencies of origin countries of demand at the airport of Rhodes	100,0	111,3	122,2	127,4	137,6	158,8	178,0	186,5	195,9	192,1	172,7	202,9

Fig. 18: Evolution of exchange rate of drachma to currencies of origin countries of international passengers at the airport of Rhodes.

The econometric model derived is an equation of the form:

$$P = 1/2 \times \left[e^{(0{,}00399537 \times D)} \times 925.332 + D \times \left(0{,}174746 \times D^2 - 43{,}2117 \times D + 7.548{,}47 \right) + 906.696 \right]$$

where: P: The annual number of international passenger of the airport of Rhodes

D: The exchange rate of drachma per year compared to the currencies of origin countries passengers of the airport

5.5. Forecasting fuzzy linear regression model

A fuzzy linear regression model has the following form:

$$Y = A_0 + A_1 \cdot x_1 + A_2 \cdot x_2 + \ldots + A_n \cdot x_n$$

where A_i, i=1,...,n, are symmetrical fuzzy numbers. Since fuzzy numbers are fuzzy sets, their membership functions can be seen as possibility functions (instead of probability functions of other methods), so the fuzzy linear regression model becomes a possibilistic one, that can be used in the context of possibility theory to provide a new methodology for capturing our vague and incomplete knowledge by means of possibility distributions. In fuzzy linear regression models, the difference between data and the estimated values is assumed to form an ambiguity which is due to the system's structure. Moreover, the proposed model seems to bring the ambiguity of relation back to the system coefficients or our inability to construct an accurate relationship which enters directly in the model through fuzzy coefficients, [7].

Fig. 19 gives the fuzzy linear regression of the international passenger for the airport of Rhodes. The fuzzy regression is based on the same variable as the econometric model. The range of limits of the fuzzy regression depends on the unpredictable events which affect the demand. In the case of the airport of Rhodes, such unpredictable event was the War in the Persian Gulf in 1991, which discontinued the upward development of the demand of the airport.

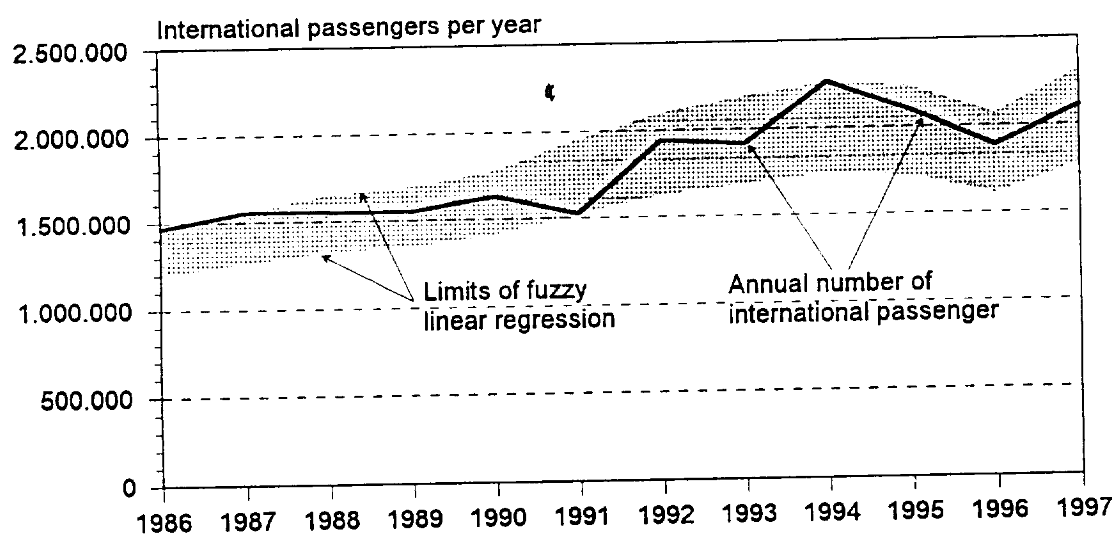


Fig. 19: Fuzzy linear regression of the international passenger demand of the airport of Rhodes.

The fuzzy regression analysis for the airport of Rhodes gives an equation of the form:

$$P = (r_0 + r_1 \cdot x_i) \pm (c_0 + c_1 \cdot D_i)$$

where: P: The annual number of international passenger of the airport of Rhodes

D: The exchange rate of drachma per year compared to the currencies of origin countries passengers of the airport

r_0=636.055,682 r_1=7.576.650 c_0=0 c_1=732,673

6. Concluding remarks

In the present paper, forecast models of demand of airports are suggested, with focus at the airport of Rhodes. Market surveys, statistical methods, econometric models and the fuzzy method has been used. The accuracy of prediction proves to be satisfactory. However, it is never possible to fully predict human behavior. For this reason, results must be carefully examined, analytical and in depth knowledge of social behavior is necessary and the forecaster must give precisions of the order of mistakes that can occur and of the assumptions on which forecasts have been developed.

References

1. Profillidis V. (1996), "Transportation Planning and Economics", Published by the University of Macedonia, pp. 233-255, Thessaloniki
2. Organization for Economic Co-operation and Development (OECD), (1996), Globalization of Economic Activities and its Implications for international Aviation, pp.6
3. Page St., Transport for Tourism, (1994), Routledge, pp. 76-78
4. Master Plan of The Airport of Rhodes, (1998), Research Project Responsible V. Profillidis, Civil Aviation Authority of Greece - Democritus University of Thrace
5. ICAO, (1985), Manual on Air Traffic Forecasting, Second Edition, pp. 3-16.
6. Ashford N, Wright P., (1979), Airport Engineering, pp. 29-38, John Wiley & Sons, New York
7. Papadopoulos B. and Sirpi M, (under publication), Similarities and Distances in Fuzzy Regression Models, Democritus University of Thrace

Bibliography

- Profillidis V. - Editor of Proceedings of International Conference (1994), Modernization of Railway and Airway Transport - The Impact of Liberalization, Democritus University of Thrace
- European Commission, (1993), Advanced Telecommunications and Information Technologies for the Future European Unified Communications - Navigation, Surveillance and Air Traffic Management System, Brussels
- European Commission, (1994), Expanding Horizons, Report by the Comité des Sages, Brussels
- Kosko B., (1993), Fuzzy Thinking: The New Science of Fuzzy Logic, Hyperion, New York