*THE UNO AVIATION MONOGRAPH SERIES*

UNOAI Report 99-8

# The Conference Proceedings of the 1999 Air Transport Research Group (ATRG) of the WCTR Society

Volume 4

Editors
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September 1999

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

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The UNO Aviation Institute Monograph Series is published at the University of Nebraska at Omaha, 6001 Dodge Street, Omaha, NE 68182.

Published as a not-for-profit service of the Aviation Institute. Funded in part by a grant from the NASA National Space Grant College and Fellowship Program.

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## About the Editors

DR. ANMING ZHANG, the Acting Head of the Department of Economics and Finance at City University of Hong Kong, joined the City as an associate professor in 1996 after teaching at University of Victoria, Canada, for six years. He received a BSc from Shanghai Jiao Tong University, MSc and PhD (1990, Economics and Business Admin.) from University of British Columbia. Dr. Zhang has published more than 20 research papers in the areas of industrial organization, international trade, and transportation. He received the Yokohama Special Prize for an Outstanding Young Researcher, awarded at the 7th World Conference on Transportation Research (WCTR), Sydney, Australia, July 1995. He won again the Overall Best Paper award (with Tae Oum and Yimin Zhang) at the 8th WCTR, Antwerp, Belgium, July 1998. Dr. Zhang has also done extensive consultancy work for government and industry.

DR. BRENT D. BOWEN is Director and Professor, Aviation Institute, University of Nebraska at Omaha. He has been appointed as a Graduate Faculty of the University of Nebraska System-wide Graduate College. Bowen attained his Doctorate in Higher Education and Aviation from Oklahoma State University and a Master of Business Administration degree from Oklahoma City University. His Federal Aviation Administration certifications include Airline Transport Pilot, Certified Flight Instructor, Advanced-Instrument Ground Instructor, Aviation Safety Counselor, and Aerospace Education Counselor. Dr. Bowen's research interests focus on aviation applications of public productivity enhancement and marketing in the areas of service quality evaluation, forecasting, and student recruitment in collegiate aviation programs. He is also well published in areas related to effective teaching. His professional affiliations include the University Aviation Association, Council on Aviation Accreditation, World Aerospace Education Organization, International Air Transportation Research Group, Aerospace Education Association, Alpha Eta Rho International Aviation Fraternity, and the Nebraska Academy of Sciences. He also serves as program director and principal investigator of the National Aeronautics and Space Administration funded Nebraska Space Grant and EPSCoR Programs.

## *ATRG President's Foreword*

The **Air Transport Research Group** of the WCTR Society was formally launched as a special interest group at the 7th Triennial WCTR in Sydney, Australia in 1995. Since then, our membership base has expanded rapidly, and includes nearly 600 active transportation researchers, policy-makers, industry executives, major corporations and research institutes from 28 countries. Our broad base of membership and their strong enthusiasm have pushed the group forward, to continuously initiate new events and projects which will benefit aviation industry and research communities worldwide.

It became a tradition that the ATRG holds an international conference at least once per year . As you know, the 1997 conference was held in Vancouver, Canada. Over 90 papers, panel discussions and invited speeches were presented. In 1998, the ATRG organized a consecutive stream of 14 aviation sessions at the 8th Triennial WCTR Conference (July 12-17: Antwerp). Again, on 19-21 July, 1998, the ATRG Symposium was organized and executed every successfully by Dr. Aisling Reynolds-Feighan of the University College of Dublin.

In 1999, the City University of Hong Kong has hosted the 3rd Annual ATRG Conference. Despite the delay in starting our conference sessions because of Typhoon Maggie, we were able to complete the two-day conference sessions and presentation of all of the papers. On behalf of the ATRG membership, I would like to thank Dr. Anming Zhang who organized the conference and his associates and assistants for their effort which were essential for the success of the conference. Our special thanks go to Professor Richard Ho, Dean of the School of Business and Economics of the University for the generous support for the conference. Many of us also enjoyed the technical visit to the new Hong Kong International Airport (Chep Lok Kok).

As you know, Professor Jaap de Wit and I look forward to welcoming you to University of Amsterdam on July 2-4, 2000 for the 4th Annual ATRG Conference.

As in the past, the Aviation Institute of the University of Nebraska at Omaha (Dr. Brent Bowen , Director of the Institute) has kindly agreed to publish the Proceedings of the 1999 ATRG Hong Kong Conference (being co-edited by Dr. Anming Zhang and Professor Brent Bowen). On behalf of the ATRG members, I would like to express my sincere appreciation to Professor Brent Bowen, Mary M. Schaffart and the staff of the Aviation Institute of University of Nebraska at Omaha for the effort to publish these ATRG proceedings. Also, I would like to thank and congratulate all authors of the papers for their fine contribution to the conferences and the Proceedings. Our special thanks are extended to Boeing Commercial Aviation – Marketing Group for the partial support for publication of this proceedings.

Finally, I would like to draw your attention to the ATRG newsletter and the ATRG website (www.commerce.ubc.ca/atrg/ ) which will keep you informed of the ATRG operations and forthcoming events. On behalf of the ATRG Networking Committee, I would appreciate it very much if you could suggest others to sign up the ATRG membership. Thank you for your attention.

**Tae H. Oum**
**President, ATRG**

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International Conference on Air Transportation Operations and Policy

June 6-8, 1999: City University of Hong Kong, Hong Kong

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# Air Transport Research Group (ATRG)
# International Conference on Air Transportation Operations and Policy
# City University of Hong Kong
# June 6-8, 1999

## The Conference

The ATRG held its 3rd Annual Conference at the City University of Hong Kong Campus in June 1999.

The 1999 Conference contained 13 aviation and airport sessions. Over 40 research presentations were featured on topics pertaining to airports and aviation: these titles are listed on the ATRG website (http://www.commerce.ubc.ca/atrg/).

## The Proceedings

Once again, on behalf of the Air Transport Research Group, the University of Nebraska at Omaha Aviation Institute has agreed to publish the Proceedings of the ATRG Conference in a four-volume monograph set.

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# Technology Intensive Employment and Hub Airports

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**Abstract**

High technology industry is a major user of air transport and many of the largest clusters of high technology firms are located near to major international airports. This study looks at the implications for the local economy of having good access to a particular form of airport, namely those that provide hub services. It takes as its empirical base the situation that has emerged in recent years in the US and explores at both the aggregate and case study levels the impact on high technology employment of a community having access to a major airport hub.

### Introduction

Stimulating and maintaining economic prosperity in a region is a major challenge. Our understanding of why some regions grow and prosper while others are less successful is far from complete. Increasingly industries are 'footloose' and relocate relatively rapidly and cheaply and this makes the challenge of defining appropriate regional policy strategies even more difficult.

There is evidence, however, that appropriate infrastructure is important in determining where and how firms locate and expand. Simply building more infrastructure, however, is seldom by itself sufficient. The infrastructure must be appropriate in its scale, form and design and its use must be effective and efficient. Airports are an important form of modern infrastructure and, when carefully and thoughtfully developed, can add to the economic potential of a region. As illustrated by a number of airports that have failed to achieve their economic development goals, however, it is clear that simply constructing a substantial airport is not of itself a guarantee that it will be used nor that it will stimulate the local economy[1].

This paper considers the role that airports can play in assisting in economic development and offers some quantification of the main effects.

### The Impacts of Airports

The deregulation of domestic US air transport in 1977 (cargo) and 1978 (passengers) together with the US's pursuit of Open Skies policies internationally from the 1980s have generated considerable benefits for the travelling public[2]. The market driven nature of air transport has enhanced its overall efficiency and added significantly to the overall contribution that it makes to the US economy. Equally, the growth in air transport has led to an inevitable expansion in airport facilities and in the ways in which airports are now used. In particular, there has been a growth in hub-and-spoke operations with a consequential increase in the number of indirect journeys being undertaken.

The growth in air transport through its add-on demands for air transport infrastructure, especially airports, has implications for the scale and spatial distribution of economic development. An airport essentially has four types of impact on the economy in its region.

*Primary Effects.*
These are the benefits to the region of the construction or expansion of the airport facility – the design of the facility, the building of the runways, the construction of the terminals and hangers, the installation of air traffic navigation systems and so on. The direct effects of this involve the local employment required in the construction process and the work done by local contractors. Indirect, multiplier effects include the benefits to the region of the wages and other incomes these workers and companies subsequent spend in the area and the tax revenues available to local governments.

These are clear gains to the local community and the local economy but they are essentially short term, being limited largely to the time period of the construction activity, and may be rather limited in their order of magnitude. It is a one-time effect. Also, airport construction involves a degree of specialist skill, manpower and equipment that may not be available locally but must be brought in from other regions. This leads to economic leakages away from the immediate area.

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1 The most dramatic examples of error in this context are found outside of the US in the case of Shannon Airport in Ireland and Mirabel in Canada.

2 The deregulations have generated a small industry in producing academic studies of variable quality but work at the Brooking Institution, for example, suggests a net annual benefit of $12.4 billion in 1992 prices from domestic passenger deregulation alone (S. A. Morrison and C. Winston, THE EVOLUTION OF THE AIRLINE INDUSTRY, The Brookings Institution, Washington, 1995).

In general, while airport development can have beneficial primary effects, save in cases where there is a policy imperative to create jobs in the very short term, these are not really the key concerns. Indeed, even if there is a desire for immediate job creation, as the English economist, John Maynard Keynes said, you may as well have one group of workers bury some money and have another dig it up again. This has the same short term benefits, indeed possibly even larger since leakages are likely to be smaller, than building or expanding an airport.

*Secondary Effects.*
Secondary effects are longer term effects that are associated with the local economic benefits of running and operating the airport – the employment involved in maintaining the facility, in handling the aircraft and passengers, in transporting people and cargo to and from the terminal and so on. Again there are direct effects stemming from the immediate jobs that are created at the airport and in the activities immediately associated with it. There are also indirect multiplier effects due to the on-going flow of income that the airport's operation injects into the local economy, which is subsequently spent locally.

These secondary effects can be extremely important in the long run to a local economy in terms of employment, income and, for local government, taxation revenue. The actual size of the secondary effect will vary among airports depending upon the nature of their operations and the extent to which the local economy is self-sufficient in meeting the needs of its residents; the indirect multiplier effects are larger if the economy meet the demands generated by the flow of additional income directly associated with the airport's activities.

To consider the potential scale of these effects, one can take Washington Dulles International Airport. Here an analysis of what the local employment effects would be of downsizing passenger throughput was conducted in the light of possible changes to the 'perimeter rule' at Ronald Reagan Washington National Airport[3]. This type of dynamic assessment is most relevant in assessing the economic impacts of air transport because generally airport policies involve changing the scale of an existing facility rather than building an entirely new one. The analysis initially assessed the direct airport employment effect of the anticipated reduced traffic at Dulles if the perimeter rule were modified[4]. The direct effect was then translated into an overall secondary impact using a regional input-output table.

On the assumption of an initial drop of 2.2 million passengers in the first year, the calculations imply 1,882 direct fewer jobs at Dulles with a further indirect job loss of 1,958 in immediate Northern Virginia region as the result of reduced local spending. An immediate reduction of 3.3 million passengers would result in losing over 5,400 jobs in the short term of which 2,758 would be directly related to the airport and the remainder the result of the reduced spending that this produces[5]. The implications are clearly that reducing the scale of airport activities does have adverse secondary consequences on the local economy because of reduced employment at the airport and because of the resultant lower spending levels in the region. Conversely airport expansions have positive secondary economic implications.

*Tertiary Effects.*
Tertiary effects stem from the stimulus enjoyed by a local economy as the result of firms and individuals having air transport services at their disposal. While most forms of business activity now involve

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[3] K.J. Button, P. Arena and R. Stough RELAXING THE PERIMETER AND HIGH DENSITY RULES: IMPLICATIONS FOR WASHINGTON DULLES INTERNATIONAL AIRPORT The Aviation Program, The Center for Regional Analysis, The Institute of Public Policy, George Mason University, 1998. The analysis was based on a local input-output analysis and also offers guidance to the types of jobs that would be most affected in the region of the airport. There may be additional economic activities in this case because air traffic would divert to National Airport but this is irrelevant in terms of gaining a handle on the scale of the secondary effects of having an airport in a particular region.

[4] The form of the estimating equation using time series data for 1977 to 1997 was:

$$LnTE_t = -4.317 + 0.723\, LnTP_t - 0.213 LnTP_{t-1} + 0.334 TP_{t-2} \quad R^2 = 0.99$$

where: $TE_t$ is employment in year t and $TP_t$, $TP_{t-1}$, $TP_{t-2}$ are passengers in years t, t-1, t-2 respectively.

[5] Although extrapolations far outside of the data base used to develop an input-output table is problematic, in this case doing so would suggest that the total secondary employment associated with Dulles is something over 21,000 jobs.

considerable use of transportation, high technology companies make particular use of air transportation. It has been estimated that those employed in the high-technology sector in the US fly over 1.6 times as much as those in traditional industries[6]. Companies in this general area conduct activities requiring considerable inter-personal contacts. These contacts are only possible with high quality transport. From a local development perspective it is often these types of firm that form the basis for economic growth because they are usually geographically mobile and represent a major growth sector.

One method of at least partly assessing the tertiary benefits of having a major airport is to directly contrast the economic performance of such cities with those that have smaller airports. One would expect, all other factors taken into consideration, that cities with large airports, and particularly those with hub airports, would attract more of this geographically mobile industry as a result of the superior aviation services enjoyed by their business travelers.

Additionally, some types of airport are likely to generate greater tertiary benefits than others of a similar size. Major hub airports[7] in particular offer a number of benefits to business travelers that extend beyond the simple size of a facility. These benefits include: more frequent flights; more direct flights (in 1996 hub airports offered non-stop flights to nearly twice the number of cities as non-hub cities with 25% more daily departures per city served[8]); more opportunities for same day return flights; greater likelihood of international flights; services geared to local market needs; and the ability in many cases to send packages on scheduled passenger services leaving after the major courier services have finished their daily pick-ups. At the same time, residents of hub cities have the same opportunities of linking to other major hubs as do those living in non-hubs.

To examine the benefits for any areas in terms of job creation in more dynamic sectors, the trends in high-technology employment in large U.S. cities can be assessed against the provision of scheduled air transport services. Defining high-technology industries is not simple. Here a fairly broad, but widely used, definition is adopted[9]. The index looks at clusterings of high-technology employment. As a result, it avoids the distorted picture that can be drawn when reference is made to the role of a single dominant high-technology company in a region. From a longer term planning perspective there are also advantages of not being a "company town."

An econometric model is employed that takes variations in high-technology employment across all 321 US Metropolitan Statistical Areas in 1994 as the phenomenon to be explained[10]. The calculations enable a rough estimation of the high-technology job stimulus that proximity to a hub airport provides. In doing this analysis, allowance was made for differences in the population sizes of the areas, number of Fortune 500 companies with headquarters, housing values, highway density, per capita defense expenditure and percentage of employment in business services. It is found that proximity to a hub airport (as defined by the Federal Aviation Administration, there are 56 hubs in the US[11]) has a positive impact on the amount of high-technology employment in an area[12]. Put into concrete, quantitative terms, the calculations indicate

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6 Simat, Helliesen and Eichner Inc. ECONOMICS IMPACT OF DULLES INTERNATIONAL AIRPORT: AN UP-DATE, Washington, 1986

7 For practical purposes, when looking at concentration of airline activities, hubs are normally treated as airports that have a large preponderance of flights operated as part of an essentially radial network by one carrier. In a few rare cases there is a general recognition that a hub has two main carriers but this only applies to a few major airports.

8 It was estimated that the disutility of having to make a transfer, irrespective of the additional overall duration of an indirect flight, was about $22.5 in 1987 (T.H. Oum and M.W. Tretheway, Airline hub-and- spoke system, TRANSPORTATION RESEARCH FORUM PROCEEDINGS Vol. 30, pp. 380-393, 1990).

9 The measure is known as the Armington Index.

10 K.J. Button and R Stough with the assistance of S. Lall and M. Trice, THE BENEFITS OF BEING A HUB AIRPORT CITY: CONVENIENT TRAVEL AND HIGH-TECH JOB GROWTH, The Aviation Program, The Center for Regional Analysis, The Institute of Public Policy, George Mason University, 1998

11 The FAA has classified communities into a four-class scheme depending on the total percentage of U.S. passenger enplanements in all services and operated by U.S. certified carriers within the 50 states and other designated areas (e.g. a large hub has 1.00% or more, a medium hub has 0.25% to 1.00%, and so on).

12 In detail the model was estimated using ordinary least-squares and the preferred specification was:

that the existence of a hub airport in a region increases that region's high-technology employment by over 12,000 jobs. This does not, of course, mean that all hub regions benefit by this amount but it is an average across hub cities.

More detailed case study analysis compares the situation at three non-hub airports (Nashville[13], Indianapolis and Milwaukee) with the major airline hubs of Cincinnati (which is a Delta Air Lines hub) and Pittsburgh (which is a US Airways hub). A simple visual inspection of trends in high-technology employment in the five locations (Figure 1) shows the more rapid and even growth in high-technology jobs in those areas with hub airports. While Milwaukee has seen some growth since the mid-1980s, this has been demonstrably slower than either Pittsburgh or Cincinnati. Indianapolis has also seen growth in its high-technology employment numbers but Pittsburgh has been steadily pulling away from it and Cincinnati has gradually, albeit slowly, been catching up. Nashville, which has fluctuated between being a hub and not being a hub, has seen a rather erratic growth path.

While the diagram is insightful, it cannot allow for variations in the nature of the different cities. The selection of the hub and non-hub cities was designed to allow comparisons with similar, medium sized cities but they are not identical. Further statistical analysis makes additional adjustments. The findings for the period to 1997 are that, allowing for factors such as differences in personal income, total air passenger traffic and a time path, the existence of a hub airport has exercised a positive and statistically significant effect on the industrial composition of Cincinnati and Pittsburgh[14]. In other words, the effect of a city being a hub, and irrespective of the total volume of airline traffic passing through it, still attracts more high-technology employment than a comparable non-hub.

Correlation between variables does not of itself imply causation in any meaningful sense. The economics and scientific literature is full of impressive correlations that are spurious or meaningless. In the case of airport hubs it could be argued that the economic growth that has been demonstrated at hub airport cities is not due to the services offered by the airlines but rather that airlines moved to these locations simply to exploit the areas' strong, natural economic performance.

The direction of causation can, however, be tested for.[15] Results for the Cincinnati area for data from 1979 through 1997 show that airline passenger traffic had a positive effect on high technology employment in the local Metropolitan Statistical Area. The causal effect of passenger traffic on employment is a reasonable proposition as it signifies increase in demand and earnings that have a multiplier effect in employment. While increases in passenger traffic may have a positive effect on per capita incomes, this is

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Ln high-technology employment = 5.407* + 0.503 hub airport* + 0.033 Fortune 500 companies* + 0.115 ln housing values + 1.354 ln highway density* + 0.141 ln defense expenditure* + 2.845 ln service employment* + 1.405 ln population size*

* denotes statistical significance at 99% confidence level; n = 303; $R^2 = 0.643$.

[13] For part of the period Nashville was a secondary American Airlines hub and this fact was allowed for in the subsequent statistical analysis.

[14] In detail the model was estimated using ordinary least squares and the preferred specification was:

Ln high-technology employment = -3.25 + 1.48 ln per capita income * - 0.07 time* + 0.12 hub dummy* - 0.75 Nashville dummy*

* denotes statistical significance at 99% confidence level; n = 40; $R^2 = 0.980$. Cincinnati and Milwaukee was taken as the base variable. The estimation adjusts for heteroscedastcity.

[15] The Granger (C. Granger, Investigating causal relations by econometric models and cross-spectral methods, ECONOMETRICA, Vol. 37, pp. 424-38, 1969) approach to the question of whether x causes y is to see how much of the current y can be explained by past values of y and then to see whether adding lagged values of x can improve the explanation. y is said to be Granger-caused by x if x helps in the prediction of y, or equivalently if the coefficients on the lagged xis are statistically significant. It is important to note that the statement x Granger causes y does not imply that y is the effect or the result of x. Granger causality measures precedence and information content but does not by itself indicate causality in the more common use of the term. The test is to see if air traffic does NOT Granger cause employment; the resultant F-statistic for Cincinnati of 6.328, at a probability level of 0.0148, implies that this can be rejected with 95% confidence. Indicating the causality is almost certainly the other way. Equally, the test is to see if air traffic does NOT Granger cause employment in Pittsburgh; the F-statistic of 6.419 and a probability of 0.07, implies one can be 90% confident the causality is the other way.

not so evident with the two-year time lags used to test for causality. In the short run, employment impacts are more evident than earnings or income effects. Similar results are found for Pittsburgh.

These findings that trace a link from the existence of a hub airport to high technology employment may initially seem counter intuitive in terms of traditional transport economics. The latter views transport provision as being derived from the final needs of consumers and producers and hence transport follows demand rather than *visa versa*. In the case of hub airports this traditional view can be misleading. Airlines offer networks of routes and select hubs in order to meet the overall demands for their services. Only a relatively small amount of traffic actually originates or is destined for a hub airport, the vast majority of traffic is transiting. A hub location is, therefore, chosen to meet this wider network criteria. The area around the hub, however, benefits from the extensive network of services that are provided at the airport; a network that is well in excess of that which would be offered if the airport were not a hub.

*Perpetuity Effects*

There is an increasingly widely accepted school of thought arguing that economic growth, once started in a region, becomes self-sustaining and may accelerate[16]. Linked to this, there is also empirical evidence that infrastructure investment can act as a catalyst for higher economic growth in an area; essentially it can act as a kick-start mechanism[17]. The construction of a new airport or the major enlargement of an existing facility may act, therefore, to set in progress a much larger and longer term development process in a region. This perpetuity effect is in addition to the tertiary effects that relate to the immediate migration of firms to an area with good air transport services. It is longer term and affects the dynamics of an area. By initially attracting undertakings to an area in sufficient numbers, airport development can lead to the crossing of important thresholds in terms of economies of scale, scope and density. In particular in the context of high-technology activities, an area can acquire a vital knowledge base that fosters local research and development and makes the region quasi-independent of others. The regional economy can feed on this to further its high-technology activities and hence to accelerate its growth.

This type of dynamic economic impact of an airport is the most abstract and the most difficult to quantify. It has been little researched. It is long term and involves the interaction of an airport with all other aspects of the local economy. It is, nevertheless, potentially a very real and important benefit that may be enjoyed by a region with high quality air services.

## Summary and Conclusions

Air transport is the fastest growing mode of transportation and by permitting the market to offer the services industry and users demand, and by allowing competitive forces to act as a stimulus for efficient supply, airline deregulation has served to assist national economic growth. At the more local level, the availability of air transport services can act as a stimulus to the economic growth of regions and cities. It achieves this through the employment and income generated in the construction and enlargement of facilities (primary effects), through the on-going activities of the airport (secondary effects); through the air services provided by the airport making the location attractive to mobile industry (tertiary effects); and through its own long term momentum (perpetuity effects). In particular, there is empirical evidence that the more mobile forms of modern industry, notably those associated with high-technology activities, are often attracted to areas offering high quality air transport services. There is also evidence that it is not simply the availability of an airport that acts as a catalyst for economic growth but rather it is generally the types of service offered at hub airports that are most important.

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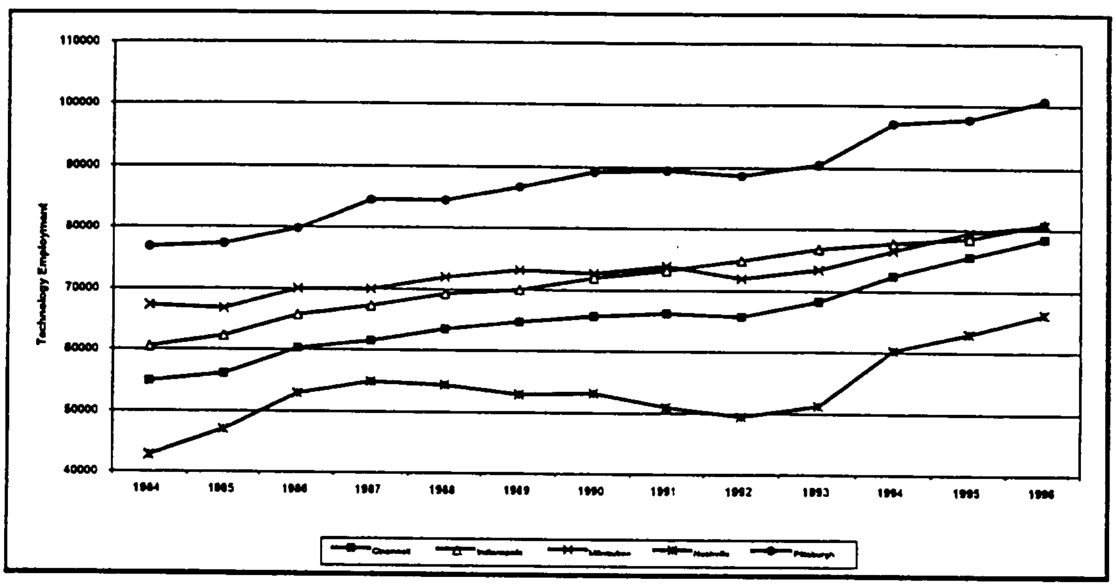
16 This is known as 'endogenous growth theory'.

17 D.A. Aschauer. Why is infrastructure important?. In Munnell, P (ed.) IS THERE A SHORTFALL IN PUBLIC CAPITAL INVESTMENT?, Conference Series. 34. Federal Reserve Bank of Boston. 1990.

**Figure 1**. Trends in High-Technology Employment at Case Study Locations



# Changes in Flight Frequency and Point-to-Point Service: Effects on Aviation Demand

**June 1999**

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Section 1

# Introduction

The air transportation system is moving towards satellite based communications, navigation, and surveillance/air traffic management (CNS/ATM). One purpose of the CNS/ATM initiative is to help airplanes fly more precisely as well as to fly more user-preferred or wind-optimal routings ("free flight"). CNS/ATM initiatives can reduce the inefficiencies of operating in the National Airspace System (NAS) by relieving airport and en route congestion. These infrastructure improvements should increase en route efficiency and allow for increased flight frequency and more direct service between city pairs.

An important question for civil aviation authorities is "what would be the effect of increased direct flight frequency and levels of direct point-to-point service on consumer demand?" Understanding these effects is important since they help determine the dynamic impact on demand of any NAS infrastructure improvements.

In this paper, The MITRE Corporation's Center for Advanced Aviation System Development (CAASD) studies the effect that changes in direct flight frequency and the average number of trip segments (average levels of point-to-point service) have on the demand for commercial passenger aviation in the United States. CAASD studied demand in a sample of 47 origin and destination (O&D) markets stratified by trip purpose, trip distance, market size, and passenger class. The results of the study found that both direct flight frequency and the average number of trip segments (a proxy for the average level of point-to-point service) are significant factors in explaining demand in many of the markets. Section 2 provides a brief discussion of how increased flight frequency and levels of direct service increase the demand for aviation. Section 3 provides a technical description of the method used to estimate the effect that changes in these variables have on demand. Section 4 provides the results and a discussion of those results. Section 5 provides extensions of the results and explains the implications of the results on the NAS.

Section 2

# Background

Airlines can influence the demand for aviation in several ways. Airlines can influence the quantity demanded by changing price and can change demand by altering the level of service. Service levels include factors such as direct flight frequency, load factors, and the number of flights it takes to get from trip origin to trip destination (trip segments).

Airlines influence the quantity demanded by changing price (fares). As price increases, consumers fly less. Figure 2-1 illustrated the process. In Figure 2-1, a price decrease from p1 to p2 results in a movement down the demand curve from p1q1 to p2q2. When consumer purchases are relatively more sensitive to changes in price, demand curves are relatively flatter (less steep).

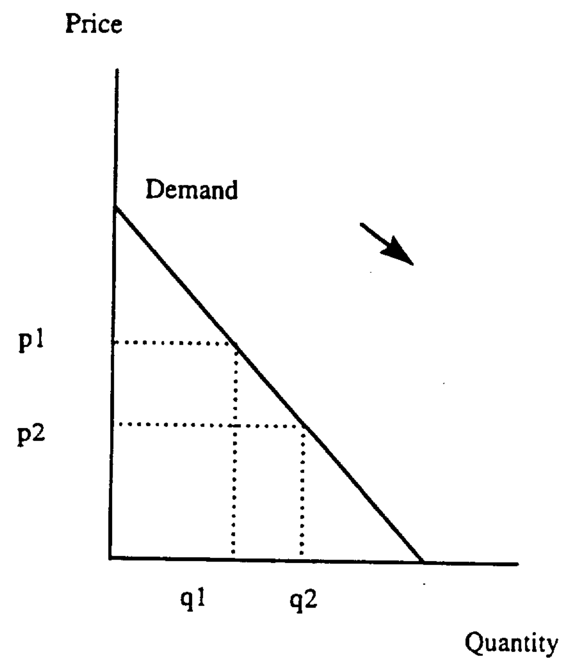


**Figure 2-1. Effect of Changes in Price on Demand**

Airlines can influence the quantity demanded by changing various aspects of the level of service provided, including the amount of traveling and waiting time. Morrison and Winston (1989) estimated that consumer willingness to pay for a one hour reduction in travel time was about $54 (in $1996). Their estimate reflected travelers' opportunity costs and the disutility of travel time (i.e., inconvenience of sitting in an airplane seat).

Consumer willingness to pay to reduce transfer time at airports is even greater. Transfer time at airports includes the time waiting for flights at an airport. For example, these waits can result from the time spent waiting between flights at a hub. Morrison and Winston (1989) estimated consumer willingness to pay for a one hour reduction in transfer time was about $116 (in $1996). Their estimate not only reflected the willingness to pay to reduce travel time, but also the additional disutility of walking through terminals and waiting at departure gates.[1]

This paper concentrates on two service factors that airlines can change to influence the amount of transfer and travel time. The two service factors are direct flight frequency and the number of flights it takes to get from trip origin to trip destination (trip segments).

Flight frequency (direct flights) is a major influence on waiting time. Consumers are more likely to find flights close to their desired departure times when there is a greater flight frequency between a particular city pair. Further, higher frequencies can reduce the average load factors between a city pair. Reduced average load factors between a city pair increase the probability of consumers obtaining a seat on their desired flight.

In many cases, increases in flight frequency reflect increased personal income in the markets involved. In these cases, it is changes in personal income that has an effect on demand. This paper concentrates on markets where changes in flight frequency independent of changes in personal income have a significant effect on demand. In these markets, increasing flight frequencies (independent of other factors) increases demand. Figure 2-2 shows the effect that these increases in flight frequency have on demand.

In Figure 2-2, the demand curves represent how much consumers are willing to buy at any given price. Willingness to pay reflects income and attributes of the product (e.g., flight time, schedule convenience, number of flights, etc.). For $Demand_1$, at a price of p1, consumers are willing to buy q1 units. As flight frequencies increase, the demand for aviation shifts to the right because consumers' willingness to pay has increased with the increased frequencies. The shift in the demand curve to $Demand_2$ illustrates the process.

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1 Morrison and Winston (1989) also found that consumer willingness to pay for reductions in scheduled delay was only about $5 per hour (in $1996). The low willingness to pay for reductions in scheduled delay is plausible since travelers generally plan ahead and make productive use of their time when there is a schedule delay.

After demand has shifted to $Demand_2$, consumers are willing to pay more for each unit. At q1, consumers are now willing to pay p2. Without an increase in price, the demand increases to q2 after the shift from $Demand_1$ to $Demand_2$.

Reducing the average number of trip segments between a city pair (increasing the level of direct point-to-point service) also increases demand. While increasing flight frequency is a way of adding direct service capacity, reducing the number of flights needed to get from origin to destination is a way of improving current service between a city pair market. Consumers prefer non-stop or direct service over connecting service since it involves less time and hassle. Consumer willingness to pay for more direct service (i.e., less transfer time) is high.[2] Consequently, reducing this waiting time by increasing the number of direct flights is very valuable to consumers.

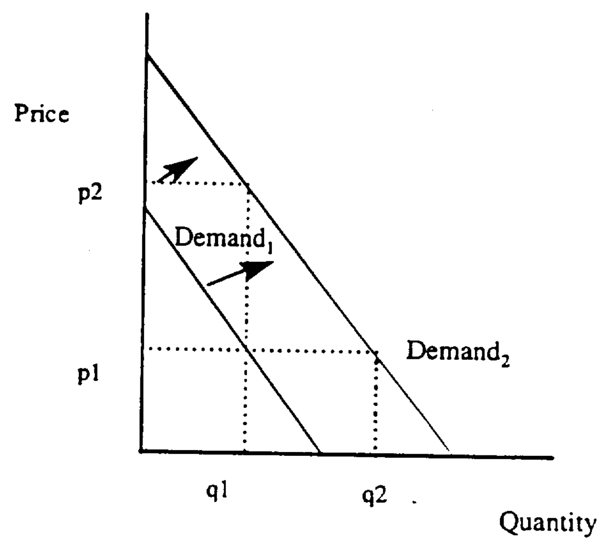


**Figure 2-2. Effects of Changes in Flight Frequency on Demand**

The influence of these two service factors is particularly important for certain routes. For example, demand is more sensitive to frequency and trip segments in markets with more business travelers since time is more valuable to them. As a general rule, whenever the value of time is a significant component of demand or maintaining a time advantage over competing modes of transportation (e.g., short haul markets) is important, demand is particularly sensitive to changes in frequency and levels of direct service.

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2 Morrison and Winston (1989) estimated consumer willingness to pay for a one hour reduction in transfer time was about $116 (in $1996).

Knowledge of how sensitive demand is to changes in price, flight frequency, and the average number of trip segments would allow for a better understanding of the tradeoff airlines face in setting fares and in deciding the number of flights and the level of direct service between city pairs. Understanding these effects is also important since they help determine the dynamic impact on demand of any NAS infrastructure improvements. Conversely, understanding these effects help determine the impact of changes in airline operations on air traffic control (ATC) infrastructure requirements.

The previous discussion and figures helps explain the relationship between improved service levels (frequency and direct service) and increased demand. However, they do not provide the precise causal relationship needed to quantify, estimate and forecast changes in demand due to changes in those service levels. The next section will.

**Section 3**

# Methodology

Traditional methods of estimating demand between city pairs use econometric analysis. Econometric analysis of aviation demand involves determining, based on historical data, a quantitative relationship between traffic (by passengers) and explanatory variables that influence the level of traffic (e.g., personal income and average fares). For domestic commercial passenger aviation between city pairs, demand is a positive function of personal income and a negative function of average fares.

Most econometric studies, however, have not considered the effect of service variables on demand. With frequency, part of the problem is identifying the extent to which frequency determines traffic levels instead of changes in traffic levels (e.g., from changes in personal income) determining changes in frequency. For example, in most markets increases in flight frequency reflect increased personal income or other factors. Some studies, however, have estimated the effect that changes in service variables have had on demand. These studies concentrated on markets where changes in flight frequency independent of changes in other factors have a significant effect on demand. The two seminal pieces on the subject are Ippolito (1981), and Eriksen and Lin (1979).

Ippolito (1981) estimated the impact that changes in flight frequency had on demand in a sample of monopoly flight segments. Ippolito found that for each one percent increase in flight frequencies, demand increased by .76 percent. The increased demand is the same effect shown in Figure 2-2. Eriksen and Lin (1979) studied the impact that changes in the level of service had on demand. They defined "service" as the ratio of non-stop jet flight time to the sum of average passenger travel time and time between desired and actual departure. This measure reflects flight frequency, stops-and-connections, and aircraft speed.

Based on a sample of 15 long-haul markets over a six-year period, they found that for each one percent change in their service variable, demand increased by .43 percent.

This study uses more recent, precise, and broad based data to more accurately estimate and forecast changes in demand due to changes in direct flight frequency and the average number of trip segments. The sample for the study consists of 47 city pairs using quarterly data from 1984 to 1996. The study estimates the effect that changes in direct flight frequencies and average number of trip segments have on demand. The study estimates these effects both together and independent of each other.

The influence of service factors is more important on certain routes. Demand is more sensitive to frequency in markets with many business travelers and in markets where competition with other modes of transportation is greater. For these reasons, it is important to have a broad-based sample that includes short- and long-haul markets, as well as business and leisure origins and destinations. The effect of frequencies and point-to-point service on demand also varies by type of traveler. Business travelers may be more sensitive to changes in these variables than leisure travelers. For these reasons, it is important to study all passenger traffic, and to study the breakdown of the total into business and leisure traffic.

To estimate demand, the study uses an ordinary least squares (OLS) regression technique. The study estimated the following three regression models for each city pair. [3]

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3 For a few of the city pairs that had direct service started or discontinued during the period studied, the study used another model instead of the model with FRQ.

$$\ln Pax = constant + b1 \ln PI + b2 \ln fare + b3 \ln TS + b4 \ln DUM$$

where DUM = dummy variable set equal to one when direct service was available.

$$\ln Pax = constant + b_1 \ln PI + b_2 \ln fare + b_3 \ln TS \quad [1]$$

$$\ln Pax = constant + b_1 \ln PI + b_2 \ln fare + b_3 \ln FRQ \quad [2]$$

$$\ln Pax = constant + b_1 \ln PI + b_2 \ln fare + b_3 \ln FRQ + b_4 \ln TS \quad [3]$$

where:

ln = natural logarithm

Pax = the number of origin and destination (O&D) passengers enplaned

PI = the combined personal income of the two cities in the city pair (in constant $1996)

fare = average fare (in constant $1996)

TS = average number of trip segments per passenger (proxy for the level of direct, point-to-point service)

FRQ = number of non-stop flights (in some cases non-stop and one-stop direct)[4]

The United States (U.S.) Bureau of Economic Analysis is the source of the data for personal income. BACK Information Services is the source of the data for passengers, fares, trip segments, and flight frequency. BACK's "OD1A" database provides the data for passengers, average fares, and average number of trip segments. OD1A represents true origin-destination data gathered from ticket stubs. OD1A data covers 10 percent of all passengers of U.S. certified carriers. It provides a unique information package, combining passenger statistics by route with data on fares and trip segments. BACK's OAG Passenger and Cargo Flight Statistics provides the data for flight frequency. These data are a modified version of data found in the Official Airlines Guide®.

The study uses each regression model for three different passenger categories. The categories are: all fare paying passengers (excludes frequent flyers);[5] leisure travelers only (defined as passengers paying discounted coach fares purchased at least two weeks prior to traveling); and business type travelers only (defined as passengers paying fares for business,

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4 The frequency variable does not include all available flights between a city pair. Non-direct flight itineraries that use more than one ticket are not included. Consequently, the variable does not capture the effects of increasing indirect flight frequency.

5 The all passenger category includes "mixed fare class" data not picked up in either the leisure or business type categories. Consequently, the results for all passengers may be inconsistent with the sum of the other categories.

first class, discounted business or first class, or full fare coach purchased within two weeks of traveling).[6]

Each equation measures the effect that changes in personal income and fares have on the demand for aviation in that market. The expected effect of increases in personal income and decreases in fares is to increase demand. Equations [1] and [3] measure the effect that changes in the average number of trip segments have on demand. Trip segments are the actual number of flights per passenger needed to travel between the city pair.[7] A reduction in the average number of trip segments increases the average level of point-to-point service. The expected effect of decreases in the average number of trip segments is to increase demand.

The quality of service offered by an airline is a vital competitive factor, especially in short-haul markets where there is also competition from surface travel. The trip segment variable used in this study captures the effect of an increase in the quality of current capacity. It does so by measuring changes in the average number of flights needed to travel between an O&D city pair market. A reduction in the average number of trip segments between an O&D city pair implies an increase in the average level of point-to-point service.

Equations [2] and [3] measure the effect that changes in flight frequency have on demand. The flight frequency variable measures the number of non-stop direct (or non-stop and one-stop direct in some markets) flights between the city pair.[8] The expected effect of an increase in direct flight frequency is to increase demand. The frequency variable used in this study captures the effect of an increase in direct point-to-point capacity.

The regression coefficients provide a framework for estimating how changes in these explanatory variables affect the dependent variable. The regression coefficients capture these effects as constant elasticities. Elasticities provide a framework for isolating the change in the dependent variable due to changes in the explanatory variable. The concept of elasticity describes the effect on demand of a one percent change in the respective

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6 The categories oversimplify actual purchase patterns. Business travelers often purchase tickets prior to two weeks of traveling, and leisure travelers can purchase tickets at the last moment.

7 Number of flights with separate ticket coupons (actual change of planes). A direct flight with stops counts as only one trip segment.

8 When a city has multiple airports, we include flights to all pertinent airports (e.g., Washington includes both National and Dulles).

explanatory variable.[9] For example, if the coefficient for the fare variable is equal to -.7, then a one percent decrease in fares results in nearly a .7 percent increase in demand.[10]

The study uses a sample of 47 city pairs using quarterly data from 1984 to 1996. The criterion used to select the sample is trip generation purposes (general business, leisure, etc.), trip length, and the population of the Metropolitan Statistical Area (MSA). Additionally, the city pairs in the sample are geographically distributed throughout the continental United States.

Trip purposes included flights between general business, manufacturing business, and leisure locations. General business locations are those whose employment in the combination of "Service, Finance, and Public Sectors" (SFP) is greater than 110 percent of the national average. Manufacturing business locations are those where manufacturing employment is greater than 108 percent of the national average. Leisure locations are those with the following characteristics: employment in SFP is greater than 110 percent of the national average; employment in manufacturing is less than 10 percent of the total employed; and the percentage of SFP employed in finance is less than 90 percent of the national average of finance employment in SFP.[11] Additionally, the sample includes locations that did not fit into any of the above categories. These locations are Atlanta, Cincinnati, Houston, Pittsburgh, and Sacramento. These are economically important locations or ones with important hubs. Nine of the city pairs in the sample included one of these Metropolitan Statistical Areas (MSAs).

MSAs are large or small depending on population. MSAs with a 1996 population of less than one million are small. Nine of the city pairs in the sample included small MSAs. There are three categories for trip length. The categories included less than 750 miles, 750-1499 miles, and greater than 1500 miles. The sample includes 24, 13, and 10 city pair markets in the sample that fell into these categories.

There are five general categories for city pair markets in this study. These categories include: from general business to general business; from general business to leisure; from leisure to leisure; from general business to manufacturing business; and from manufacturing

9 Elasticity = $[(1.01)^{\text{value of coefficient}} - 1] * 100$

10 Elasticity = $[(1.01)^{-.7} - 1] * 100 = -.694$

11 The source for employment data is the U.S. Bureau of Labor Statistics (BLS). BLS aggregates data according to Standard Industrial Classification (SIC) categories. All population and employment data refer to 1996.

business to manufacturing business.[12] The numbers of city pairs in each category are 31, 6, 1, 5, and 4, respectively.[13] Within each category, there are categories for city pairs by distance and by size. Table A-1 in the appendix shows the city pairs in their respective categories.

Section 4

# Results and Discussions

## 4.1 Results

Table 4-1 shows the summary results for the coefficients for the price and trip segment variables for the models ran with the trip segment variable (TS) only.[14] Table A-2 in the appendix presents the complete results for the models ran with the trip segments variable (TS).

12 These categories represent trip purpose as a function of relative employment patterns. Obviously, travel within a category is for all the aforementioned reasons. Trade, industry, and academic sources often use trip generation purposes like these to analyze markets. While the percentages used here to define each category are somewhat arbitrary, they adequately differentiate between trip purpose.

13 City pairs with "other cities" are included in one of the five categories.

14 Summary results are only for the price and trip segment coefficients that are significant at a 90 percent level of confidence or higher. The 90 percent confidence is used instead of the 95 or 99 percent confidence to capture more markets where the underlying variables may be significant. The impact of the TS and fare variables in some of these markets, while not as strong as in those significant at a 95 percent confidence or higher, may still strongly influence demand.

**Table 4-1. Summary Regression Results with TS (Equation 1)**

| Passenger Category and Variable | Number of Significant TS Coefficients | Mean | Median | Maximum | Minimum | Standard Deviation |
|---|---|---|---|---|---|---|
| All – fare | 46 | -.76 | -.75 | -.26 | -1.47 | .26 |
| All – TS | 21 | -1.68 | -1.29 | -.35 | -5.11 | 1.25 |
| Leisure – fare | 35 | -.88 | -.81 | -.39 | -2.14 | .39 |
| Leisure –TS | 27 | -4.34 | -2.66 | -.82 | -29.09 | 5.91 |
| Business – fare[15] | 26 | -.98 | -1.02 | -.40 | -1.64 | .35 |
| Business – TS | 29 | -4.17 | -2.69 | -.87 | -26.99 | 5.07 |

The estimated regression coefficients provide a framework for estimating how changes in the explanatory variables affect the dependent variable.[16] The regression coefficients capture these effects as a constant elasticity. As noted in Section 3, these elasticities provide a framework for isolating the change the dependent variable due to changes in the explanatory variable.

The second column in Table 4-1 shows the number of markets where TS is a significant factor in explaining demand in each of the respective categories. The results show that TS is a significant factor in about 60 percent of the markets in the leisure and business passenger categories (27 and 29 markets for leisure and business, respectively, out of a total of 47 markets in the sample), and about 45 percent in the all passenger category. The third and

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15 The business fare elasticity is significant in fewer markets than the leisure fare elasticity. If aggregated across all the 35 markets where the leisure fare is significant, the business elasticity would be considerably lower.

16 Most of the models have adjustments for serial correlation. A common finding in time series regression is the presence of serial correlation (residuals are correlated with their own lagged values). Serial correlation is inconsistent with the assumption in ordinary least squares (OLS) regression theory that the disturbances are not correlated with each other in any fashion. The presence of serial correlation results in inefficient and unreliable coefficients. Econometricians have developed extensions of regression analysis to deal with serial correlation. Correcting for serial correlation provides for statistically more reliable coefficients and estimated standard errors. The adjusted coefficients provide more reliable estimates of the independent variable's impact on the dependent variable and on its significance level.

fourth columns in Table 4-1 show the mean and median regression coefficient values for TS in the markets where it is significant. In markets, where it is a significant factor, a one percent increase in the average number of trip segments reduces demand by about 2.70 percent in both the leisure and business categories (based on the median values).[17] In some cases, the coefficient for TS is very negative (e.g., Pittsburgh-Philadelphia at -14.96 for leisure). In the sample, the markets with the most negative coefficients for the TS variable are short-haul markets where a move away from point-to-point service would result in most consumers driving instead.

Table 4-2 shows the summary results for the coefficients for the price and frequency variables for the models run with the frequency variable (FRQ) only.[18] Table A-3 in the appendix presents the complete results for the models ran with the flight frequency variable (FRQ).

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17 We use median values to reduce the impact of outliers.

18 Summary results are only for the price and frequency coefficients that are significant at a 90 percent level of confidence or higher.

**Table 4-2. Summary Regression Results for Models with FRQ (Equation 2)[19]**

| Passenger Category and Variable | Number of Significant FRQ Coefficients | Mean | Median | Maximum | Minimum | Standard Deviation |
|---|---|---|---|---|---|---|
| All – fare | 46 | -.80 | -.79 | -.20 | -1.52 | .28 |
| All – FRQ | 18 | .39 | .35 | .83 | .06 | .24 |
| All – DUM | 4 | .30 | .19 | .11 | .72 | .29 |
| Leisure – fare | 34 | -.84 | -.78 | -.33 | -1.83 | .33 |
| Leisure – FRQ | 19 | .53 | .50 | 1.38 | .13 | .36 |
| Leisure – DUM | 1 | .42 | ---- | ---- | ---- | ---- |
| Business – fare[20] | 26 | -1.33 | -1.34 | -.53 | -2.70 | .51 |
| Business – FRQ | 7 | .85 | .80 | 1.18 | .51 | .21 |
| Business – DUM | 1 | 2.33 | ---- | ---- | ---- | ---- |

The second column in Table 4-2 shows the number of markets where FRQ is a significant factor in explaining demand in each of the respective categories. The results of the models show that direct flight frequency is a significant factor in explaining demand in some markets. It is a significant factor in about 40 percent of the markets in the leisure and

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19 The sample has five city pair markets where direct air service either started or was discontinued during the period studied. The impact of this effect is a significant factor in explaining demand in four of those markets in the all-passenger category. In these markets, the effect of having direct air service increased demand by between 11 and 72 percent.

20 The coefficient for business fares is higher than in the model with the TS variable. The difference is due to the absence of the TS variable. Some of the change in demand attributed to fares in this model are probably the result of changes in the average number of trip segments.

all passenger categories, but only about 15 percent in the business passenger category.[21] The third and fourth columns in Table 4-2 show the mean and median regression coefficient values for FRQ in the markets where it is significant. In markets, where it is a significant factor, a one percent increase in the number of direct flights increases demand by about .5 and .8 percent in the leisure and business passenger categories, respectively (based on the median values). In four cases, the coefficient for FRQ is very high (greater than one). In two of those markets, the average capacity per plane increased substantially. However, the two other markets do not have any characteristics that would explain why the coefficients are so high.

## 4.2 Discussion

While the markets with the most elastic trip segment elasticity are short-haul markets, the TS variable is significant in markets of all distances. The proportion of long-haul markets (more than 1,500 miles) where TS is significant is not significantly different from short-haul markets (less than 750 miles).[22] The study also compared the summary results to the results from each general category. For example, the summary coefficient of price for leisure passengers is compared to the average coefficient of price for leisure passengers in the general business to leisure category. There are not any statistically significant differences between the categories.[23]

The FRQ variable is significant in markets of all distances. However, the proportion of long-haul markets (more than 1,500 miles) where FRQ is significant is significantly higher than in short-haul markets (less than 750 miles).[24] As before, the study compared the

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21 In many of the markets, increases in direct flight frequency were probably due to increases in personal income. Changes in demand in these markets were probably the result of changes in personal income or other factors. Consequently, the frequency variable is not significant in the majority of the markets.

22 The differences are not significantly different at a 95 percent level of confidence using a two-tailed test for difference between proportions.

23 The differences are not significantly different at a 95 percent level of confidence in all but two of the 30 tests. In those two tests, the differences are not significantly different at a 99 percent level of confidence.

24 The differences are significantly different at a 95 percent level of confidence using a two-tailed test for difference between proportions.

summary results to the results from each general category. As before, there are not any statistically significant differences between the categories.[25]

Table 4-3 shows which of the two variables are significant when running the regressions with both the TS and FRQ variables together (equation [3]). The results show the total number of markets where the variables are significant.

**Table 4-3. Comparison of Results (by Number of Markets)**

| Passenger Class | Trip Distance (miles) | TS | FRQ (or DUM) | Both | None |
|---|---|---|---|---|---|
| All | <750 | 8 | 5 | 1 | 10 |
| All | 750-1500 | 5 | 4 | 2 | 2 |
| All | >1500 | 2 | 3 | 3 | 2 |
| Leisure | <750 | 15 | 2 | 2 | 5 |
| Leisure | 750-1500 | 3 | 1 | 3 | 6 |
| Leisure | >1500 | 4 | 5 | 0 | 1 |
| Business | <750 | 15 | 0 | 1 | 5 |
| Business | 750-1500 | 7 | 1 | 2 | 3 |
| Business | >1500 | 4 | 3 | 1 | 2 |

The third column in Table 4-3 shows the number of markets where only TS is a significant factor in explaining demand in each of the respective categories. The fourth column shows the number of markets where only FRQ is a significant factor, and the fifth column shows the number of markets where both are significant factors. While the TS variable is significant across all passenger categories and trip distances, the variable for frequency is not. For short-haul markets (less than 750 miles), TS is likelier than FRQ to have an impact on demand. This is especially true in the leisure and business passenger categories. For long-haul markets (greater than 1500 miles), FRQ is likelier to have an impact than in short haul markets. When running the regressions with both TS and FRQ, the

25 The differences are not significantly different at a 95 percent level of confidence using a two-tailed test for difference between proportions.

proportion of long-haul markets where FRQ is significant is significantly higher than in short-haul markets in all of the passenger categories.[26]

Section 5

# Extensions and Implications

## 5.1 Extensions

The results of the study show that the average number of trip segments (the average level of point-to-point service) has a significant effect on demand in about 60 percent of the markets in the leisure and business passenger categories.[27] In both of these markets, a one percent decrease in the average number of trip segments increases demand by about 2.7 percent (based on median values). If the median results of the sample are applied to the whole country, then these elasticity measures may be useful in estimating NAS-wide impacts.[28]

A reduction in the average number of trip segments (an increase in the average level of point-to-point to service) will have dynamic effects on demand. If changes in the average number of trip segments also have a significant impact on 60 percent of all domestic passenger traffic, then a one percent reduction in the average number of trip segments increases demand by about 1.62 percent system wide (.6 multiplied by an elasticity of 2.7). Consequently, a one percent reduction in the system wide average number of trip segments will increase demand by about 6.9 billion revenue passenger miles (RPMs) (based on 1996 passenger traffic).[29]

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26 The differences are significantly different at a 95 percent level of confidence using a two-tailed test for difference between proportions.

27 The all passenger category includes "mixed fare class" data not picked up in either the leisure or business type categories. Consequently, the results for all-passengers may appear inconsistent with the sum of the other categories. For consistency, we do not use the results from the all-passenger category in this section.

28 This section uses the median value of elasticities in markets where the trip segment variable is significant in a broad-based sample of 47 city pairs that is reasonably representative of the NAS. Trip segments are more significant in some markets than in others, while in other markets they are not significant at all. The results of this study also provide information on analyzing these specific markets.

29 Airlines are likelier to reduce the average number of trip segments in markets where it matters most (often short-haul markets). Airlines are likely to reduce trip segments only in markets where changes in trip segments have a significant impact on demand. Improvements in the NAS implemented system wide should result in airlines trying to exploit potential gains to trade in all these markets. However, airlines

The results of the study show that changes in direct flight frequency (point-to-point capacity) have a significant effect on demand in about 40 percent and 15 percent of the markets in the leisure and business passenger categories, respectively. In these markets, a one percent increase in direct point-to-point flight frequency increases demand by about .5 and .8 percent, respectively. If the median results of the sample are applied to the whole country, then these elasticity measures may also be useful in estimating NAS-wide impacts.[30]

If changes in direct point-to-point flight frequency also have a significant impact on 40 percent and 15 percent of all leisure and business passenger traffic, then a one percent increase in direct flight frequency increases leisure demand by about .20 percent (an elasticity of .5 multiplied by .4) and business demand by about .12 percent (an elasticity of .8 multiplied by .15). Based on estimates of leisure and business's share of total traffic, the system wide elasticity is about .18 percent.[31] Consequently, a one percent increase in system wide direct flight frequency increases demand by about 750 million RPMs (based on 1996 passenger traffic).[32]

Increased consumer surplus is probably the main benefit to society of improved aviation service factors. The increased RPMs from the increase in flight frequency and the reduction in average trip segments increase consumer surplus since they increase consumer willingness to pay. Consumer surplus is the difference between what consumers pay and what they would have been willing to pay for the product. Federal guidelines on "best practices" for regulatory actions call for the use of consumer surplus in any decision-making process. These guidelines also stipulate that consumer surplus be given a monetary value wherever possible. Based on rough estimates of the consumer surplus for domestic passenger aviation (Homan 1998) and constant prices, the consumer surplus increases annually by about

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may put more emphasis in higher elasticity markets. Consequently, the system wide increase in demand of 1.62 percent is probably understated.

30 This section uses the median value of elasticities in markets where the flight frequency variable is significant in a broad-based sample of 47 city pairs that is reasonably representative of the NAS. Flight frequencies are more significant in some markets than in others, while in other markets they are not significant at all. The results of this study also provide information on analyzing these specific markets.

31 The December 7, 1997 *Washington Post* reported that about 70 percent of all passengers are leisure passengers and that about 30 percent are business related passengers.

32 Airlines are likelier to increase flight frequencies in markets where it matters most. Airlines are likely to increase flight frequencies only in markets where changes in frequency have a significant impact on demand. Improvements in the NAS implemented system wide should result in airlines trying to exploit potential gains to trade in all these markets. However, airlines may put more emphasis in higher elasticity markets. Consequently, the system wide elasticity of .18 percent is probably understated.

$390 million following a one percent increase in flight frequency and about $3.3 billion following a one percent reduction in average trip segments.

## 5.2 Implications

This study is part of a project in support of the Federal Aviation Administration's (FAA's) Office of System Capacity to better understand the implications of FAA decisions on the NAS and its users. One of these decisions is the extent that the air transportation system moves towards satellite-based communications, navigation, and surveillance/air traffic management (CNS/ATM). A purpose of the CNS/ATM initiative is to help airplanes fly more precisely as well as to fly more user-preferred or wind-optimal routings ("free flight"). CNS/ATM initiatives can reduce the inefficiencies of operating in the NAS by relieving airport and en route congestion. These infrastructure improvements should increase en route efficiency and allow for increased flight frequency and more direct service between city pairs. Future increases in the number of direct flights and reductions in the average number of trip segments will also occur due to changes in airline operations and airport improvements. In all these cases, the results of the study show that the dynamic impact on demand will put an increased burden on NAS capacity.

History has shown that airlines have usually chosen to accommodate growth by adding frequencies and inaugurating new city pair services. Over the last 20 years factors such as deregulation and improvements in airplane performance have influenced airline market development to an even greater extent. Consequently, airlines have been able to employ frequency and new city pair growth even more fully. For example, the availability of intermediate size, long range airplanes favors new services and greater frequencies. The North Atlantic market demonstrates this effect. Here, the advent of fuel efficient twin jet aircraft performing extended range twin engine operations (ETOPS) has encouraged new services. The smaller capacities of many of these planes also promotes nonstop services between new city pairs.

As noted in this report, increased frequencies and fewer trips between trip origin and destination provide greater value for consumers. The more valuable air service has stimulated demand beyond what has occurred due to just increased incomes and lower fares. As airlines continue to increase flight frequency and add point-to-point service, this dynamic effect on demand will continue. The results of this study show that continued increases can have a significant impact on demand. This impact on demand can result in additional infrastructure requirements for the NAS. For example, if long term improvements in services result in a 10 percent increase in flight frequency and a 10 percent reduction in the average number of trip segments, then demand would increase by nearly 20 percent (based on 1996 passenger traffic).

The results of the study also have implications for studying airline decision-making and the effect of hubs. The extensive use of hubs in the deregulatory era has allowed for an increase in the potential number of connections offered by airlines. These increased connections allowed for increased frequencies, the introduction of point-to-point service between new city pairs, and a reduction in the average number of trip segments between many O&D city pairs. These factors have resulted in significant dynamic effects on demand.[33]

Currently, airlines face tradeoffs between improving service and cutting costs. Airlines face tradeoffs between price sensitive leisure travelers and more time sensitive business travelers. Airlines also face tradeoffs between offering service from hubs or bypassing hubs. Knowledge of the underlying price and service elasticities can help in understanding these tradeoffs. Future work being done in fiscal year 1999 that integrates these relationships into a study of hubs and airline decision-making processes will provide a better understanding of those tradeoffs.

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33 The hub system gives passengers from spokes and passengers from hubs more frequent service than would be possible with single plane service (as often was the case before deregulation). Hubs also resulted in fewer passengers changing airlines (interlining) when they changed planes. For more information, see Morrison and Winston (1995), pp. 19-28.

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Appendix

# Sample and Regression Results

### Table A-1. City Pairs in the Sample

| City Pair | Size | Distance |
|---|---|---|
| **Manufacturing to Manufacturing** | | |
| Charlotte - Milwaukee | large to large | <750 miles |
| Cincinnati - Charlotte | large to large | <750 miles |
| Cincinnati - Detroit | large to large | <750 miles |
| San Jose - Detroit | large to large | >1500 miles |
| **General Business to Manufacturing** | | |
| Chicago - Chattanooga | large to small | <750 miles |
| Denver - Dayton | large to small | 750-1499 miles |
| Boston - Cleveland | large to large | <750 miles |
| San Diego - Detroit | large to large | >1500 miles |
| Wichita - Birmingham | small to small | <750 miles |
| **General Business to Leisure** | | |
| Seattle - Reno | large to small | <750 miles |
| Tampa - New Orleans | large to large | <750 miles |
| Las Vegas - Kansas City | large to large | 750-1499 miles |
| Cincinnati - Orlando | large to large | 750-1499 miles |
| El Paso - Tucson | small to small | <750 miles |
| Omaha - Orlando | small to large | 750-1499 miles |
| **Leisure to Leisure** | | |
| Orlando - New Orleans | large to large | <750 miles |

## Table A-1. City Pairs in the Sample (Continued)

| City Pair | Size | Distance |
|---|---|---|
| **General Business to General Business** | | |
| Washington - Raleigh | large to small | <750 miles |
| Nashville - Raleigh | large to small | <750 miles |
| St. Louis - Albuquerque | large to small | 750-1499 miles |
| Phoenix - Salt Lake City | large to large | <750 miles |
| Cincinnati - Omaha | large to small | <750 miles |
| Washington - Nashville | large to large | <750 miles |
| Phoenix - San Diego | large to large | <750 miles |
| San Antonio - Dallas | large to large | <750 miles |
| Sacramento - Salt Lake City | large to large | <750 miles |
| Tampa - Atlanta | large to large | <750 miles |
| Washington - Jacksonville | large to large | <750 miles |
| Chicago - Buffalo | large to large | <750 miles |
| Denver - Kansas City | large to large | <750 miles |
| Pittsburgh - Philadelphia | large to large | <750 miles |
| Boston - Washington | large to large | <750 miles |
| Seattle - Los Angeles | large to large | 750-1499 miles |
| San Diego - Dallas | large to large | 750-1499 miles |
| Houston - Miami | large to large | 750-1499 miles |
| Austin - Chicago | large to large | 750-1499 miles |
| New York - Miami | large to large | 750-1499 miles |
| Denver - Atlanta | large to large | 750-1499 miles |

## Table A-1. City Pairs in the Sample (Concluded)

| City Pair | Size | Distance |
|---|---|---|
| **General Business to General Business** | | |
| Philadelphia - St. Louis | large to large | 750-1499 miles |
| Los Angeles - Denver | large to large | 750-1499 miles |
| Washington - San Francisco | large to large | >1500 miles |
| Boston - Houston | large to large | >1500 miles |
| New York - Phoenix | large to large | >1500 miles |
| Seattle - St. Louis | large to large | >1500 miles |
| Miami - San Francisco | large to large | >1500 miles |
| Seattle - Chicago | large to large | >1500 miles |
| San Francisco - Boston | large to large | >1500 miles |
| Washington - Los Angeles | large to large | >1500 miles |

## Table A-2. Regression Results with TS Only

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **Manufacturing to Manufacturing** | | | | | |
| Charlotte Milwaukee | all | 3.15 (6.75)[1] | -.58 (-3.28)[1] | -.922 (-4.31)[1] | .92 51 |
| "* | leisure | 4.16 (5.24)[1] | -1.04 (-3.86)[1] | -.87 (-2.48)[2] | .91 43 |
| "* | business | .68 (.36) | .81 (1.00) | -1.95 (-3.35)[1] | .65 35 |
| Cincinnati Charlotte* | all | NA | -.75 (-3.60)[1] | -.29 (-.89) | .90 51 |
| " | leisure | 1.80 (2.54)[2] | .34 (1.17) | -4.38 (-6.29)[1] | .49 49 |
| "* | business | NA | -.97 (-1.42) | -3.90 (-6.27)[1] | .85 44 |
| Cincinnati Detroit* | all | 2.3E-5 (3.12)[1] | -.50 (-2.27)[2] | -1.03 (-.60) | .83 51 |
| "* | leisure | -2.26E-5 (1.57) | .38 (.81) | -5.02 (-1.22) | .49 45 |
| "* | business | .0002 (4.11)[1] | NA | -9.97 (-2.62)[1] | .81 51 |
| San Jose-Detroit | all | 1.06 (3.51)[1] | -.89 (-6.39)[1] | -1.16 (-3.35)[1] | .65 52 |
| "* | leisure | 2.91 (2.79)[1] | -1.44 (-6.91)[1] | -1.75 (-3.34)[1] | .67 45 |
| "* | business | 1.66 (1.18) | .32 (1.01) | -.06 (-.09) | .37 44 |
| **General Business to Manufacturing** | | | | | |
| Chicago Chattanooga | all | NA | -.85 (-3.26)[1] | .56 (.38) | .49 51 |
| "* | leisure | 3.13 (3.18)[1] | -.55 (-2.25)[2] | -5.73 (-2.53)[2] | .64 45 |
| "* | business | NA | .35 (.63) | 1.81(1.13) | .76 51 |
| Denver-Dayton | all | -.02 (-.15) | -1.16 (-6.85)[1] | -.65 (-3.08)[1] | .70 51 |
| "* | leisure | .08 (.39) | -1.36 (-4.96)[1] | -.20 (-.63) | .72 45 |
| "* | business | NA | .13 (.71) | -1.18 (-2.15)[2] | .74 51 |

## Table A-2. Regression Results with TS Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to Manufacturing** | | | | | |
| Boston Cleveland* | all | .16 (.40) | -.79 (-7.17)[1] | NA | .56 51 |
| "* | leisure | -.77 (-1.18) | -.89 (-4.79)[1] | -.54 (-.46) | .41 45 |
| "* | business | 1.25 (.37) | -.38 (-1.01) | -2.74 (-2.95)[1] | .56 45 |
| San Diego Detroit | all | .30 (1.14) | -1.23 (-10.09)[1] | .20 (.83) | .69 52 |
| " | leisure | .82 (2.92)[1] | -1.35 (-11.78)[1] | -.02 (-.09) | .77 49 |
| " | business | .57 (.78) | -.72 (-3.34)[1] | -.15 (-.35) | .34 51 |
| Wichita Birmingham* | all | .79 (1.33) | -.51 (-2.21)[2] | -1.80 (-1.67)[3] | .39 50 |
| "* | leisure | 4.03 (4.45)[1] | -.38 (-1.19) | -.29 (-.30) | .58 43 |
| " | business | NA | NA | NA | NA |
| **General Business to Leisure** | | | | | |
| Seattle-Reno* | all | 1.72 (3.33)[1] | -.43 (-2.13)[2] | -3.23 (-5.86)[1] | .91 51 |
| "* | leisure | 1.96 (3.86)[1] | -.22 (-1.01) | -3.21 (-5.88)[1] | .90 45 |
| "* | business | 1.85 (1.14) | -1.31 (-4.02)[1] | -2.68 (-1.67)[3] | .74 51 |
| Tampa New Orleans* | all | .26 (.43) | -1.02 (-8.01)[1] | -.54 (-2.08)[2] | .87 51 |
| "* | leisure | 1.10 (.32) | -.57 (-2.43)[2] | -.82 (-1.65)[3] | .76 45 |
| "* | business | 12.27 (.99) | -1.14 (-4.28)[1] | -.87 (-1.94)[3] | .85 51 |
| Kansas City Las Vegas* | all | .74 (1.97)[2] | -.48 (-2.75)[1] | .22 (.50) | .78 51 |
| "* | leisure | -1.04 (-.80) | -1.21 (-3.13)[1] | .25 (.35) | .71 45 |
| "* | business | .69 (.66) | -1.34 (-2.96)[1] | -2.97 (-6.03)[1] | .89 51 |

## Table A-2. Regression Results with TS Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to Leisure** | | | | | |
| Cincinnati Orlando* | all | 1.50 (4.89)[1] | -.61 (-3.30)[1] | -1.77 (-4.53)[1] | .86 51 |
| "* | leisure | 3.86 (5.32)[1] | -.22 (-.64) | -3.31 (-5.89)[1] | .90 45 |
| "* | business | -.48 (-.22) | -.40 (-1.91)[3] | -2.19 (-2.96)[1] | .81 51 |
| El Paso-Tucson* | all | NA | -.82 (-3.56)[1] | -.17 (-.55) | .84 51 |
| "* | leisure | -.75 (-.86) | -1.07 (-3.67)[1] | -.21 (-.52) | .76 45 |
| " | business | NA | NA | NA | NA |
| Omaha-Orlando* | all | 2.60 (6.10)[1] | -.54 (-1.89)[3] | -1.29 (-4.27)[1] | .85 47 |
| " | leisure | 2.86 (14.80)[1] | -.77 (-6.14)[1] | .02 (.03) | .87 49 |
| "* | business | 4.16 (2.05)[2] | -1.27 (-5.27)[1] | -2.23 (-4.12)[1] | .93 40 |
| **Leisure to Leisure** | | | | | |
| Orlando New Orleans* | all | .42 (1.28) | -.75 (-8.48)[1] | -1.99 (-10.06)[1] | .93 51 |
| "* | leisure | 2.89 (4.12)[1] | -.13 (-.66) | -2.26 (-7.22)[1] | .75 45 |
| "* | business | 13.63 (1.33) | -.59 (-2.04)[2] | -3.24 (-6.03)[1] | .91 51 |
| **General Business to General Business** | | | | | |
| Washington Raleigh* | all | .38 (1.42) | -.45 (-4.19)[1] | -.4 (-.14) | .52 46 |
| "* | leisure | .07 (.03) | -.44 (-1.69)[3] | -3.07 (-1.07) | .78 40 |
| "* | business | NA | NA | NA | NA |

## Table A-2. Regression Results with TS Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| Nashville Raleigh* | all | .81 (7.24)[1] | -.59 (-3.95)[1] | -.35 (-2.04)[2] | .92 51 |
| "* | leisure | 1.58 (9.50)[1] | -.73 (-2.82)[1] | -1.93 (-5.92)[1] | .91 45 |
| "* | business | -.77 (-.81) | .52 (.85) | -1.39 (-2.43)[2] | .71 51 |
| St. Louis Albuquerque | all | 2.10 (3.11)[1] | -.78 (-4.88)[1] | -.37 (-1.09) | .89 52 |
| " | leisure | 5.59 (10.49)[1] | NA | -.04 (-.08) | .78 49 |
| "* | business | 10.94 (2.75)[1] | -.56 (-1.77)[3] | -.14 (-.30) | .87 49 |
| Salt Lake City Phoenix* | all | .80 (1.55) | -.91 (-4.97)[1] | -.44 (-.56) | .92 51 |
| "* | leisure | 1.51 (2.20)[2] | -.16 (-.52) | -2.80 (-2.37)[2] | .74 45 |
| "* | business | -1.25 (-.62) | -1.64 (-5.48)[1] | -2.77 (-2.26)[2] | .88 51 |
| Cincinnati Omaha* | all | NA | -1.08 (-4.07)[1] | .55(.70) | .55 51 |
| "* | leisure | -.78 (-.74) | -.73 (-2.11)[2] | .91 (.94) | .39 45 |
| "* | business | -5.11 (-1.44) | .26 (.58) | .43 (.53) | .59 49 |
| Washington Nashville* | all | .77 (3.63)[1] | -.26 (-1.72)[3] | -.38 (-.89) | .42 51 |
| "* | leisure | 1.12 (3.73)[1] | -.05 (-.29) | -.80 (-1.39) | .51 45 |
| "* | business | .85 (1.53) | .06 (.21) | -2.58 (-8.48)[1] | .77 51 |
| Phoenix San Diego | all | .91 (3.65)[1] | -1.14 (-4.34)[1] | -14.04 (-1.13) | .65 52 |
| "* | leisure | NA | .30 (.67) | -12.67 (-2.64)[2] | .74 45 |
| "* | business | 3.79 (3.26)[1] | -1.41 (-3.15)[1] | 30.54 (.84) | .90 45 |

## Table A-2. Regression Results with TS Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| San Antonio Dallas | all | .20 (2.96)[1] | -.54 (-4.08)[1] | -4.55 (-.82) | .44 52 |
| "* | leisure | NA | -.96 (-4.68)[1] | -29.09 (-5.42)[1] | .81 45 |
| " | business | .94 (7.94)[1] | -1.18 (-8.54)[1] | -26.99 (-1.90)[3] | .93 49 |
| Salt Lake City Sacramento* | all | .87 (1.68)[3] | -.98 (-7.35)[1] | .53 (.83) | .92 51 |
| "* | leisure | 1.50 (1.67)[3] | -.65 (-2.31)[2] | -3.05 (-2.48)[2] | .84 45 |
| "* | business | -1.80 (-1.44) | -1.03 (-5.31)[1] | 1.18 (1.52) | .91 32 |
| Tampa-Atlanta* | all | .29 (1.43) | -.76 (-8.70)[1] | -1.31 (-.82) | .94 51 |
| "* | leisure | 3.46 (5.51)[1] | -.46 (-2.12)[2] | -2.91 (-1.68)[3] | .94 45 |
| "* | business | NA | -.48 (-2.17)[2] | -10.07 (-3.12)[1] | .81 51 |
| Washington Jacksonville | all | .95 (6.61)[1] | -.90 (-7.29)[1] | -.59 (-2.90)[1] | .69 52 |
| "* | leisure | 1.66 (3.11)[1] | -.02 (-.11) | -1.22 (-2.87)[1] | .65 45 |
| "* | business | .50 (.72) | -.93 (-2.84)[1] | -1.57 (-2.44)[2] | .40 51 |
| Chicago Buffalo** | all | -.30 (-.53) | -.69 (-11.74)[1] | -.02 (-.08) | .80 48 |
| "* | leisure | .65 (.66) | -.63 (-2.48)[2] | -1.83 (-2.11)[2] | .52 45 |
| "* | business | -2.46 (-1.38) | .58 (.98) | -3.33 (-5.59)[1] | .82 47 |
| Denver Kansas City | all | .84 (5.14)[1] | -.64 (-10.29)[1] | -5.11 (-3.52)[1] | .90 52 |
| " | leisure | 2.15 (9.11)[1] | -.54 (-5.95)[1] | -4.77 (-2.58)[2] | .84 49 |
| "* | business | -2.26 (-1.15) | -.95 (-3.23)[1] | -7.58 (-3.19)[1] | .73 51 |

## Table A-2. Regression Results with TS Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| Pittsburgh Philadelphia | all | 1.00 (6.74)[1] | -.70 (-12.00)[1] | -2.27 (-1.24) | .89 52 |
| "* | leisure | 2.28 (.87) | -.93 (-1.97)[2] | -14.96 (-3.52)[1] | .76 45 |
| "* | business | -1.47 (.54) | .60 (1.34) | -8.44 (-10.89)[1] | .91 51 |
| Boston Washington* | all | 1.07 (8.07)[1] | -.74 (-11.20)[1] | .28 (.53) | .66 51 |
| "* | leisure | 2.84 (8.37)[1] | -.84 (-4.52)[1] | -1.81 (-1.73)[3] | .71 45 |
| "* | business | NA | .08 (.17) | -3.15 (-1.22) | .58 51 |
| Seattle Los Angeles* | all | 3.27 (4.43)[1] | -.02 (-.19) | -4.61 (-3.00)[1] | .63 51 |
| "* | leisure | 3.62 (3.78)[1] | -.04 (-.36) | -3.18 (-2.01)[2] | .64 45 |
| "* | business | 12.66 (1.69)[3] | -.25 (-1.20) | -.84 (-.51) | .81 51 |
| | | | | | |
| San Diego Dallas* | all | .83 (4.00)[1] | -.83 (-6.48)[1] | -.34 (-1.51) | .80 51 |
| "* | leisure | 2.24 (3.62)[1] | -.64 (-2.44)[2] | -.34 (-.80) | .80 45 |
| " | business | NA | NA | NA | NA |
| Houston-Miami* | all | NA | -.76 (-6.42)[1] | -1.47 (-1.85)[3] | .83 51 |
| "* | leisure | .22 (.18) | -.39 (-1.70)[3] | -2.66 (-2.25)[2] | .77 45 |
| "* | all | -2.91 (-1.09) | -.69 (-2.90)[1] | -2.23 (-3.47)[1] | .91 51 |
| Austin-Chicago | all | 2.32 (9.70)[1] | -.56 (-5.39)[1] | -.60 (-1.44) | .90 52 |
| " | leisure | 2.64 (10.12)[1] | -.52 (-4.08)[1] | -1.36 (-4.10)[1] | .91 49 |
| " | business | 1.65 (2.82)[1] | -.41 (-1.90)[3] | -1.31 (-3.45)[1] | .33 52 |

## Table A-2. Regression Results with TS Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| New York Miami | all | .15 (.60) | -.46 (-3.44)[1] | -2.32 (-2.72)[1] | .49 52 |
| " | leisure | 1.78 (3.30)[1] | -.46 (-2.27)[2] | -2.36 (-1.68)[3] | .79 45 |
| " | business | NA | -.85 (-3.34)[1] | -5.60 (-7.31)[1] | .92 51 |
| Denver-Atlanta | all | 1.02 (7.52)[1] | -1.12 (-6.07)[1] | -.29 (-.56) | .81 52 |
| " | leisure | 2.40 (6.68)[1] | -1.09 (-3.42)[1] | -.31 (-.46) | .88 45 |
| " | business | NA | -.60 (-1.88)[3] | -1.47 (-1.52) | .83 48 |
| Philadelphia St. Louis* | all | 1.36 (1.69)[3] | -1.10 (-5.19)[1] | -1.55 (-2.51)[2] | .52 51 |
| " | leisure | 3.48 (5.07)[1] | -.98 (-3.76)[1] | -2.39 (-3.39)[1] | .73 45 |
| " | business | -1.57 (-.13) | -1.37 (-2.94)[1] | -1.57 (-2.65)[1] | .83 51 |
| Los Angeles Denver | all | 1.13 (4.95)[1] | -.71 (-13.37)[1] | -.48 (-.93) | .85 52 |
| " | discount | 3.09 (3.47)[1] | -.81 (-4.95)[1] | -.26 (-.24) | .82 45 |
| " | business | -7.29 (-.81) | -.06 (-.13) | .20 (.24) | .91 51 |
| Washington San Francisco** | all | -.42 (-.50) | -.34 (-2.34)[2] | -1.29 (-4.10)[1] | .67 47 |
| " | leisure | 1.95 (4.08)[1] | -1.08 (-4.90)[1] | NA | .87 44 |
| " | business | 1.09 (6.53)[1] | -1.02 (-3.38)[1] | -1.25 (-2.16)[2] | .77 50 |
| Boston-Houston | all | 1.18 (4.25)[1] | -.73 (-7.01)[1] | -.73 (-1.91)[3] | .62 52 |
| " | leisure | 1.28 (1.57) | -.69 (-3.50)[1] | -1.58 (-3.02)[1] | .61 45 |
| " | business | -.05 (-.04) | -1.08 (-4.44)[1] | -3.35 (-7.20)[1] | .87 51 |

## Table A-2. Regression Results with TS Only (Concluded)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | TS (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| New York Phoenix | all | .83 (4.42)[1] | -.57 (-5.21)[1] | -1.15 (-3.45)[1] | .76 52 |
| "* | discount | 1.65 (5.64)[1] | -.60 (-3.50)[1] | -1.60 (-4.07)[1] | .86 45 |
| "* | business | NA | -.66 (-3.33)[1] | -2.83 (-6.36)[1] | .73 51 |
| | | | | | |
| Seattle-St. Louis | all | .51 (.97) | -1.47 (-5.86)[1] | -1.08 (-1.66)[3] | .68 52 |
| " | leisure | 1.40 (2.75)[1] | -1.71 (-5.70)[1] | -.54 (-.84) | .73 49 |
| "* | business | -1.73 (-.52) | -1.05 (-3.30)[1] | .34 (.51) | .68 51 |
| Miami San Francisco* | all | NA | -1.07 (-5.93)[1] | -.14 (-.47) | .71 51 |
| "* | leisure | .85 (2.09)[2] | -.76 (-3.90)[1] | -.06 (-.15) | .67 45 |
| "* | business | NA | -.27 (-.92) | -.41 (-1.01) | .92 51 |
| Seattle-Chicago | all | 1.28 (3.18)[1] | -1.17 (-5.43)[1] | -.24 (-.42) | .61 52 |
| "* | leisure | 2.08 (2.18)[2] | -2.14 (-7.23)[1] | 1.15 (1.22) | .71 45 |
| "* | business | -2.74 (-1.26) | -1.23 (-3.05)[1] | -1.79 (-2.28)[2] | .70 51 |
| San Francisco Boston | all | .80 (2.73)[1] | -.77 (-5.45)[1] | -1.58 (-3.31)[1] | .58 52 |
| " | leisure | 2.21 (6.95)[1] | -.83 (-4.66)[1] | -2.74 (-3.99)[1] | .67 49 |
| "* | business | NA | NA | NA | NA |
| Washington Los Angeles** | all | 1.56 (2.41)[2] | -.44 (-4.34)[1] | -.44 (-1.44) | .73 48 |
| "* | leisure | .88 (.92) | -1.16 (-5.11)[1] | .73 (1.01) | .74 45 |
| "* | business | NA | -1.47 (-5.98)[1] | -2.30 (-5.93)[1] | .85 51 |

Legend:

1. Significant at a 99 percent level of conference

2. Significant at a 95 percent level of confidence

3. Significant at a 90 percent level of confidence

* Adjusted for first order serial correlation

** Adjusted for fourth order serial correlation

NA. Adequate data not available or spurious correlation results when variable included

## Table A-3. Regression Results with FRQ Only

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | FRQ (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **Manufacturing to Manufacturing** | | | | | |
| Charlotte Milwaukee* | all | 3.75 (4.02)[1] | -.82 (-4.09)[1] | .57 (1.79)[3] | .83 26 |
| "* | leisure | 6.60 (3.09)[1] | -.96 (-2.76)[1] | .56 (1.17) | .80 26 |
| "* | business | -3.47 (-1.42) | -1.51 (-1.46) | .20 (.23) | .31 26 |
| Cincinnati Charlotte* | all | -3.43 (-1.52) | -.79 (-3.81)[1] | -.35 (-1.36) | .90 51 |
| "* | leisure | 2.97 (.80) | -.36 (-.95) | -.84 (-1.31) | .55 45 |
| "* | business | NA | -2.70 (-3.07)[1] | -.04 (-.07) | .69 44 |
| Cincinnati Detroit* | all | 2.7E-5 (3.44)[1] | -.54 (-2.50)[2] | .16 (1.06) | .83 51 |
| "* | leisure | -1.69E-5 (-1.13) | .06 (.12) | 1.32 (2.34)[2] | .53 45 |
| "* | business | .0001 (3.41)[1] | NA | -.76 (-.69) | .78 51 |
| San Jose-Detroit | all | .97 (16.60)[1] | -.98 (-7.63)[1] | .24 (3.56)[1] (DUM) | .65 52 |
| " | leisure | 1.92 (4.75)[1] | -.75 (-4.40)[1] | .42 (4.74)[1] (DUM) | .57 49 |
| "* | business | 1.50 (1.33) | .36 (1.35) | NA | .53 44 |
| **General Business to Manufacturing** | | | | | |
| Chicago Chattanooga* | all | NA | -.81 (-3.40)[1] | .11 (1.93)[3] (DUM) | .52 51 |
| "* | leisure | 3.19 (3.37)[1] | -.69 (-1.53) | .13 (1.14) (DUM) | .59 45 |
| "* | business | NA | .48 (.87) | .14 (1.13) (DUM) | .76 51 |

## Table A-3. Regression Results with FRQ Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | FRQ (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to Manufacturing** | | | | | |
| Denver-Dayton* | all | -.13 (-.89) | -1.15 (-6.41)[1] | .13 (2.35)[2] (DUM) | .69 51 |
| "* | leisure | .07 (.35) | -1.38 (-5.20)[1] | .06 (.87) (DUM) | .72 45 |
| "* | business | -.86 (-1.52) | -.01 (-.05) | .01 (.06) (DUM) | .72 51 |
| Boston Cleveland* | all | .10 (.20) | -.80 (-6.37)[1] | -.13 (-1.01) | .55 51 |
| "* | leisure | -.83 (-1.22) | -.92 (-4.71)[1] | -.05 (-.32) | .40 45 |
| "* | business | 4.40 (1.54) | -.56 (-1.21) | -.51 (-.89) | .48 45 |
| San Diego Detroit* | all | .02 (.03) | -1.19 (-7.46)[1] | .17 (1.94)[3] | .68 51 |
| " | leisure | .53 (1.95)[3] | -1.30 (-10.24)[1] | .22 (3.11)[1] | .76 44 |
| " | business | .60 (.72) | -.88 (-3.78)[1] | -.02 (-.11) | .33 46 |
| Wichita Birmingham* | all | .75 (1.20) | -.52 (-2.19)[2] | .06 (.71) (DUM) | .35 50 |
| "* | leisure | 4.01 (4.48)[1] | -.35 (-1.16) | -.04 (-.25) (DUM) | .58 43 |
| " | business | NA | NA | NA | NA |
| **General Business to Leisure** | | | | | |
| Seattle-Reno* | all | .58 (1.82)[3] | -.36 (-2.23)[2] | .70 (9.61)[1] | .92 51 |
| "* | leisure | .96 (3.17)[1] | -.12 (-.77) | .72 (11.27)[1] | .92 45 |
| "* | business | 2.35 (1.70)[3] | -1.64 (-4.86)[1] | -.63 (-1.33) | .74 51 |

## Table A-3. Regression Results with FRQ Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | FRQ (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to Leisure** | | | | | |
| Tampa New Orleans* | all | .29 (.39) | -1.15 (-7.86)[1] | -.01 (-.15) | .86 51 |
| "* | leisure | 1.13 (.40) | -.45 (-1.81)[3] | .16 (1.13) | .75 45 |
| "* | business | .71 (.11) | -1.50 (-5.37)[1] | -.27 (-1.38) | .85 51 |
| Kansas City Las Vegas* | all | .65 (2.13)[2] | -.88 (-3.68)[1] | -.01 (-.09) | .80 51 |
| "* | leisure | -.47 (-.48) | -1.13 (-2.99)[1] | -.36 (-1.32) | .71 45 |
| "* | business | 3.17 (1.52) | -1.51 (-2.74)[1] | -.04 (-.07) | .82 51 |
| Cincinnati Orlando | all | 1.52 (7.22)[1] | -1.17 (-6.96)[1] | .09 (1.20) | .81 52 |
| "* | leisure | 4.41 (4.16)[1] | -.94 (-1.98)[2] | -.20 (-1.08) | .80 45 |
| "* | business | .84 (.30) | -.53 (-2.44)[2] | .12 (.68) | .77 51 |
| El Paso-Tucson* | all | NA | -.94 (-4.35)[1] | .20 (3.47)[1] | .86 46 |
| "* | leisure | -.73 (-.78) | -1.11 (-4.29)[1] | .27 (3.58)[1] | .82 40 |
| " | business | NA | NA | NA | NA |
| Omaha Orlando* | all | 1.37 (3.53)[1] | -.58 (-2.10)[2] | .72 (5.64)[1] (DUM) | .84 51 |
| " | leisure | 2.88 (12.13)[1] | -.78 (-6.05)[1] | -.01 (-16) (DUM) | .87 49 |
| "* | business | 1.80 (1.09) | -1.05 (-4.08)[1] | 2.33 (5.30)[1] (DUM) | .94 40 |
| **Leisure to Leisure** | | | | | |
| Orlando New Orleans* | all | -.48 (-.93) | -.90 (-5.02)[1] | .33 (2.51)[2] | .80 51 |
| "* | leisure | -2.47 (-.64) | -.20 (-.42) | .50 (2.01)[2] | .56 45 |
| "* | business | -3.16 (-1.48) | -1.87 (-5.82)[1] | -.22 (-.63) | .84 51 |
| **General Business to General Business** | | | | | |
| Washington Raleigh* | all | .47 (.94) | -.46 (-4.51)[1] | -.03 (-.22) | .52 46 |
| "* | leisure | -.78 (-.23) | -.45 (-1.68)[3] | .17 (.53) | .77 40 |
| "* | business | NA | NA | NA | NA |
| Nashville Raleigh* | all | .79 (5.83)[1] | -.55 (-3.71)[1] | .09 (1.43) | .92 51 |
| "* | leisure | 1.56 (6.80)[1] | .21 (.80) | .50 (3.30)[1] | .88 45 |
| "* | business | -.80 (-.79) | .55 (.84) | -.26 (-.89) | .67 51 |

## Table A-3. Regression Results with FRQ Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | FRQ (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| St. Louis Albuquerque | all | 1.93 (3.11)[1] | -.68 (-4.21)[1] | .24 (2.19)[2] | .89 52 |
| " | leisure | 4.99 (7.69)[1] | NA | .22 (1.41) | .79 49 |
| "* | business | 8.50 (2.18)[2] | -.66 (-2.12)[2] | .75 (1.76)[3] | .88 49 |
| Salt Lake City Phoenix* | all | .17 (.32) | -.85 (-6.06)[1] | .45 (3.90)[1] | .93 51 |
| "* | leisure | 1.01 (1.09) | -.48 (-1.39) | .22 (.64) | .71 45 |
| "* | business | 1.43 (2.71)[1] | -1.72 (-5.37)[1] | -.23 (-.29) | .87 51 |
| Cincinnati Omaha* | all | NA | -1.13 (-4.40)[1] | .09 (1.42) (DUM) | .56 51 |
| "* | leisure | -1.59 (-1.54) | -.74 (-2.18)[2] | .10 (1.01) (DUM) | .39 45 |
| "* | business | NA | .32 (.89) | .19 (.83) (DUM) | .57 49 |
| Washington Nashville* | all | .82 (3.60)[1] | -.30 (-1.93)[3] | .14 (1.33) | .43 51 |
| "* | leisure | 1.23 (3.74)[1] | -.06 (-.29) | .27 (1.54) | .52 45 |
| "* | business | .97 (.65) | .36 (.64) | .44 (1.09) | .43 51 |
| Phoenix San Diego | all | .78 (3.96)[1] | -.58 (-2.17)[2] | .68 (4.18)[1] | .74 52 |
| "* | leisure | NA | .65 (1.44) | 1.38 (1.67)[3] | .72 45 |
| "* | business | 3.81 (3.89)[1] | -1.40 (-3.03)[1] | .43 (.59) | .90 45 |
| San Antonio Dallas | all | .21 (2.60)[1] | -.58 (-4.48)[1] | -.03 (-.23) | .44 52 |
| "* | leisure | NA | -.41 (-1.51) | -.49 (-1.15) | .83 45 |
| " | business | .94 (7.21)[1] | -1.25 (-10.86)[1] | .09 (.51) | .92 49 |
| Salt Lake City Sacramento* | all | .19 (.29) | -.97 (-7.79)[1] | .37 (1.74)[3] | .93 51 |
| "* | leisure | 1.49 (1.21) | -.90 (-3.10)[1] | -.01 (-.03) | .82 45 |
| "* | business | .17 (.10) | -1.41 (-5.41)[1] | NA | .91 32 |
| Tampa-Atlanta* | all | .47 (2.28)[2] | -.75 (-9.49)[1] | .07 (1.10) | .94 51 |
| "* | leisure | 3.31 (4.46)[1] | -.68 (-2.62)[1] | -.18 (-.81) | .93 45 |
| "* | business | NA | -.91 (-4.03)[1] | -.38 (-1.13) | .77 51 |

## Table A-3. Regression Results with FRQ Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | FRQ (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| Washington Jacksonville | all | .71 (5.37)[1] | -.93 (-7.30)[1] | .06 (2.19)[2] | .67 52 |
| "* | leisure | .90 (2.05)[2] | -.01 (-.06) | .13 (2.02)[2] | .61 45 |
| "* | business | .01 (.01) | -.99 (-3.01)[1] | -.13 (-1.20) | .34 51 |
| Chicago Buffalo** | all | -.31 (-.56) | -.67 (-9.49)[1] | .08 (.64) | .80 48 |
| "* | leisure | -.36 (-.21) | -.63 (-2.37)[2] | 1.27 (1.27) | .47 45 |
| "* | business | -4.02 (-.96) | 1.03 (1.25) | -.86 (-.42) | .68 47 |
| Denver Kansas City | all | .75 (3.48)[1] | -.78 (-11.55)[1] | .04 (.40) | .87 52 |
| " | leisure | 2.10 (8.20)[1] | -.60 (-6.72)[1] | .22 (1.70)[3] | .82 49 |
| "* | business | NA | -1.65 (-4.94)[1] | NA | .70 51 |
| Pittsburgh Philadelphia | all | .96 (6.69)[1] | -.70 (-13.02)[1] | .14 (1.32) | .89 52 |
| "* | leisure | 1.43 (.43) | -.91 (-1.67)[3] | .81 (1.33) | .71 45 |
| "* | business | 2.97 (.30) | -2.15 (-2.44)[2] | -1.35 (-1.56) | .69 51 |
| Boston Washington* | all | 1.23 (4.42)[1] | -.72 (-11.45)[1] | -.05 (-.71) | .66 51 |
| "* | leisure | 1.75 (2.23)[2] | -.90 (-4.50)[1] | .25 (1.49) | .71 45 |
| "* | business | NA | NA | NA | NA |
| Seattle Los Angeles* | all | -1.28 (-.79) | -.09 (-.81) | .83 (2.92)[1] | .60 51 |
| "* | leisure | -1.09 (-.54) | -.03 (-.24) | .91 (2.58)[1] | .65 45 |
| "* | business | 14.03 (1.83)[3] | -.15 (-.74) | 1.02 (1.83)[3] | .83 51 |
| San Diego Dallas* | all | 1.11 (2.15)[2] | -.79 (-5.60)[1] | -.05 (-.26) | .79 51 |
| "* | leisure | 3.42 (3.04)[1] | -.62 (-2.37)[2] | -.43 (-1.08) | .80 45 |
| " | business | NA | NA | NA | NA |
| Houston-Miami* | all | NA | -.84 (-8.20)[1] | .24 (1.39) | .83 51 |
| "* | leisure | .03 (.02) | -.53 (-2.29)[2] | .26 (.96) | .75 45 |
| "* | all | -1.03 (-.21) | -.78 (-3.03)[1] | -.48 (-.89) | .90 51 |
| Austin-Chicago | all | 2.35 (11.12)[1] | -.58 (-5.84)[1] | .15 (1.76)[3] | .91 52 |
| " | leisure | 2.84 (9.95)[1] | -.60 (-4.42)[1] | .30 (2.51)[2] | .89 49 |
| "* | business | .06 (.02) | -1.00 (-3.61)[1] | -.25 (-.44) | .28 51 |

## Table A-3. Regression Results with FRQ Only (Continued)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | FRQ (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| New York Miami | all | -.56 (-1.13) | -.69 (-5.72)[1] | .09 (.56) | .42 52 |
| "* | leisure | -.31 (-.37) | -.56 (-3.17)[1] | .74 (2.87)[1] | .81 45 |
| "* | business | -2.99 (-1.14) | -1.29 (-4.29)[1] | -1.15 (-1.41) | .84 51 |
| Denver-Atlanta | all | 1.02 (7.75)[1] | -1.21 (-6.59)[1] | .19 (1.75)[3] | .82 52 |
| "* | leisure | 2.46 (7.46)[1] | -.99 (-3.08)[1] | -.20 (-.98) | .88 45 |
| "* | business | NA | -1.78 (-12.84)[1] | 1.18 (5.26)[1] | .84 48 |
| Philadelphia St. Louis* | all | 1.20 (1.66)[3] | -1.05 (-4.24)[1] | .03 (15) | .46 51 |
| "* | leisure | 2.79 (3.46)[1] | -.81 (-2.73)[1] | -.01 (-.04) | .65 45 |
| "* | business | -3.88 (-.52) | -1.66 (-3.53)[1] | .52 (.87) | .80 51 |
| Los Angeles Denver | all | 1.11 (6.06)[1] | -.71 (-15.67)[1] | .16 (2.35)[2] | .86 52 |
| "* | discount | 3.20 (3.34)[1] | -.78 (-5.65)[1] | .23 (1.23) | .83 45 |
| "* | business | -7.32 (-.85) | -.29 (-.65) | -.61 (-1.00) | .90 51 |
| Washington San Francisco** | all | .48 (.82) | -.20 (-1.11) | .12 (1.32) | .57 47 |
| "* | leisure | 1.43 (2.48)[2] | -1.04 (-4.84)[1] | .22 (1.67)[3] | .87 44 |
| "* | business | -1.75 (-.84) | -.60 (-2.04)[2] | -.21 (-.42) | .76 50 |
| Boston-Houston | all | .36 (.37) | -.86 (-6.79)[1] | .36 (2.65)[1] | .55 46 |
| "* | leisure | -1.14 (-1.16) | -.33 (-2.04)[2] | .52 (2.26)[2] | .21 40 |
| "* | business | 5.99 (1.46) | -.17 (-.44) | .30 (1.31) | .80 46 |

## Table A-3. Regression Results with FRQ Only (Concluded)

| City Pair | Passenger Class | PI (t-stat) | fare (t-stat) | FRQ (t-stat) | $R^2$ & N |
|---|---|---|---|---|---|
| **General Business to General Business** | | | | | |
| New York Phoenix | all | .88 (4.80)[1] | -.35 (-3.27)[1] | .26 (3.39)[1] | .76 52 |
| "* | leisure | 1.65 (5.51)[1] | -.41 (-2.38)[2] | .30 (2.61)[1] | .83 45 |
| "* | business | NA | -1.09 (-4.42)[1] | .88 (3.01)[1] | .55 51 |
| Seattle-St. Louis | all | .76 (1.54) | -1.18 (-4.81)[1] | .22 (.96) | .67 52 |
| " | leisure | 1.20 (2.34)[2] | -1.48 (-5.06)[1] | .41 (1.66)[3] | .74 49 |
| "* | business | -1.82 (-.50) | -.93 (-2.96)[1] | .79 (1.87)[3] | .69 51 |
| Miami San Francisco* | all | NA | -1.09 (-6.17)[1] | -.07 (-1.14) | .72 51 |
| "* | leisure | 1.10 (2.27)[2] | -.73 (-3.53)[1] | -.05 (-.96) | .67 41 |
| "* | business | NA | NA | NA | NA |
| Seattle-Chicago* | all | .08 (.12) | -1.52 (-6.08)[1] | .80 (4.11)[1] | .67 51 |
| "* | leisure | .81 (.89) | -1.83 (-6.56)[1] | .67 (3.02)[1] | .75 45 |
| "* | business | -4.29 (-1.32) | -.47 (-1.14) | .80 (1.74)[3] | .69 51 |
| San Francisco Boston | all | .32 (.91) | -.83 (-5.90)[1] | .39 (3.76)[1] | .60 52 |
| " | leisure | 1.15 (2.40)[2] | -.77 (-4.24)[1] | .51 (3.43)[1] | .65 49 |
| "* | business | -4.21 (-1.30) | .02 (.24) | .51 (2.68)[1] | .84 51 |
| Washington Los Angeles** | all | 1.21 (1.77)[3] | -.47 (-4.83)[1] | .10 (1.51) | .73 48 |
| "* | leisure | .25 (.27) | -1.09 (-4.93)[1] | .27 (1.94)[3] | .76 45 |
| "* | business | NA | -1.66 (-5.35)[1] | -.51 (-1.37) | .75 51 |

Legend:

1. Significant at a 99 percent level of conference

2. Significant at a 95 percent level of confidence

3. Significant at a 90 percent level of confidence

* Adjusted for first order serial correlation

** Adjusted for fourth order serial correlation

NA. Adequate data not available or spurious correlation results when variable included

# Glossary

## ACRONYMS

| | |
|---|---|
| ATC | Air Traffic Control |
| BLS | United States Bureau of Labor Statistics |
| CAASD | The MITRE Corporation's Center for Advanced Aviation System Development |
| CNS/ATM | Communications, Navigation, and Surveillance/Air Traffic Management |
| ETOPS | Extended Range Twin Engine Operations |
| FAA | Federal Aviation Administration |
| MSA | Metropolitan Statistical Area |
| NAS | National Airspace System |
| O&D | Origin and Destination |
| OAG | Official Airlines Guide |
| OLS | Ordinary Least Squares Regression |
| PI | Personal Income |
| RPMs | Revenue Passenger Miles |
| SFP | Service, Finance, and Public Sector |
| SIC | Standard Industrial Classification |
| U.S. | United States |

## TERMS

| | |
|---|---|
| DUM | Proxy for the presence of direct air service in markets where direct air service was started or discontinued during the period studied |
| FRQ | Number of Direct Flights (nonstop, or nonstop and one stop) |
| TS | Average number of trip segments (proxy for the average level of direct point-to-point service) |

# Methods for Economic Appraisal in the Norwegian Aviation Sector

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Paper presented at the 3rd Air Transportation Research Group (ATRG) Conference
City University of Hong Kong, June 6-8 1999

The Norwegian Civil Aviation Administration (NCAA) is responsible for building and operation of the Norwegian airport system, and the air traffic management systems. The airport network for scheduled transport consists of 26 short take-off and landing airports, and 15 full length runway airports. The number of passengers arrived/departed on domestic routes amounts to approx 19 millions per year for a population of 4.5 millions, placing Norwegians among the most frequent flyers in Europe.

In 1998, the Ministry of Transport and Communications initiated a national transport planning process, encompassing all the transport sectors. The report from this work will be launched in late autumn 1999. To be able to select profitable projects across sectors, the need for an instrument for economic appraisal in the aviation sector has emerged.

In the autumn '98, the Standing Advisory Committee (SAC) for Cost-Benefit Analysis (CBA) in the Norwegian public sector launched a final report, giving methodological advice to future CBA work. Simultaneously, Molde College and the Institute of Transport Economics were commissioned by the NCAA to develop methods for economic appraisal in the aviation sector. This work was supposed to be developed with reference to the recommendations from the SAC report, and the experiences from CBA work carried out in other parts of the transport sector, the road sector in particular.

This paper presents the main contents of this work. Methodological problems will be addressed, such as the handling of project risk and uncertainty, projects with mutual dependency, and the methodology for analysing projects influencing the probability of fatal accidents. The CBA methodology in the aviation sector is also compared to the SAC report, and the arguments for some important divergences are commented upon.

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# 1 Introduction: Economic and financial analysis within the NCAA[2]. Decision-making between the devil and the deep blue sea ?

The NCAA has a somewhat special role in the Norwegian transport sector compared to other authorities like e.g. the Public Roads Directorate (NPRD) and the Railtrack administration (NSB). NCAA's role is special due to the fact that the framework for the economic activities is given by revenues from aviation taxes and commercial activities related to the airports. These revenues amounted to approximately NOK 2.7 billions in 1997.

Although toll financing has become very popular on Norwegian public roads, the vast majority of road projects are financed by public funding. When public investments are considered, the natural question is: How will this project serve the community? What are the total costs, and the total benefits of the project? Only projects where the total benefits exceed the total costs (and where equity problems are acceptable) should be recommended for implementation. Because this is such a natural setting for investments based on public funding, the NPRD has developed tools for economic impact assessment over the past 30 years. Any proposed road project is now subject to a thorough and broad analysis that includes external effects (time, accidents, environment), aimed at visualising the true economic costs and benefits to society.

Whereas politicians have demanded broad and thorough analysis from the NPRD for years, the NCAA may seem to have been left alone with their prioritising, because they "do not demand public funding". The picture is not quite as simple as that: For larger investments, like new airports et cetera, politicians have engaged in the debate. The general picture is still the same: Almost any road investment is subject to public scrutiny, whereas the NCAA has a more autonomous position because they are exempted from the annual public debate on the use of scarce public funds.

Investments in the Norwegian aviation sector have therefore been made on the basis of financial cashflow analysis alone. Still, a lot of investments are effectively determined by guidelines and requirements established by institutions like ICAO and ECAC.

The fact that investment decisions made by the NCAA affect other parties, should indicate that there is a need for a broader perspective in the analysis of such projects. In its efforts to optimise the transport system as a whole, the Ministry of Transport has called for actions to improve cross modal planning in recent years. This also means that the methodology with respect to analysis procedures should be harmonised. This is the reason why the NCAA wants to develop a tool for incorporating impacts for passengers, operators and the environment into their analysis.

Making priorities subject to a full economic impact analysis instead of a more narrow financial cashflow approach, may significantly alter the portfolio of projects that reaches implementation. Many investments may very often represent a financial loss for the NCAA, but still be good projects when benefits for the operators or the passengers are taken into account. Typical benefits that may justify such projects are:

[2] Norwegian Civil Aviation Authority

- Reductions in travel time
- Reductions in accident risk
- Reductions in environmental hazards

The dilemma of the NCAA is, however, still present: It still has to finance its activities through revenues from user charges and other commercial activities, rather than from public funding. This must be combined with the "public service obligation" to take the welfare of passengers and operators into account when deciding on how to spend this revenue. As a result of this, the NCAA may very well face decision dilemmas where the financial analysis says one thing, while the economic impact analysis give other recommendations.

Many other civil aviation authorities are in the same, - or similar, situations. Their role is a mixture of running a business and carrying out the responsibilities of providing public services. Whereas the road administrations around the world have done a lot of development work to establish a good methodology for a broad impact assessment, the work that is done in the aviation sector is far more limited. The next three sections present some issues related to such an effort. Section 2 gives a brief overview of cost benefit analyses (CBA) in the aviation sector. Section 3 discuss some important factor prices used in CBA. Section 4 deals with some methodological topics, and in section 5 we give some brief examples to illustrate why the broader view of the impact analysis is necessary. Section 6 provides some conclusions.

# 2 Cost-Benefit analysis (CBA) in the aviation sector – an overview

CBA is a systematic attempt to measure, value and weight together all the costs and benefits with respect to whether the project is profitable or not. One main purpose with CBA is to provide a basis for the choice and the ranking of projects. Therefore, it is important that the analyses are comparable across different projects. CBA gives the net changes in the use of real resources, measured in monetary terms. The most important economic effects to be analysed within the aviation sector are:

- Changes in generalised travel costs, often in terms of changes in time costs. If present, changes in air ticket costs and transport costs to/from airports should also be taken into consideration.
- Environmental effects, like noise and emissions.
- Effects on safety.
- Investments and operating costs.

Network effects are relevant when flight corridors and routes are affected. These include effects on the generalised travel costs for passengers in other parts of the network, as well as for different operators.

Figure 2.1 illustrates the flow of resources in the aviation sector that is relevant in CBA.

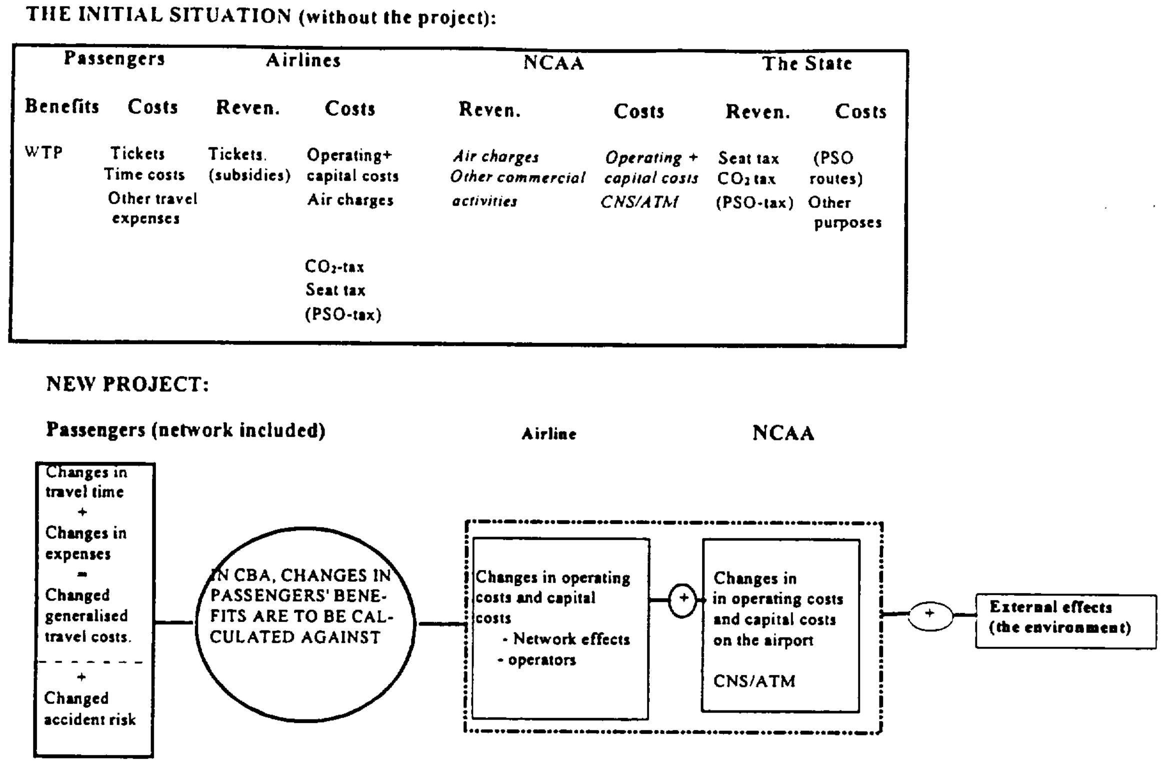


**Figure 2.1** The resource flow in the aviation sector

Figure 2.1 presents the flow of economic resources between agents in the aviation sector. The upper part of the figure describes the present flows in the Norwegian aviation sector. The system is driven by the passengers willingness to pay (WTP). One part of the total WTP is the actual payments made through the air tickets. These payments constitute the revenue side for the airlines. The cost side for the airlines consists of various charges for the NCAA's services, taxes to the government, and costs concerning operations and capital. The air charges constitute the revenue side for the NCAA, to cover the costs of different services. The revenues for the State consist of taxes for $CO_2$, and a seat tax. The PSO tax is in brackets because taxes to cover the expenses for operation of routes under Public Service Obligation are still not levied.

The lower part of the figure shows the situation when a project is implemented that alter the travel costs. The changes in generalised travel costs is the main factor on the benefit side, and should be calculated against the costs for airlines and the NCAA, where the external effects are also taken into consideration. Eventual network effects should also be a part of the picture.

A CBA should be considered because frequently there are no reason to expect that changes in air ticket prices will be able to capture the changes in consumer surplus that is caused by the project. To illustrate this, figure 2.2 shows a situation where the changes in air ticket revenues do not reflect the changes in economic benefits for the passengers.

Consider two airports with different demand elasticity. A reduction in generalised travel costs from $G_0$ to $G_1$ gives an increase in consumer surplus (B) and increased air ticket revenues R. The difference in R does not coincide with the difference in B.

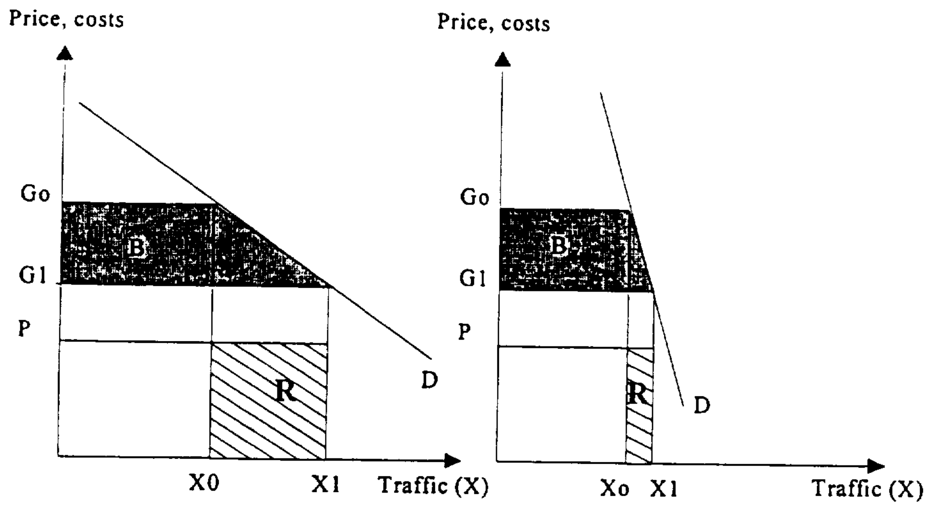


**Figure 2.2** Revenues and consumer surplus

In the aviation sector, CBA is recommended for the following most common project categories:

1. *Projects motivated from standards or regulations.* If there is an unambiguous link between the project and standards/regulations, there is no point in doing a CBA. A cost-efficiency analysis should in most cases be sufficient. However, there may be a case for CBA if there are alternatives with different effects for the benefit side or the external cost side.
2. *Projects with environmental effects.* CBA should be done if there are effects for third parties that are not included in the NCAAs financial analyses. These effects may be either environmental externalities or travel costs. If the environmental effects are internalised through procedures for recycling/disposal, or the implicit costs of choosing a more environmental-friendly design are captured in the financial analysis, then a CBA may be omitted. The underlying assumption is that there are no effects in the traffic market.
3. *CNA/ATM/ILS-services.* When considering improved equipment for navigation, communication and instrument landing, a CBA may be carried out if alternative routing of flights affect travel time, or if accident risk or the environment is affected. If standards or regulations demand such items, refer to point 1 above.
4. *Terminals.* A CBA is relevant if the travel time is affected or if there are changes in airline costs (from e.g. delays or operating hours) that are not internalised. Small projects are normally subject to a financial analysis only.
5. *Extended runways.* These projects normally affect regularity, the size of aircraft to be served, and possibly the accident risk (however, one should be aware of "risk compensation" here). As a main rule, CBA should be carried out for such measures.

So far, the CBA within the aviation sector in the future seem to be carried out comparable to what is actually done in e.g. the road sector. However, there are some methodological issues which become apparent when analysing projects within the aviation sector. A couple of these issues are addressed in section 4. The next section discusses a bundle of important factor prices concerning intangibles in the CBA.

# 3 Factor prices

## *3.1 General*

To evaluate all consequences of planned investments in the air sector in money terms, we will find that in many cases there are no markets for the effects that we want to include in the analysis. In other cases we do not recognise the market price as a measure of the real value of the consequences. This may be due to monopolies or other market failures.

The methods to evaluate factor prices should be consistent across sector borders. This does not mean that prices should be the same all over, but that the principles for calculation of prices should be consistent across sector borders.

The main methods of assessing these unit prices are in some way or another based upon the society's willingness to pay for reducing or increasing certain variables. These methods are mainly:

- *Willingness-to-pay (WTP) surveys*
- *Damage cost analyses.*
- *Indirect valuation*

Normally, damage cost analyses will include an element of WTP, because it is often necessary to take into account also the costs of statistical lives and reduced health.

## *3.2 Value of time*

The value of travel time savings is frequently the largest element in CBAs for projects in the transport sector. The purpose of the trip is an important criterion when calculating this effect. Here we have chosen to concentrate only on private travel and business travel. Commonly the value of travelling time that alternatively might be spent working, has been calculated by applying gross wage costs. For leisure travel the common approach has been to apply the net wage rate, since that is the amount that the wage earner must sacrifice to have additional leisure time.

In recent years there have been several attempts to estimate the value of time (VOT). Among these is the Norwegian value of time study (Ramjerdi et al 1997). The main purpose of the study was to produce VOT estimates for CBAs in the transport sector. The scope of the study was to estimate the VOT for travel with cars, buses, ferries, trains and aircraft. Several travel purposes are analysed, but we will only focus on business and private travel.

The methodology applied is two approaches to WTP analysis, Stated Preference (SP) and Transfer Price (TP). *Private travel* demand may be expressed as a function of generalised travel cost and analysed by means of a logit model. For *business travels,* attempts were made to estimate VOT by means of a revised version of "Hensher's formula" (Hensher 1977). This formula is founded on the assumption that both employer and employee will benefit from shorter travelling time.

The estimate found for business travel by air turned out to be higher than the marginal productivity of labour (the gross wage rate). Therefore it is recommended in the Norwegian VOT study that a conservative estimate should be applied till further analyses are carried out, meaning that for the time being the estimate for business travel by air is the average gross wage rate for this group.

In table 3.1 the actual values of VOT for the air sector are shown.

| | *Private travel* | *Business travel* |
|---|---|---|
| Travel time | 173 | 213 |
| Waiting time between departures | 19 | 71 |

**Table 3.1** Value of time for air travel (NOK)

The VOT for delays are from the equivalent Swedish study (Algers & al 1995), and assumed to be 50 % higher than the VOT for travelling time.

The methodological approach in the Norwegian study has formerly been applied in similar studies in Britain (Bates & al 1987), The Netherlands (HCG 1990) and Sweden (Algers et al 1995). It is fair to say that the results of these analyses, including the Norwegian one, have been discussed a great deal for methodological weaknesses. However, they are the most updated estimates we have so far, but they should of course be applied with care.

### 3.3. Accident costs

Accidents luckily occur very rarely in regulated air traffic. When they occur, however, the consequences usually are of huge dimensions. We therefore will have to look into *accident frequencies* as well as *accident costs,* to be able to include changes in accident risk into the economic appraisals.

*Accident frequencies*

NCAA has performed an analysis of accident risks in Norwegian commercial aviation, both route and charter traffic as well as other commercial traffic. From a data set consisting of all flights within the Norwegian territory for the period 1985 – 1994, accident risks are estimated (Fugleberg 1999). The effects of certain security measures are estimated. These are *precision landing system*, *radar control* and *rows of landing lights >720m.* In addition the effects of terrain factors like hills or peaks are analysed. Additional estimations are performed to isolate the effects of scheduled[3] versus non-scheduled flights on accident risk and to adjust for the total risk of having an accident during the whole leg, including take-off, cruise and landing. On average 16% of all accidents for scheduled flights are fatal.

The results show that accident risk for scheduled flights, varies between 1.05 per million legs and 3.6 per million legs, depending upon combinations of the above mentioned security measures. The effect of introducing e.g. radar control (ILS not being used) is a reduction of accident risk from 3.0 per million to 1.5 per million. For non-scheduled flights the accident risk varies between 2.1 per million and 62.9 per million. Introducing e.g. radar is estimated to reduce risk from 49.6 per million to 2.1 per million (without ILS).

*Costs of accidents*

The costs per accident are assumed to consist of loss of *statistical lives*, *injury* costs, *material* costs and *administration* costs. However, injury costs are omitted because they are found to

[3] Route and charter flights

be of little importance in the aviation sector[4]. From Elvik (1993) and in analogy with calculations for the railway sector, the cost of a statistical life in an aviation accident is estimated to be NOK 17.0 millions, which is about 2.0 mill Euro. Material costs are assumed to be 100% of aircraft value for fatal accidents. For non-fatal accidents the material cost is assumed to be 50 % of aircraft market value. Average material accidents for scheduled flights are found to be NOK 44 millions. Average administrative costs are found to be NOK 4 millions.

For an average accident we assume an average number of 60 passengers in the aircraft, a risk of fatal accident of 0.16 and a mortality rate of 0.9. The material and administrative costs are as stated above. We may then construct an example of the costs of one accident:

| | |
|---|---|
| Loss of statistical lives: | NOK 147 millions |
| Material costs: | NOK 44 millions |
| Administrative costs: | NOK 4 millions |
| Total: | NOK 195 millions |

The average cost of one accident must be calculated separately for each airport. To calculate the expected reduction or increase in accident costs, the cost of one accident must be multiplied with the actual accident risk or by the change in risk due to the investment or the measures taken.

### 3.4 Environment costs

Environment costs in the aviation sector consist of *noise* and *emissions* (local, regional and global effects). In addition we have pollution of ground and water from de-icing of aircrafts and runway. This is taken into account by adding the fully satisfying remedy costs to the cost side of the analysis.

*Noise*

As one of the biggest sources of environment disturbance on and close to airfields, noise is treated in a detailed way in the CBA manual for the aviation sector. The basis is a WTP analysis performed in 1994 at Fornebu airport close to Oslo, where noise problems have been substantial over a long period of time (Thune-Larsen 1995). The applied method was conjoint analysis (CA) in combination with contingent valuation (CV). This was used to estimate the people's willingness to pay for a reduction of subjective noise disturbance by 50%. Within each noise zone of 5 dBA EFN (which mean that noise is weighted differently over the day) the WTP for noise reduction is measured.

We then calculated the WTP for noise reductions for people that are much annoyed by airport noise within each noise zone. This leads us to a WTP for a reduction to 50 % of noise disturbance of NOK 3600 per year for much annoyed persons within the noise zones (50 dBA or more). Assuming for practical purposes that this value is constant per percent change, we may derive that a change in subjective noise disturbance is worth NOK 72 per year per percent reduction.

This goes for noise increases as well as decreases. In reality, however, there is reason to believe that the percentage change in cost is bigger for deterioration than for improvement in

[4] For *fatal* accidents the risk of losing ones life is found to be about 0.9.

the environment factor (Sælensminde & Hammer 1994). The bigger the change, the bigger the error made by applying a linear approximation is.

For the whole country, inside zone 50 – 55 dBA there are 5% of the population that feel «much annoyed» by air-traffic noise, increasing gradually to 31% for zone 65 dBA and above. The change in noise disturbance that people perceive (subjective noise) is assumed to be proportional to the logarithm of the noise pressure measured by dBA EFN. A map of the assumed noise zones before and after the planned project is effectuated, must be derived from measurements. Then the change in number of people that are much annoyed may be calculated for each noise zone. The total WTP from «much annoyed» people may then be calculated.

*Local and regional emissions*
Local emissions are connected to take-off and landing under the altitude of 100 meters. Emissions from aircraft under an altitude of 1000 meters are usually classified as regional emissions.

The combustion of aircraft fuel leads to the emission of a lot of substances that may influence the environment in several ways. Since some of these substances are proportional to fuel consumption and others are not, we have chosen to evaluate only a small number. Our calculations therefore only include $NO_X$, VOC (volatile organic components) and particles. Since there seems to be no WTP-analyses or other recent relevant studies for Norway, we have chosen to apply values that are recommended in a meta-analysis from ECMT[5]. The authors have analysed numerous European studies of indirect (shadow) cost of emission of $NO_X$, VOC and particles. Other emission costs are reviewed as well. But emissions of these substances are small from air transport, or the costs are considered to be taken care of by other components. The valuation of VOC is assumed to reflect the cost of other substances as well. There is a need to separate between densely and sparsely populated areas since the concentration of the substances is important for the damage effect. We have not considered the possibility that the emission of these substances may have other effects, e.g. on the production of ozone or greenhouse effects. The numbers are in the form of cost per kilogram emission and transformed from ECU.

| | Densely populated areas | Sparsely populated areas |
|---|---|---|
| NOX | 70 | 35 |
| VOC | 70 | 35 |
| Particles | 615 | 0 |

**Table 3.2** Costs in NOK per kilogram from local and regional emission to air.

For the airports in question, the average emissions are calculated from composition of the air fleet that uses the airport. The emission factors of each category of aircraft are assumed known from special tables calculated by NILU[6] that should be updated regularly in the future. The average length of a leg by the most common aircraft to and from the airport is calculated, and the average emission costs per leg may be found. From this the change in emission costs per year may be calculated.

[5] The council of transport ministers in the OECD, ECMT (1998).
[6] Knudsen & Stromsoe (1990), Norwegian Institute for Air Research.

*Global emissions*
Global emissions are understood as having an impact on the global environment, regardless of the location of the emissions. Such problems are the depletion of the ozone layer and the greenhouse effect. Here we will concentrate on the latter. Among the gases that contribute to the greenhouse effect, carbon dioxide ($CO_2$) is the most important one. We will consider $CO_2$ as a representative for all climate gases and place all climate costs on this gas.

We are aware that some gases that are emitted in the higher layers of the atmosphere are under suspicion of contributing more to climate changes than gases that are emitted on the ground level. Among these are $NO_X$ and VOC, and we assume that the price for local and regional emissions to some extent will compensate for that.

It seems that neither damage costs nor WTP will give a satisfactory answer to what the best way of assessing the cost of $CO_2$ emissions will be. We have chosen to use «indirect political willingness to pay», i.e. to take the Kyoto agreement as a "constraint". We then calculate the price or tax on $CO_2$ that will be necessary to fulfil the Kyoto-agreement for Norway's part. This means that $CO_2$ emissions should be stabilised on the 1990-level from 2010 on. Calculations are made by means of the macro-economic model GODMOD (Jensen 1998). The calculations show that it will be necessary to charge NOK 740 per tonne $CO_2$ in 2010 to stabilise on the 1990-level. The main underlying assumption is that an international agreement forces all industrialised countries to charge $CO_2$-emissions to fulfil their part of the Kyoto agreement. If we assume that the charge is 0 in 1990, with a linear increment, the charge in year 2000 will be NOK 370. This may be seen as a compromise between the presence and the future, not letting either of them take all the costs.

The consumption of fuel per minute on a standard flight can be found from the above mentioned tables. The burning of one kilogram jet-fuel produces 3.15 kilograms $CO_2$. Knowing the average additional flight-time produced by the planned project makes it possible to calculate the $CO_2$-cost connected to a specific investment.

In the next section, some methodological topics will be discussed that frequently emerges when doing CBA within the aviation sector.

# 4 CBA for aviation projects – some methodological topics

## 4.1 The interdependency problem

Within the NCAA's jurisdiction, it will quite frequently be the case that the value of a single project will depend on whether other projects are implemented or not. When working with economic analyses of specific interdependent projects, it is necessary to ensure that adequate limitations are made so that only projects with a strong case for mutual interdependency are considered. Otherwise, one may end up calculating the economic benefit of an entire airport system, because there is almost always a possibility to identify more or less significant interdependency with other projects, within the project's economic life span. When doing analytic work, one important challenge is to define and deal with this kind of interdependency in a practical way. This problem will now be assessed in two ways. First, the nature of interdependency will be examined. Thereafter, some practical guidelines will be developed. The discussion is limited to projects with *sequential* interdependence.

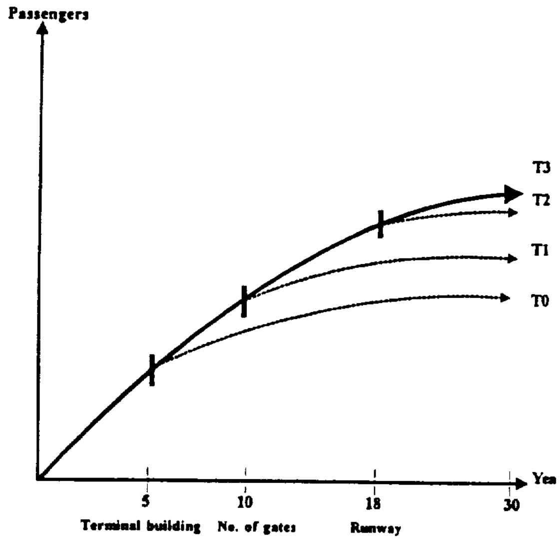


**Figure 4.1** Traffic growth - sequential dependency

One indicator of mutual dependency is impacts in the traffic market. Figure 4.1 illustrates the problem of sequential inter-dependency, illustrated by the impacts from a stepwise upgrading of an airport. $T_3$ represents the traffic growth in a 30 year span, without any capacity constraints on the airport. In year 5, the lack of terminal throughput capacity limits the traffic growth to $T_0$. If the capacity is expanded, the growth rate will follow $T_3$ until the next capacity constraint occur, for instance the number of gates available. Without expansion, the traffic growth is limited to $T_1$. Correspondingly, if the need for extra runway length in year 18 is not met, the growth is limited to $T_2$. The figure shows that the benefits from the expanded terminal building in year 5 are limited if the number of gates remain unchanged after year 10. The traffic is assumed to be growing, but with an annually declining growth rate. This is so because even if there are no excess capacity during peak hours, the assumption is that there are capacity available between peak hours to be used by people who are able to change travel behaviour.

The NCAA operates with guidelines for capacity expansion. If these guidelines take the form of mandatory regulations, then it can be said that a project A in year X will entail project B in year Y and project C in year Z. A strong sequential interdependency is established, implementing project B before project A is meaningless. This is a case for designing a *package* of projects, where the net present value for the entire package is calculated.

However, there are several points to be made when it is necessary to design project packages:

1. Sequential project packages may be designed from standards that represent constraints considering the planning and decision-making process. When the demand side is given, criteria are established to define the timing and sequence of the various measures to be taken. The projects in the package are resolved simultaneously.
2. If such constraints are not defined, one should assess different packages, and implement the most profitable one.
3. With respect to the *financial* side of the story, project packages makes it difficult to assess the financial profitability of single projects. This may be in conflict with a financial framework that deals with the profitability of single projects (as in the NCAA).

Figure 4.2 illustrates the investment costs and annual revenues from the project package in figure 4.1. The situation is simplified in the sense that the annual revenues are constant when the capacity constraint is effective. The annual operating costs are omitted.

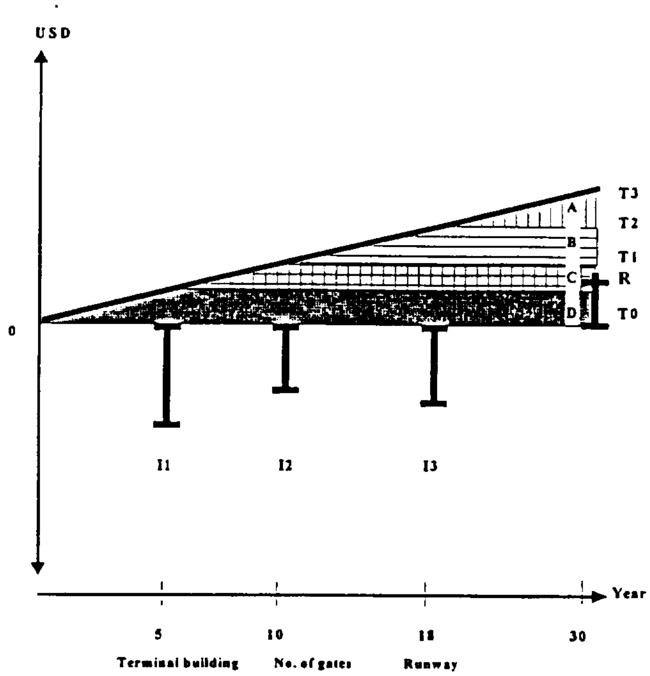


**Figure 4.2** Costs and revenues - sequential dependency

The area **D** is the revenues in the base case. The area **C** is the additional revenues when the terminal is upgraded in year 5, area **B** is added revenues when the number of gates is increased in year 10, and **C** is added when the runway is upgraded in year 18. The **Is** are the different investments and **R** is the residual value of the investments after year 30 (the economic life span).

This illustration applies for both the financial revenues and the passengers' benefits in a cost-benefit perspective.

To design a framework for a practical approach to solve this kind of interdependence problems, the following guidelines have been recommended to the NCAA:

A. The case of *uncertain* dependency: If there are reasons to be in doubt whether the projects $T_2$ and $T_3$ will actually be carried out, then the recommendation is to consider the projects as separate and independent. The consequence is that the projects are analysed with respect to declining traffic due to capacity constraints occurring at a later stage. Thus, the traffic volume that constitutes the market for e.g. project $T_1$ is defined by the area between the curves $T_1$ and $T_2$ in figure 4.1.

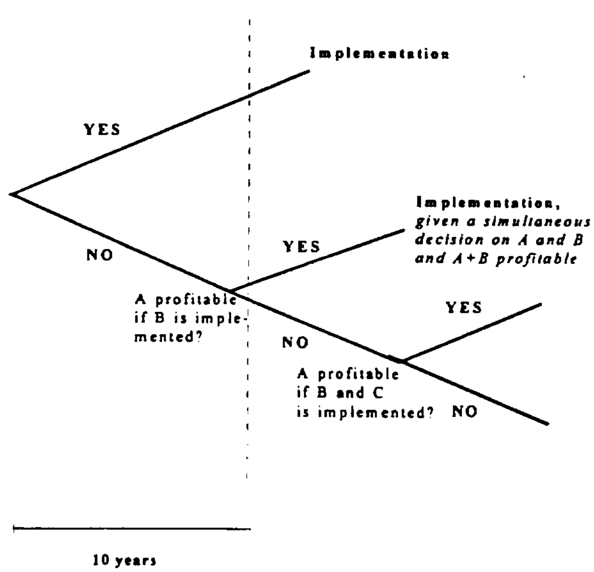


**Figure 4.3** Decision tree - sequential dependency

- If $T_1$ is a profitable project on its own, it may be implemented independently. Area C in fig. 4.2 is the relevant revenue area.
- If profitability of $T_1$ over the life cycle is dependent of the implementation of $T_2$ and/or $T_3$, then a strong connection through binding decisions on implementation of the entire profitable package must be established.
- However, linking of projects is not recommended if profitability of the package is dependent of projects to be implemented more than 10 years from now. Most often, it is not possible to make meaningful binding decisions for a long time span. The decision tree in figure 4.3 illustrates this situation.

B. The case of *certain* dependency: If there is no doubt about the strong dependency, then the projects should be considered as a package within the following framework:

1. Projects that are linked within a time span of 10 years are considered within the package.

2. For projects to be implemented more than 10 years from now, the recommendation is that the interdependency is linked with such a degree of uncertainty that they should not be included in the analysis.

### *4.2 The network problem and the value of time.*

Network considerations emerge frequently when doing economic appraisal of projects for e.g. increased airport capacity. The network effects can be categorised as follows:

A. Effects within the airport network, affecting services for airlines and passengers.
B. Effects on other transport modes.

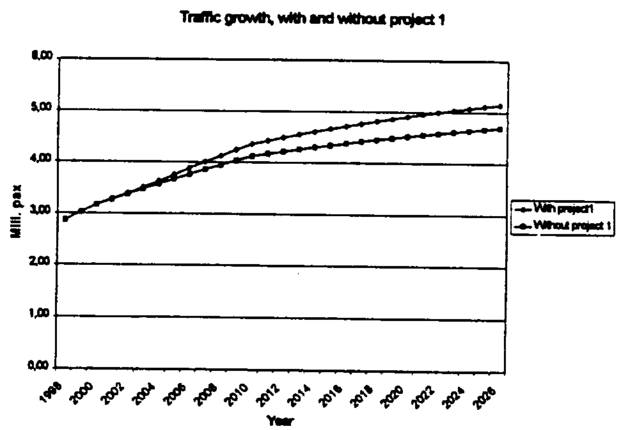


**Figure 4.4** Traffic growth with and without constraints

Point B will be commented upon here. The effects on other transport modes are mainly connected to traffic spill-over. When capacity constraints are reached during peak hours, several adjustments may take place. Some traffic will divert to less attractive slots. Other parts of the traffic market will either be deterred because of higher generalised transport costs, or change to other modes. These effects may seem trivial from a theoretical viewpoint, but there are some practical matters that should be carefully examined:

1. *Traffic forecasts*. The forecasts determine the traffic diversion and traffic deterrence from capacity constraints. Figure 4.4 illustrate the number of passengers that constitute the market for improvements in airport infrastructure. The lower curve represents the anticipated traffic volumes that will use the airport under the capacity constraint, while the upper one indicates the forecasted number of passengers without the constraint. The distance between the two curves gives the forecasted amount of traffic that will be served by the extended airport capacity, but which will either be diverted to other modes or deterred from travelling, without airport capacity expansion.

2. *Alternative transport modes, traffic deterrence and the travellers' benefits.* As an airport reaches the capacity constraint, transport costs increase abruptly. Figure 4.5 illustrates this situation. The marginal generalised travel costs for using the existing airport infrastructure is given by $MC_A^1$. As capacity problems emerge (at volume $X_0$), MC increases towards infinity as the capacity constraint is reached (somewhere near $X_1$). The $MC_R$ curve is the generalised travel costs of using alternative transport modes, e.g. road transport combined with the use of a nearby airport. This curve makes the generalised

reservation costs for the air passenger. If the generalised travel costs by air exceed this level, some passenger will switch to the competing mode (here $X_2 - X_1$), others will give up travelling.

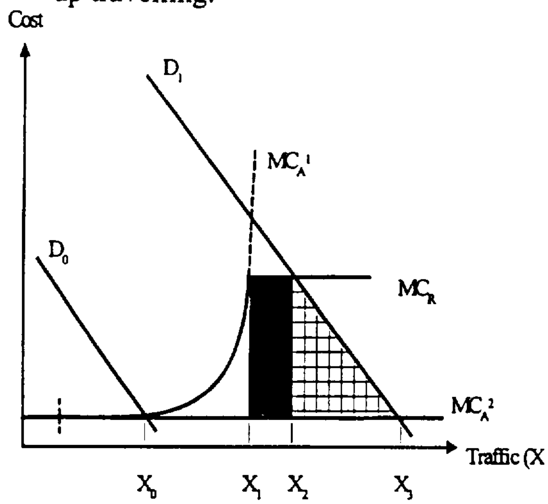

**Figure 4.5** Benefits of increased airport capacity

The curve $MC_A^2$ is the generalised transport cost if the capacity is increased. For simplicity, this cost is represented as constant. The benefits from this capacity increase are given by the shaded and the hatched area. The shaded area represents the benefits for those who switch to competing modes, while the hatched area illustrates the benefits for the traffic that is deterred because of the more expensive alternative mode, compared to the travel costs after the capacity is expanded. In addition to these areas, there will of course be benefits from cost reduction for the traffic $X_1 - X_0$.

3. *The value of time in transport chains*. The value of time for a typical air passenger is significantly higher than for various surface transport modes (see section 3.2), especially for leisure travels. Most VOT studies are directed towards partial analyses of travellers in different sectors, without studying the consumer's VOT through a chain of various modes. When using the recommended VOTs of different transport modes in an analysis which includes diversion of traffic from one mode to another, one might face a rather dramatic change in VOTs which raises questions about the rationale for this big difference. After all, the same group of travellers is considered, although some differences may be explained from the characteristics of the transport mode. These questions are important when considering multi-modal passenger transport.

## *4.3 Defining the base case and different projects.*

Defining the project's main objective is the point of departure for the CBA. It is important that the description of the objective does not include any specific means. As an example, if the take-off and landing routines on a given airport create unacceptable noise for the surrounding dwellings, the objective should be "reduce the noise by xx EFN" and not e.g. "build a mound to reduce aircraft noise by xx EFN). In this way, no relevant means to meet this objective are excluded.

The definition of the base case is also a vital prerequisite for the CBA, because the projects or project alternatives are compared to the base case. The list of possible projects that meet the objectives should be complete. The CBA may well show that all the projects turn out to be unprofitable, leaving the base case as the most profitable one. In such cases, none of the projects should be implemented.

The base case should represent the expected situation during the economic life span without any changes, i.e. without any project being implemented. However, one point has to be stressed. The base case has to include projects that are approved for implementation. Thus, the base case is not necessarily a 'do nothing' alternative, but should include the expected effects from approved, but not yet implemented projects. Correspondingly, optimising the use of the existing infrastructure should be included in the base case. Another aspect that should be taken into consideration, is the technological development. As an example, the number of aircraft movements on a given airport may represent a constraint which may be desirable to relax. An eventual trend towards larger aircraft will influence the forecasted aircraft movements and thus the need for increased capacity of this kind.

### *4.4 NCAA as a corporation.*

Up to now, NCAA has mainly operated on the basis of financial analyses, where the individual airport is the financial unit. There has been a weak tradition for consolidated account, where e.g. the entire network of airports is considered. If the situation of airport 1 influences the traffic volume on airport 2, this may give a net financial effect for the NCAA that is not represented by financial analyses at the airport level. As an example and as commented in section 4.2, capacity constraints on airport 1 may transfer passengers to airport 2 which is situated in the vicinity. The revenue effect for the NCAA from this transfer effect may be practically zero, because the transferred passengers generate revenue to the NCAA via airport 2 with connected routes. The CBAs are in essence "global" analyses where such network effects should be taken into account. Financial analyses must include the entire influence area to be able to capture all the financial effects without double counting.

### *4.5 Project risk and uncertainty*

Dealing with project risk and uncertainty has always been a major challenge for investors, regardless of whether the project is financed with private or public funds. The fact that we are dealing with future effects makes our estimates just that – *estimates* with an inherent uncertainty. This brings us over to a stochastic world where we should be dealing with *probabilities* and *expected values* rather than deterministic figures.

Traditionally, the treatment of project risk and uncertainty has been on a very crude level in most impact assessments. In the Norwegian public roads sector the only treatment of risk has been to carry out a simple sensitivity analysis of alternative figures for investment costs and traffic forecasts. Recently, a national standing advisory committee on cost benefit analyses (SAC) has given its recommendations on "good practice" for economic impact assessments in the Norwegian public sector. One of the main suggestions for improvements was related to the treatment of project risk and uncertainty. The previous debate on this issue has to a large extent been related to the level of the discount rate in the calculations of the net present values.

Returns on private investments are usually a composite of two factors: A risk free rate of return plus a compensation for the risks of that investment. The last part is commonly denoted "the risk premium". There have been some disagreements about whether or not (or to what extent) one should include such a risk premium in the discount rate for public investment analysis. In order to discuss this question we need to divide the risk premium into two further components: *Non-systematic* risk which is risk connected to the outcome of the specific project in question, and *systematic risk* which is due to "macro-factors" like general business cycles, fluctuations in the oil prices etc. The latter kind of risk is unavoidable and genuine even to a whole public sector. The former kind is, some argue, not relevant when analysing public projects because it is *diversible*, meaning that a negative surprise in one project eventually will balance with a positive surprise in another. Additionally, the risk will be distributed over all taxpayers, and because any project will be small compared to the total budget for public spending, the effect of a possible "surprise" can be ignored.

SAC argued, partly on this basis, that if all figures were calculated as *expected values* (based on some information on relevant probability distributions), the only relevant risk premium to include into the discount rate was the systematic risk component. The size of this component would in turn depend on to what extent the returns from the project had a (positive or negative) correlation to the National income. The concrete recommendation was to categorise typical public investments into risk-groups with different discount rates, on the basis of such information.

In this work for the NCAA, we have chosen not to follow SAC's recommendations on this issue, partly on a fundamental background and partly on a more practical one:

- The *fundamental* counter-argument is, as we see it, that the assumed diversity of project specific risk is not plausible when we are talking of only a *part* of the "public" budget (i.e. the budget of the NCAA). There is no precedence that should support an assumption that a bad outcome in a NCAA project would be compensated e.g. from the health budget, - not even from the budget for the public roads. As seen from our point of view, this project specific risk is therefore highly *relevant* to the decision-maker.
- The more practical problem emerged when we were seeking empirical evidence on the relevant risk premiums for typical NCAA projects. Trying to extract such information from the stock exchange proved impossible. There was no information available that could enable us to assign a "market value" for the risk premium to the relevant project categories. There is, however, no fundamental reason why this information should not be obtained at a later stage through further analysis. The job that needs to be done is to find "market copies" of the different public investment projects, - and then extract the risk premium on the stock exchange for this group of market copies.

So, does this leave us with "business as usual" as our only option for the treatment of project risk and uncertainty? Not quite. We have found it necessary to stick with the rather crude approach of using one single discount rate with no risk-dependent discrimination between projects. However, we have made some important steps in the right direction towards a more satisfying treatment of project risk: First, we have recommended that the use of *expected values* should replace the use of *most probable outcome*. This is an important step forward because it forces the analyst to thoroughly assess the range of possible outcomes and the connected probabilities for these outcomes. We realise that one rarely will have a formal probability distribution as a platform for the calculation of expected values, but even the use of subjective probabilities will be an improvement. Second, we have advocated that the use of sensitivity analysis should be extended and improved. By stressing the fact that

- Only factors that effectively *are* affected by risk and uncertainty should be altered
- The range for variation is within plausible limits
- Factors that typically would be correlated, also should be altered together in a scenario,

there are reasons to expect that the information value of the sensitivity analyses will improve. The last bullet-point above moves the sensitivity analysis over to a scenario analysis where one e.g. can illustrate the effects of general business cycles and create one scenario under a cycle peak, and another under a cycle trough. The latter would then typically include a lower estimate for investment costs and a low traffic forecast.

# 5 The use of CBA in the aviation sector – two examples

In our report to the NCAA, the CBA methodology is implemented on a couple of projects, to show how CBA should be carried out in practice. This section presents briefly two cases that represent important parts of the NCAA's jurisdiction.

## *5.1 Terminal building at Stavanger airport, Sola*

### 5.1.1 The setting

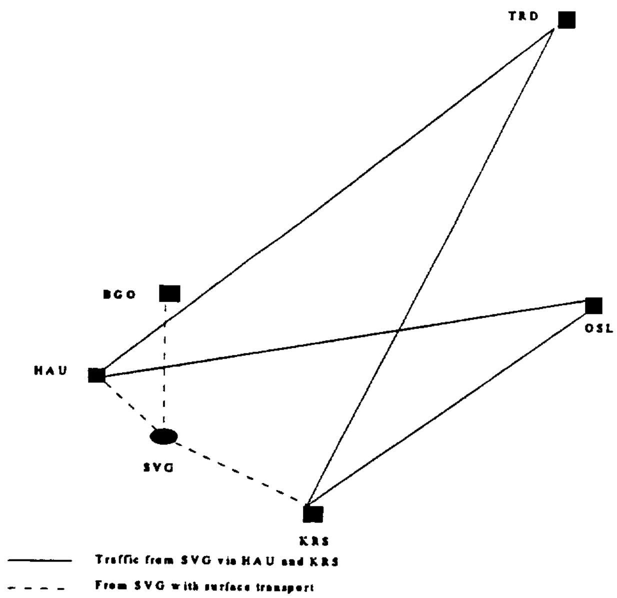


**Figure 5.1** Alternative routes, travels from SVG

The setting for the first example is a medium-sized airport at Sola near Stavanger (SVG) where the capacity constraints in terminal capacity is assumed to be the limiting growth constraint in the near future. Without expanded capacity, one segment of the growing number of passengers is able to adapt to less attractive slots until these slots are full. This example focuses on the remaining segment which in stead will use the services of neighbouring airports, resulting in more expensive transport mainly because surface transport have to be used between these airports. This situation is described more formally in section 4.2. The increase in transport costs entails deterrence effects in this traffic market. Figure 5.1 shows the SVG airport and the neighbouring airports. Without extended capacity, people use car to the airports in Kristiansand (KRS) and Haugesund (HAU), and air transport from there. Bergen (BGO) is situated too far to serve as an alternative airport. Passengers with Bergen as their final destination will go there by car.

In this example, the main benefit of extended terminal capacity will be the travel time savings (TTS) of travelling from SVG instead of using HAU and KRS as alternative airports. In addition, TTS for travellers with KRS and BGO as final destinations are taken into consideration. To be able to calculate these benefits, traffic forecasts have to be made. In addition, the following factors have to be assessed:

- The travel purposes (business travels and others).
- The destinations from SVG.
- The level of diverted traffic, and the distribution between HAU and KRS.
- Time costs and other costs for surface transport.
- The share of travels that are deterred because of higher transport costs.

In addition, there are reasons to expect some delays for passengers and operators during peak hours. The benefits of avoiding delays may be significant, and should be object to careful attention. The details in the forecasts of traffic and delays are not examined in this paper.

These benefits are calculated against the investment costs and operating costs for both the NCAA and the operators. Environmental effects and the eventual value of changes in accident risks are also to be included. The accident risk assessment is done by comparing the changes in accident risk when transferring passengers from air to surface transport. Especially when the actual surface transport is by car, a significant rise in accident risk in terms of expected loss of statistical lives has to be included in the calculations. All the economic effects within the project's life span is discounted, and the net present value is calculated, using an appropriate discount rate.

### 5.1.2 The project: New passenger terminal building

The main objective is to increase the passenger capacity at SVG airport. The main obstacle is the terminal building. Various solutions have been assessed, and the most convenient project is a new terminal building, which is submitted to a full economic assessment.

The investment costs have a discounted value of NOK 275 millions. The residual discounted value of the investment after 30 years is NOK 7 millions. The increased operating costs are NOK 170 millions, discounted over a 25 year span.

These kinds of projects within the NCAA have up to now been assessed by means of financial analyses. If the project has proven positive financial NPV, then the project has been approved for implementation. It is worth noting that the financial analysis do not comprise the benefits or costs from travel time savings, environmental external effects and changes in accident risk. It may well turn out that a financially unprofitable project may prove clearly profitable in the economic sense, when these intangible factors are taken into consideration. In this case, the surface transport to nearby airports takes between 2 and 3 hours, resulting in extra time costs, vehicle operating costs and accident costs as the most significant effects.

### 5.1.3 The analysis: Costs and benefits.

The various costs and benefits for this projects are calculated over the project's economic lifetime. In addition to the net present value (NPV), the most important effects are presented for various agents like the NCAA, the State, the passengers, the operators and the environment. The presentation method is chosen to inform the decision-makers of both the economic and the financial effects. Table 5.1 illustrate the real economic effects, including external effects and excluding fiscal taxes. The financial cashflow is also illustrated. The resource flows and cashflows from figure 2.1 are recognised.

The benefits adds up to NOK 582 millions, exceeding the costs of 541 millions. Thus, the net present value is NOK 41 millions, This indicates that the project should be carried out from an economic perspective. The NPV/Cost ratio should be > 0, and is approximately 0.1 here. This ratio is a pure *ranking criterion.* The cost side in the NPV/C ratio is the payable costs for the NCAA, and gives NPV with respect to the use of NCAA's budget. However, the main decision criteria should be the NPV > 0. Project ranking under budget constraints is done by use of the NVP/C ratio.

| Costs and benefits SVG example | Economic impacts | | Financial cashflow | |
|---|---|---|---|---|
| | Benefits | Costs | Revenue | Cost |
| **C1 Passenger benefits** | | | | |
| C1.1 Business travels | 370 | | | |
| C1.2 Others | 0 | | | |
| C1.3 Delays | 54 | | | |
| C1.4 Ticket costs | | | | 1550 |
| **S1 Accident costs** | 137 | | | |
| S1.1 Statistical lives | n.a.*) | | | |
| S1.2 Injuries | n.a. | | | |
| S1.3 Material damage and administration | n.a. | | | |
| **E1 The environment** | | | | |
| E1.1 Local and regional emissions ($NO_x$, VOC, particles) | | 6 | | |
| E1.2 Global emissions ($CO_2$) | | 36 | | |
| **P1 The State/general taxes** | | | | |
| P1.1 Fiscal aviation taxes | | | 92 | |
| P1.2 VAT on NCAA investments and operating costs | | | 62 | |
| **P2 Operators/airlines** | | | | |
| P2.1 Operating costs | | 122 | | 122 |
| P2.2 Aviation charges to the NCAA | | | | 95 |
| P2.3 Fiscal aviation taxes | | | | 92 |
| P2.4 Ticket revenues | | | 1550 | |
| P2.5 Delay costs | 21 | | 21 | |
| *SUM financial cashfloe operators/airlines* | | | *1571* | *309* |
| **P3 Other commercial activities (shops, taxfree)** | | | n.a. | 22 |
| **P4 NCAA** | | | | |
| P4.1 Investments | | 223 | | 275 |
| P4.2 Residual value | | -7 | | |
| P4.3 Maintenance and operations | | 161 | | 171 |
| P4.4 Revenues from aviation taxes | | | 95 | |
| P4.5 Other commercial activities | | | 22 | |
| *SUM financial cashflow NCAA* | | | *117* | *446* |
| *SUM economic impacts* | 582 | 541 | | |
| Net present value (NPV) | 41 | | | |
| NPV/Cost ratio | 41/446 ≈ 0,1 | | | |

**Table 5.1** SVG example, economic impacts and financial cashflow (mill. NOK).

### 5.1.4 Economic viability vs. financial cashflow.

The new SVG terminal seems to be economic profitable. However, the financial cashflow gives a negative result of NOK 329 millions, meaning that this project would not have passed a simple cashflow analysis. It is the travel time savings and the increase in accident costs that give the most significant contribution to the difference between the economic and the financial assessment here. As pointed out in section 1, this kind of difference gives reasons to discuss NCAA's role as a self financing agent in markets where elements of intangible goods constitute a significant share of the economic impacts. This example represents an obvious case for focusing on the role of economic vs. financial analysis as basis for decisions within the NCAA.

## 5.2 *Instrumentation for precision landing (ILS)*

### 5.2.1 The setting

The setting for this example is a small local airport (MOL) that is served by two air services: One following a triangular route from the national hub (OSL) via MOL and the neighbouring town to the north (KSU) and back to OSL. This route is serviced by Boeing 737 aircrafts at a frequency of five flights per day. The other service is a coastal route between the regional hubs BGO and TRD, which is servicing MOL and KSU both on the northbound and the southbound route. This coastal service is serviced by Fokker F50 aircrafts. The situation is illustrated in Figure 5.1.

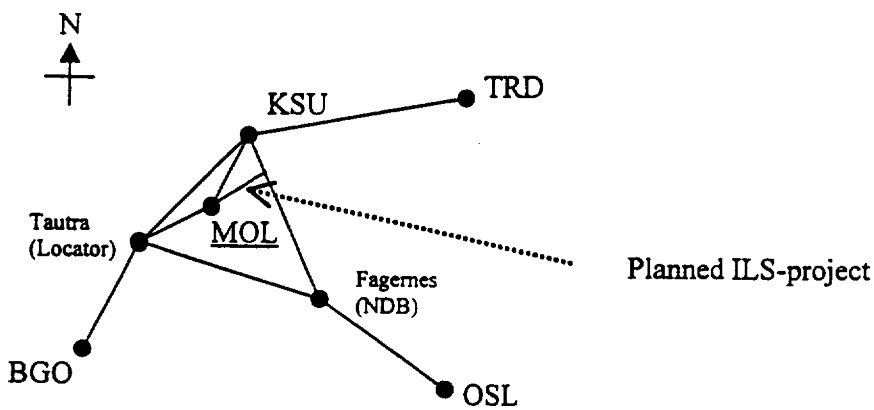


**Figure 5.1 Illustration of the flight connections servicing MOL (non scale)**

Currently MOL has an ILS system for landing from the west. When western winds exceed 5 m/s the approach is done by a circulating manoeuvre from the west, followed by a landing from the east. Western winds totally dominate the weather-conditions in the area, meaning that the vast majority of landings is currently done from the east.

### 5.2.2 The project: ILS from the east

The NCAA wants to carry out an impact analysis of building an ILS system for landings from the east. The necessary initial investment for such a system (partly based on components transferred from another airport) is estimated to be NOK 5 millions and the system is likely to have a economic life of 15 years. Within a planning horizon of 25 years this gives a discounted (7% discount rate) total investment of NOK 6.4 millions. The investment will after 25 year have a residual value of NOK 0.3 millions. Discounted maintenance and operating costs are estimated to amount to a total figure of NOK 2.4 millions.

The establishment of ILS systems is usually motivated through their anticipated effect on flight safety. However, in this case the system will also have other important effects on both the user benefit side, and on the operator side. Apart from the northbound BGO-MOL leg, approaching the airport from the west represents a *detour* from all connected airports. This means that passengers currently face an estimated travel time loss of between 2.5 and 5 minutes compared to a direct approach from the east. Equivalently the operators would save aircraft operating costs from a shorter average leg, and consequently there would also be a positive environmental impact due to less fuel consumption.

### 5.2.3 The analysis: Costs and benefits

Based on the method for economic impact assessment established through this project, we have carried out an analysis of the overall economic viability of this ILS system. We have divided the impacts into effects for the NCAA, for the operators, for the passengers, for the operators and effects for the environment. In order to illustrate the financial cashflow implications, we have included figures that illustrate the cashflow for the operators and for the NCAA. In table 5.2, the columns representing economic impacts illustrate the real economic impact, including external effects and excluding fiscal taxes.

| **Costs & Benefits ILS example** | **Economic impacts** | | **Financial cashflow** | |
|---|---|---|---|---|
| | Benefits | Costs | Revenue | Costs |
| C1 Passenger benefits | | | | |
| C1.1 Business journey | 13.1 | | | |
| C1.2 Other journeys | 8.6 | | | |
| S1 Accident costs | | | | |
| S1.1 Statistical lives | 0.3 | | | |
| S1.2 Injuries | | | | |
| S1.3 Material damage and administrative costs | 0.1 | | | |
| E1 The environment | | | | |
| E1.1 Local and regional emissions (NOx,VOC,Part.) | 2.4 | | | |
| E1.2 Global emissions (CO2) | 10.9 | | | |
| P1 The State/general taxes | | | | |
| P1.1 Fiscal aviation taxes | | | 0.0 | 0.0 |
| P1.2 VAT on NCAA investments and operating costs | | | 1.3 | 0.1 |
| P2 Operators/airlines | | | | |
| P2.1 Operating costs | 13.6 | | 13.6 | |
| P4 NCAA | | | | |
| P4.1 Investments | | 4.9 | | 6.1 |
| P4.2 Residual value | 0.2 | | 0.3 | |
| P4.3 Maintenance and operations | | 2.2 | | 2.4 |
| *SUM financial cashflow NCAA* | | | *0.3* | *8.4* |
| SUM *economic impacts* | 49.2 | 7.2 | | |
| Net present value (NPV) | 42.0 | | | |
| NPV/Cost ratio | 42.0/8.4<br>4.98 | | | |

**Table 5.2 ILS system example, economic impacts and financial cashflow**

The benefit side amounts to NOK 49.2 millions, and the costs (maintenance and investments) totals NOK 7.2 millions. Thus, the project has a net present value of NOK 42 millions, and a net benefit/cost-ratio of almost 5. This should indicate that the project should be carried out, and that it probably also would be ranked among the top projects in comparison with other projects within a budget constraint.

### 5.2.4 Economic viability vs. financial cashflow

If we consider the financial cashflow figures for the NCAA, the project does not seem to pass a simple cashflow analysis. The project does only cause extra investment and maintenance costs for the NCAA. However, if we include the effects for the operators into the cashflow analysis, the total savings in operating costs exceed the costs of the NCAA, and the project seems viable also from a cashflow viewpoint.

The vast majority of the benefit in the economic impact analysis stems from benefits in the intangibles category; i.e. the passengers and the environment. Although the establishment of ILS systems is mainly done as a safety measure, this is a case where the major benefits from the project comes from a reduction in travel time and less environmental damage.

In other words: This case gives a rationale for the extension of the scope of impact assessment in the aviation sector from a pure financial cashflow analysis towards the broader view of a full economic impact analysis.

# 6 Conclusions

The NCAA is an agent that is responsible for its own financial viability. At the same time, the NCAA's role in the Norwegian transport sector calls for a broader economic appraisal of projects within its jurisdiction. Making priorities subject to a full economic impact analysis instead of a more narrow financial cashflow approach, may significantly alter the portfolio of projects that reaches implementation. The dilemma for the NCAA is obvious: One may very well face situations where the financial analysis says one thing, while the economic impact analysis gives other recommendations. The financial source for NCAA's activities is the revenues from user charges and other commercial activities. The significant elements of intangibles may call for some kind of public-private partnership, to be able to take the welfare effects properly into account.

In this paper, we have briefly described the CBA tool that is developed for the NCAA. Even if there are still problems to be solved, like e.g. the value of time in multi-modal passenger transport, the method is applicable to most projects. The two examples included in the paper illustrate the decision dilemma where unprofitable financial results are achieved on one hand, and profitable economic outcomes on the other.

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# A Study on Inter-city Air/Rail Traveler's Behavior Considering Arrival Margin Time

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A behavior of inter-city traveler such as air and/or high speed rail passenger is affected by relatively lower frequency services. This paper proposes a disaggregate modal choice model which can evaluate the reduction of utility caused by low frequency of services. The model adopts arrival margin time as an index of influence of a destination arrival time. A questionnaire surveys were carried out for the travelers between Akita and Tokyo both at the airport and the railway station. The results show that line-hole time, egress time, and arrival margin time are the major choice factors of transportation mode for a long distance travel. It is clarified that an estrangement between a desirable trip schedule and service schedule makes negative utility for a passenger.

*Keywords: Air traveler's behavior, Arrival margin time, Disaggregate logit model*

## 1.Introduction

Most of inter-city air transportation network in Japan has low frequency service, while competitive railway network has much more frequent services. If the timetable of a transportation service doesn't fit for passenger's desirable itinerary, a traveler will choose an alternative transportation mode whose schedule is closer to his desirable time. Air passenger demand in Japan has been estimated by using the departure airport choice models and/or trip generation models.(Morichi and et. Al. 1994). The previous models take account of flight schedule as for an expected waiting time. For example, a half of average flight time span is added into the travel time for a modal choice behavior model. Since popular local inter-city air services in Japan have only two, three or four flights in a day, the assumed waiting time must be 2, 3 or four hours which is apparently different from actual waiting time.

This paper discusses the mode choice behavior of inter-city traveler and proposes the arrival margin time that will play a center role of traveler's timetable valuation and directly affect to the transportation mode choice. Traveler's evaluation is formulated as a linear utility function with the variable of the arrival margin time. Then, traveler's modal choice behavior is modeled by a popular disaggregate logit model.

## 2. Traveler's Modal Choice Behavior

### (1) Factors of Modal Choice

Time-related factors and monetary cost factors must influence traveler's modal choice behavior.

Previous modal choice models deal with line-haul time, egress time, access time, and the expected waiting time as time-related factors. In addition to these factors, this paper proposes an arrival margin time for the most important index of traveler's mode choice. A definition of the arrival margin time is shown in the following section.

The alternative, which maximizes traveler's utility, should be chosen through the model. If a transportation service whose schedule does not match with a traveler's desirable itinerary, the traveler feels some sort of disutility to use that transportation mode. A desirable arrival time is defined as the time, which realize the maximum utility and must also include some amount of margin time from the time deadline for a certain trip purpose. Unnecessary time difference between a desirable arrival time and an actual arrival time must decrease a traveler's utility. Actual arrival time at a destination, which is automatically fixed by the timetable, will influence traveler's utility as shown in Fig-1.

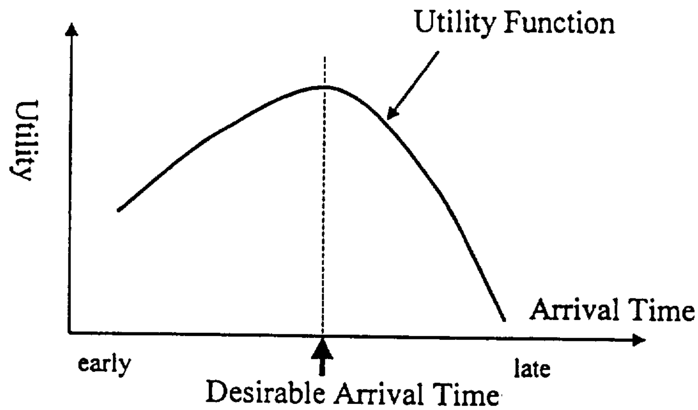



Figure 1 The General Concept of a Utility Function

(2) Definition of Arrival Margin Time

This paper defines arrival margin time as the time difference between desirable destination arrival time and actual destination arrival time (either plus or minus) as shown Figure-2 (1) and-2 (2).

Time difference between traveler's itinerary and the timetable, that is, arrival margin time must bring disutility. If actual arrival time is earlier than desirable arrival time, arrival margin time is positive value. The disutility is brought by the unnecessary early departure time or by the unnecessary idle time at the destination. If actual arrival time is later than the desirable arrival time, arrival margin time is negative value. The disutility is brought by the late arrival time at the destination which close to the deadline. One should feel very bad.

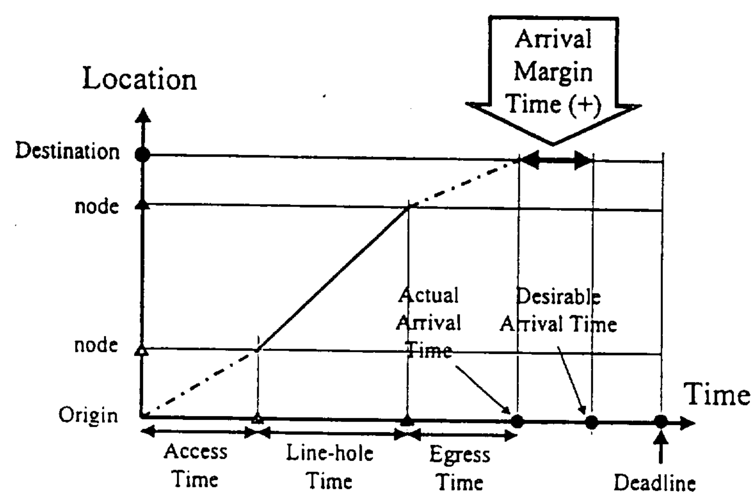



Fig-2 (1) A Concept of The Arrival Margin Time (+)

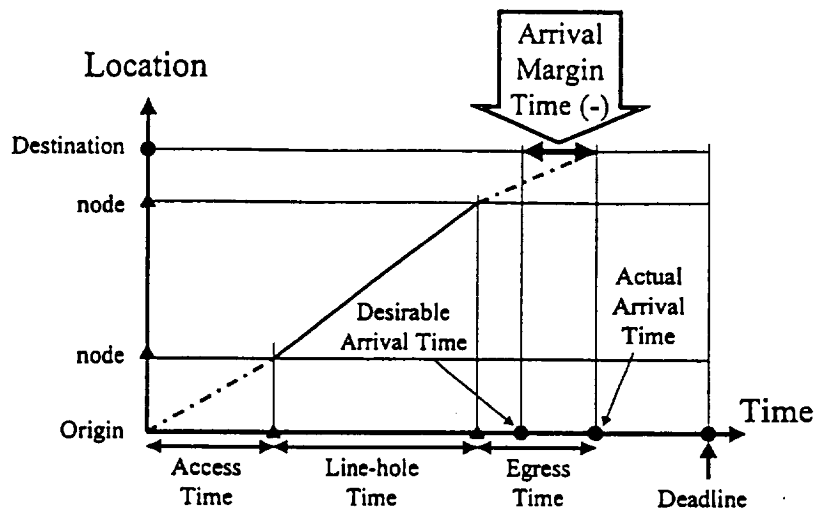


Fig-2 (2) A Concept of The Arrival Margin Time (-)

For the sake of convenient calculation, time difference between actual node arrival time and the time deducted egress time from desirable destination arrival time is regarded as arrival margin time. It is assumed that those values (Fig-2 (1) and Fig-3) are equivalent.

Evaluation of disutility is possible by adopting arrival margin time as an index.

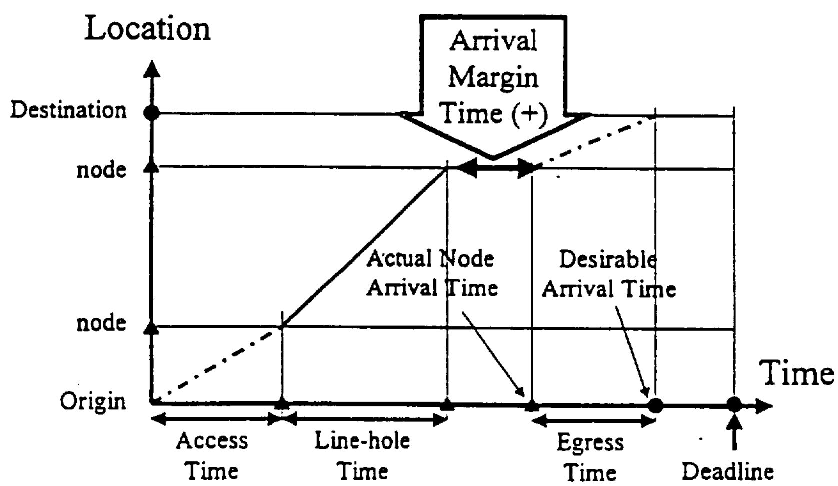


Fig-3 Calculated Arrival Margin Time

(3) Model Design

Time related factors and monetary factors influence traveler's modal choice behavior. Disaggregate logit model[2)] is introduced as the modal choice model. It is assumed that utility function is linear in the parameters. Systematic component of utility is shown as follows.

$$V_{ni} = \sum_{k=1}^{K} \theta_k X_{ink} \quad ,(i \in A_n) \qquad (1)$$

Where

$n$: traveler

$i$: alternative

$A_n$: set of alternatives

$V_{n}$: systematic components of the utility of $i$
$X_{ink}$: characteristic of $i$, $n$, and $k$
$\theta_k$: parameter

Based on random utility theory, the assumption that the random component is Gumbel distributed brings the probability $P_{in}$ that traveler $n$ would choose alternative $i$ as follows.

$$P_{in} = \frac{e^{V_{ni}}}{\sum_{j \in A_n} e^{V_{nj}}} = \frac{1}{\sum_{j \in A_n} e^{(V_{jn} - V_{in})}}, \quad (i \in A_n) \qquad (2)$$

3. Surveys of Inter-City traveler's behavior

(1) Outline

In order to estimate parameters, questionnaire surveys are carried out. The behavior of travelers between Akita and Tokyo (about 600km) both at the airport and the railway station are surveyed. Since long-haul bus services and private cars can not compete with air and rail, then ignored.

(2) Surveys

The questionnaire survey of air passenger's behavior is carried out at Akita airport. The survey of railway passengers is carried out at Akita railway station only for the bullet train bound for Tokyo. Results of the survey are shown in table-1.

The survey items are as follows:

1. purpose of the trip
2. originate place of the trip
3. destination place of the trip
4. desirable arrival time
5. access transportation mode
6. egress transportation mode
7. passenger's attributes (age, sex, and occupation).

Table-1 Results of Surveys

| Route | Mode | Number of Samples | % of Respondents |
|---|---|---|---|
| Akita Tokyo | Air | 526 | 37% |
| Tokyo Akita | Air | 650 | 41% |
| Akita Tokyo | Bullet Train | 615 | 32% |
| Tokyo Akita | Bullet Train | 228 | 12% |

4.Modal Choice Model

(1) Selection of Variables

If desirable arrival time is not defined, arrival margin time can not be computed. Passengers who didn't enter desirable arrival time are ignored. To suppose arbitrary desirable arrival time will decrease the confidence of the model. It is assumed that entered desirable arrival time is the time which brings maximum utility. Since the influence on behavior of early arrival is different from the influence of late arrival, arrival margin time should be distinguished positive value and negative value. Positive value and negative value are dealt with different variables.

The variables included the model are positive arrival margin time, negative arrival margin time, line-haul time, egress time, access time, fare, age, "on the way" trip dummy, and business trip dummy.

(2) The Assumptions of Routes and Travelers

Some assumptions are implicit in this model.

- Railway services are higher frequency. If railway alternative is chosen, there is no time difference between the itinerary and the timetable. Travelers can choose the railway service whenever he wants to use, and the arrival margin time is zero.
- The differences of each alternative are timetable, fare, and travel time (line-haul, access, and egress). Characteristics of the alternative included systematic components of utility are described by these factors.

A traveler's mode choice model is constructed based on the assumption stated the above. There are seven choice alternatives for the passenger between Tokyo and Akita. They are a railway service all over the day or one of the six air flights available in a day.

(3) Passenger Segmentation

Utility function seems to be different between on the way trip and the way back trip. The difference of trip purposes, such as business trip and private trip, must also affect to the shape of utility function. Passengers are segmented by the trip characteristics in the above and parameters of the model are estimated independently.

Passengers are segmented as follows.

Table-2 Segmentation of Samples

| Segmentation Pattern | segment 1 | segment 2 |
|---|---|---|
| non-segmentation | - | |
| Pattern 1 | on the way trip | the way back trip |
| Pattern 2 | business trip | private trip |

(4) Estimation Results of Parameters

Model parameters of both trip directions from Akita to Tokyo and from Tokyo to Akita are estimated separately. Positive arrival margin time, negative arrival margin time, egress time, and line-haul time are adopted as significant factors of the modal choice model, while variables of access time, fare, age, "on the way" trip dummy, and business trip dummy are omitted from the model by the t-test.

a) The Parameters of the Trip from Akita to Tokyo

The estimated parameters of the trip from Akita to Tokyo are shown in table-3 and figure-4. Non-business trip model can not be built because of shortage of samples. The results show a contrastive characteristic of the function between "on the way" trip and the way back trip. Regarding the on the way trip model, it was found that the later arrival after the desirable arrival time should reduce the passenger's utility more than the unnecessary earlier arrival for unit time period.

Regarding the way back trip, on the contrary, the earlier arrival would reduce utility more than the later arrival. Line-haul time affects more to the way back trip passengers than passenger on the way trip. Relative importance of parameters for business trip model are almost the same as those of non-segmentation model, however, all of them, travel time in particular, are found to be more sensitive. Egress time especially influences the most on the modal choice behavior for business trip passengers.

b) The Parameters of the Trip from Tokyo to Akita

Samples of "back" trip and non-business trip are too few to calculate the models. Egress time variable is rejected by the results of t-test. The results of non-segmentation model, "on the way" model, and business trip model are almost similar (table-4, fig-5). The reason is that the differences between samples of each model are small. The ratio of "on the way" trip samples to all samples is high in this route, and the ratio of business trip samples to all samples is similar.

Later arrival factor contributes to disutility more than earlier arrival factor and line-haul time factor relatively. The units of all factors are minutes. The ratio between each parameter means the weight between factors.

c) The evaluation between the route from Akita to Tokyo and the route from Tokyo to Akita

To evaluate difference of traveler's behavior between these directions, samples of the models are not segmented. The results of the models of both directions are shown in table-5, and fig-6. Positive arrival margin time, negative arrival margin time, and line-haul time are adopted as the factors of the models. Characteristics of parameters of both models are almost the same. The parameter of negative arrival margin time is as from three to four times much as the parameters of line-haul time. These results show the differences of each evaluated weight of time related factors.

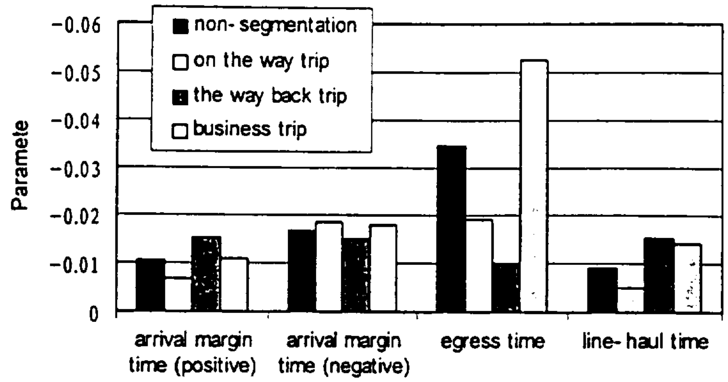



Figure-4 Result of 「Akita→Tokyo Trip」

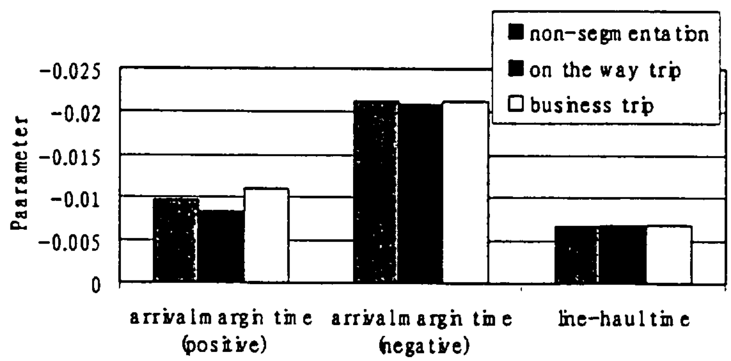



Figure-5 Result of 「Tokyo→Akita Trip」

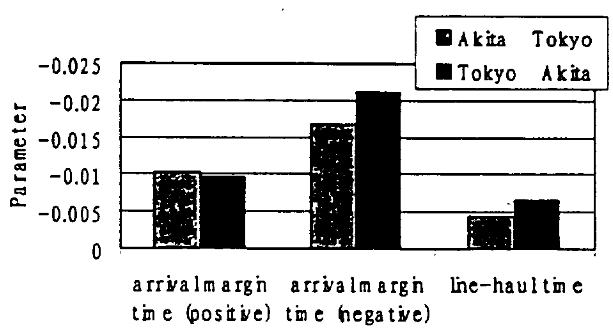



Figure-6 Result of Both Direction (non-segmentation)

Table-3 Result of 「Akita→Tokyo Trip」

| Akita Tokyo | non-segment samples:158 | on the way trip samples:97 | the way back trip samples:59 | business trip samples:119 |
|---|---|---|---|---|
| AMT (positive) | -0.0105 (-7.08) | -0.0068 (-4.02) | -0.0152 (-5.20) | -0.0109 (-6.13) |
| AMT negative | -0.0169 (-6.99) | -0.0187 (-5.18) | -0.0150 (-4.31) | -0.0181 (-6.43) |
| egress time | -0.0345 (-4.41) | -0.0191 (-2.11) | -0.0099 (-4.96) | -0.0526 (-5.20) |
| line-haul time | -0.0093 (-11.65) | -0.0051 (-5.97) | -0.0155 (-3.03) | -0.0142 (-13.24) |
| chai-squea | 228 | 139 | 96 | 186 |
| 2 | 0.335856 | 0.314277 | 0.311105 | 0.350128 |

*AMT : arrival margin time  ( ) : t-value

Table-4 Result of 「Tokyo→Akita Trip」

| Tokyo Akita | non-segment samples:114 | on the way trip samples:99 | business trip samples:95 |
|---|---|---|---|
| AMT (positive) | -0.0097 (-7.11) | -0.0083 (-5.90) | -0.0110 (-6.64) |
| AMT negative | -0.0212 (-5.66) | -0.0208 (-5.44) | -0.0213 (-5.31) |
| line-haul time | -0.0066 (-7.42) | -0.0069 (-6.66) | -0.0068 (-7.03) |
| chai-squea | 172 | 142 | 151 |
| 2 | 0.337536 | 0.316057 | 0.343215 |

*AMT : arrival margin time  ( ) : t-value

Table-5 Result of Both Routes (non-segmentation)

| non-segment | Akita Tokyo samples:158 | Tokyo Akita samples:114 |
|---|---|---|
| AMT (positive) | -0.0103 (-7.21) | -0.0097 (-7.11) |
| AMT negative | -0.0167 (-7.18) | -0.0212 (-5.66) |
| line-haul time | -0.0045 (-6.38) | -0.0066 (-7.42) |
| chai-squea | 220 | 172 |
| 2 | 0.323725 | 0.337536 |

*AMT : arrival margin time  ( ) : t-value

## 5. Conclusion

### (1) Summary of the Results

This paper proposes inter-city traveler's modal choice model specified evaluation of the timetable. Arrival margin time signifies time difference between traveler's itinerary and the timetable. It is an index of passenger's evaluation of the timetable in the model. The model can estimate the influence of the timetable to traveler's utility.

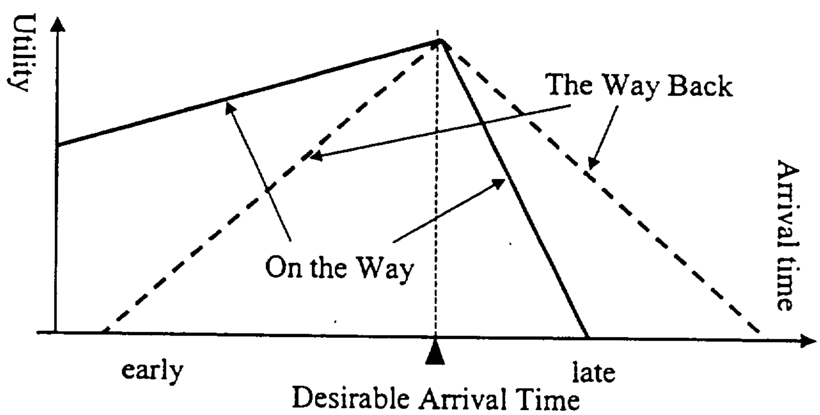
As the results of "on the way" trip model and "back" trip model, parameters of disutility by the time difference between itinerary and the timetable vary according to trip purposes.

Later arrival brings more disutility than earlier arrival in "On the way" trip. The characteristic of "back" trip is the contrary. (fig-7)

These results show that the degree of constraint of desirable arrival time of "on the way" trip is larger than the constraint of "back" trip. Line-haul time has great influence on "back" trip traveler's behavior, but influence on "on the way" trip traveler is relatively small. "On the way" passengers will regard certainty of arrival time as important and "back" passengers will regard total travel time as important. Business trip travelers are relatively sensitive to time related factors. Arrival time tends to be constrained in business trip. Therefore it is natural that the factors of later arrival and uncertainty of arrival time are regarded as important.

### (2) Summary of Method and Problem

It is possible to express time difference between traveler's itinerary and timetable by arrival margin time. Traveler's evaluation of the timetable is reflected in utility function. Disutility of earlier




arrival and disutility of later arrival can be estimated respectively by regarding positive arrival margin time and negative arrival margin time as different variables.

In this paper, model samples are segmented according to the purpose of trip. The purpose of a trip is a factor of the differences of utility functions. Characteristics of parameters are different between segments.

The method to regard arrival margin time as an immediate index of evaluation of the timetable has

Figure-7 Relation Between Utility and Arrival Time

problems. The distinction of entered desirable arrival time is a problem. Although this paper regards entered desirable arrival time as the time maximizing utility of the passenger, a respondent may be constrained arrival time. And it is supposed that entered time might include margin time to avoid later arrival. The meaning of arrival margin time is varied by the interpretation of entered desirable arrival time. It is necessary to exclude the bias of a reply in future.

### (3) Conclusion

The conclusions of this paper are shown as follows.

- This paper proposes the method to consider traveler's evaluation on the timetable and develops inter-city modal choice model. Factors of the traveler's modal choice behavior are line-haul time, egress time, and arrival margin time. Arrival margin time is applied to estimate traveler's evaluation of the timetable.
- Time related factors such as arrival margin time, line-haul time, and egress time are regarded as important. The influences on traveler's utility of each factor are different according to the purpose of trip. Later arrival brings large disutility especially in "on the way" trip and business trip.

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**Paper for presentation at Air Transport Research Group Conference**
**Hong Kong 6-8 June 1999**

**Title:** The privatisation of Australia's airports

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**Abstract:**

The key civil airports in Australia were administered by a government department until 1988. At that stage, the Federal Airports Corporation was formed to operate a system of airports along commercial lines. By 1994, though, policy thinking shifted in favour of privatisation, largely to allow the government to reduce its debt burden. So far, the government has received US$2.6 billion for 17 of the 22 airports. All but one of the remaining airports are in the Sydney region where on-going debates about an appropriate site for a second major airport have delayed the sales.

The paper describes the sales processes involved for the 17 airports and presents details about the new owners, the commitments they have entered into, and the regulatory system that has been established for the post-privatisation era. It is too early to assess the performance of the new owners, but this paper documents the pre-privatisation situation to assist future researchers.

**Key words:** airports, privatisation, performance

## Introduction

Prior to the 1980's, the Federal Government had financial responsibilities for aerodromes in Australia serving regular air passenger services and it owned and operated all of the major airports. Over a period of time, it had attempted to pass ownership and management of the airports serving narrower regional needs to the local authorities while expressing an objective to recover all of the costs of maintaining and development the civil aviation sector from users. During the mid-1980's, though, the case for a stronger system of financial accountability became pressing. The local ownership programme was accelerated and the major airports were corporatised under the Federal Airports Corporation (FAC).

In part, the commencement of the FAC in 1988 reflected national policies designed to reform the public sector and to increase the scope for competition. However, by 1994 policy-thinking shifted in favour of privatisation and, subsequently, the FAC was disbanded and 17 of its 22 airports were sold to the private sector. The remaining 5 airports have been set up as airport companies wholly-owned by the Government in preparation for sale. However, four of these are in the Sydney region where further progress on privatisation cannot be achieved until continuing issues about the siting of a second major airport have been settled. Starting from a position where it budgeted to receive US$1.4 billion for the sale of all of the FAC's airports, including Sydney, the Government so far has collected US$2.6 billion[1] in gross proceeds. Taking the FAC's estimates of earnings before depreciation, interest and taxes (EBDIT) together with the sale prices, the average price-earnings ratio was 17.1. This is much higher than price-earnings ratios of privatised airports in Europe. Should Sydney's airports be sold on similar terms, the Government would receive another US$ 1.8 billion after deducting sale expenses[2].

In this paper, we describe the background to privatisation and how the process was conducted in Australia In addition, we present details about the new owners. One of the aims of the Government was to maximise the proceeds from the sales, and on this score it has been successful. But the privatisation initiative also had other objectives. These are set out in the paper and we examine the mechanisms that were put into place during the sale process and we describe the post-sale regulatory framework.

A key concern is that the new airport owners have scope to increase their aeronautical charges because they are local monopolies and their demand is insensitive to price. As a result, the post-privatisation regulatory framework in Australia involves price-capping

[1] All dollar values in this paper have been expressed first in constant (1998/99) dollar values using the Australian Consumer Price Index and then have been converted at the rate of one AUD is equal to $0.633 US.

[2] No allowance has been made in this estimate for assets held by the Government at Badgerys Creek. Badgerys Creek had been proposed as the site for Sydney's second major airport but, following an unfavourable environmental impact study, the Government is considering other options.

and monitoring. The paper describes these regulatory frameworks, but it is too early at this stage to assess the success or otherwise of these mechanisms and to shed light on issues raised in the literature on the regulation of airports. Such issues include, for example, the risk that price-cap regulation results in a weak incentive to invest in capacity and to improve quality. The Government is committed to undertaking a review of its regulations prior to 2002, and there is no doubt that researchers and policy makers will revisit these matters.

By documenting the processes that led to privatisation, explaining how privatisation was effected and the commitments that have been entered into by the Government and the new owners, the intention of the authors is to facilitate future research. Furthermore, the paper illustrates the complexity of an exercise in selling off a system of airports and the demands it creates for information about airports and the markets they serve. The paper commences with information about the size and growth performance of the Australian airports, and then describes how Government policies towards airports moved gradually to privatisation. Remaining sections document the sales processes and their outcomes together with an account of the new regulatory framework. Although it is too early to pass judgements on the success or otherwise of privatisation other than in terms of the amounts received by the Government, we conclude with observations about the initial actions of the new airport lessee companies.

## Airports offered for sale

Table 1 shows the relative sizes of the airports in the last year when the FAC owned and operated its full set of 22 airports[3]. Australia's major cities are located around the periphery of a large land mass and there has been little potential for the development of hub-and-spoke airline networks in the domestic market. As Australia's most populous city, Sydney is the major domestic airport, followed by Melbourne. However, Sydney is the dominant international gateway while Brisbane vies with Melbourne as the second busiest international airport.

It is clear from Table 1 that the air transport traffic is concentrated at a small number of airports. Approximately two-thirds of all domestic airline trips in Australia occur within the triangle formed by connecting the eastern capital cities of Sydney, Melbourne and Brisbane. The national capital, Canberra, and the country's premier resort area, the Gold Coast (Coolangatta Airport), are the major centres also included in this area. To the west, Adelaide and Perth each serves more than 3 million passenger movements each year, but Perth's international traffic is more than 7 times the size of Adelaide's. Of the remaining capital cities, Darwin is advantageously located in the far north of Australia to serve as an important regional gateway, while Hobart is situated in an island State with a small

[3] In a sense, the privatisation process commenced in April 1993 when the small general aviation airport, Cambridge, located close to Hobart Airport was sold to a local investor. This reduced the number of FAC airports from 23 to 22.

resident population. The busiest general aviation airports are located in or near the major cities.

**Table 1: Relative size of the FAC's airports - 1996/97**

| Airport | Type of airport | Passengers (millions)[1] | Aircraft (thousands)[1] | Tonnes landed (millions) | Revenue US$ 1998/99 (millions) | Share of FAC Revenue |
|---|---|---|---|---|---|---|
| Sydney | International | 20.76 | 275.6 | 12.32 | 158.60 | 39.6% |
| Melbourne | International | 13.48 | 152.3 | 7.03 | 81.31 | 20.3% |
| Brisbane | International | 10.26 | 157.1 | 5.32 | 68.14 | 17.0% |
| Perth | International | 4.59 | 95.2 | 2.42 | 33.89 | 8.5% |
| Adelaide | International | 3.69 | 103.1 | 1.60 | 18.00 | 4.5% |
| Coolangatta (Gold Coast)[2] | Domestic | 1.94 | 86.0 | 0.74 | 6.52 | 1.6% |
| Darwin | International | 1.01 | 81.1 | 0.69 | 5.49 | 1.4% |
| Canberra | Domestic | 1.76 | 107.2 | 0.78 | 5.10 | 1.3% |
| Bankstown (Sydney)[3] | General aviation | 0.00 | 621.0 | 0.00 | 4.69 | 1.2% |
| Hobart[2] | Domestic | 0.85 | 15.0 | 0.32 | 3.49 | 0.9% |
| Townsville[2] | Domestic | 0.68 | 59.9 | 0.32 | 2.85 | 0.7% |
| Alice Springs[4] | Domestic | 0.80 | 44.3 | 0.37 | 2.84 | 0.7% |
| Launceston | Domestic | 0.59 | 45.5 | 0.26 | 2.71 | 0.7% |
| Essendon (Melbourne) | General aviation | n.a. | 68.9 | 0.08 | 2.33 | 0.6% |
| Parafield (Adelaide) | General aviation | n.a. | 292.1 | n.a. | 1.30 | 0.3% |
| Moorabbin (Melbourne) | General aviation | 0.03 | 342.1 | n.a. | 1.17 | 0.3% |
| Jandakot (Perth) | General aviation | n.a. | 378.0 | n.a. | 0.75 | 0.2% |
| Archerfield (Brisbane) | General aviation | n.a. | 254.5 | n.a. | 0.73 | 0.2% |
| Mount Isa | Domestic | 0.10 | 6.7 | 0.05 | 0.45 | 0.1% |
| Total | | 60.55 | 3,185.8 | 32.29 | 400.35 | 100.0% |

Notes: (1) Passenger and aircraft numbers are totals for arriving and departing movements; (2) Limited international services operate from time to time to Coolangatta, Hobart and Townsvillle airports; (3) Camden and Hoxton Park general aviation airports included with Bankstown; (4) Tennant Creek included with Alice Springs.
Source: Federal Airports Corporation, *Annual Report 1996/97*.

The marketability of Australia's airports was largely influenced by an impressive record of growth and profitable operation. Table 2 shows that the total passenger throughput for the FAC airports between 1987/88 and 1996/97 grew at an average annual rate of growth (AARG) of 7.8%. Airports with above-average growth, Brisbane and Perth, were becoming important gateways as Australia's popularity as a long-haul tourist destination increased. As a group, the airports serving domestic traffic grew at the slowest rates, though these were still buoyant markets over the long-term.

Aircraft movements grew less strongly as larger aircraft assumed greater importance so that landed tonnes improved almost in line with the number of passengers. Indeed, for Sydney, Brisbane and Perth, landed tonnes increased at a faster rate than the number of passengers. When the FAC was formed, one of the goals it was set was to keep its aeronautical charges as low as possible by increasing its income from other sources. The FAC's successes in this regard, achieved largely through retailing and property sources, shows up in the growth rate for revenue. As a result, the FAC's airports collectively earned a surplus before depreciation, interest and taxes of US$262 million in 1996/97 on an asset base of US$1.99 billion[4]. However, Tables 2 and 3 also show that some of the smaller domestic and general aviation airports did not share in the growth and profits (as calculated in the FAC's accounts).

[4] This does not include Head Office activities.

## Table 2: Average annual rates of growth of FAC airports – 1988/89 to 1996/97[1]

| Airport | Type of airport | Passengers | Aircraft | Tonnes landed | Revenue |
|---|---|---|---|---|---|
| Sydney | International | 5.7% | 3.3% | 6.0% | 11.9% |
| Melbourne | International | 7.0% | 4.4% | 4.6% | 9.1% |
| Brisbane | International | 8.5% | 4.7% | 8.9% | 14.4% |
| Perth | International | 8.3% | 5.3% | 9.7% | 14.1% |
| Adelaide | International | 6.1% | 2.9% | 5.4% | 10.6% |
| Coolangatta (Gold Coast)[3] | Domestic | 6.8% | 1.0% | 4.7% | 8.2% |
| Darwin[2] | International | 7.5% | -1.0% | 6.3% | 11.0% |
| Canberra[2] | Domestic | 4.1% | 0.5% | 2.6% | 4.8% |
| Bankstown (Sydney)[4] | General aviation | n.a. | 0.6% | n.a. | 21.7% |
| Hobart[3] | Domestic | 6.8% | -10.6% | 3.6% | 9.3% |
| Townsville[23] | Domestic | 4.2% | -5.8% | -3.1% | 1.7% |
| Alice Springs[25] | Domestic | 2.3% | 0.9% | -1.7% | 5.2% |
| Launceston | Domestic | 5.1% | 2.3% | -3.6% | 3.3% |
| Essendon (Melbourne) | General aviation | n.a. | 0.4% | -5.9% | 4.5% |
| Parafield (Adelaide) | General aviation | n.a. | 2.5% | n.a. | 17.4% |
| Moorabbin (Melbourne) | General aviation | n.a. | -0.9% | n.a. | 16.8% |
| Jandakot (Perth) | General aviation | n.a. | 4.5% | n.a. | 15.0% |
| Archerfield (Brisbane) | General aviation | n.a. | -0.3% | n.a. | 11.8% |
| Mount Isa[2] | Domestic | 5.9% | -17.9% | 0.2% | 5.7% |
| Total | | 7.8% | 3.0% | 7.0% | 12.5% |

**Notes:** (1) Alice Springs, Canberra, Darwin, Mount Isa and Townsville airports were transferred to the FAC during 1989/90, the year of a lengthy pilots' dispute. The AARG for these airports is for the shorter period of 1990/91 to 1996/97; (2) AARG of for period 1990/91 to 1996/97; (3) Limited international services operate from time to time to Coolangatta, Hobart and Townsville airports; (4) Camden and Hoxton Park general aviation airports included with Bankstown; (5) Tennant Creek included with Alice Springs.

**Sources:** Federal Airports Corporation, *Annual Reports 1987/88 to 1996/97.*

## Table 3: Profitability of FAC airports - 1996/97 (US$000 at 1998/99 values)

| Airport | Total Revenue | Operating expenses | EBDIT[1] | Depreciation | EBIT[2] | Assets |
|---|---|---|---|---|---|---|
| Sydney | 158,598 | 51,088 | 107,510 | 40,054 | 67,456 | 786,945 |
| Melbourne | 81,305 | 26,568 | 54,737 | 17,032 | 37,706 | 307,371 |
| Brisbane | 68,137 | 18,920 | 49,216 | 21,875 | 27,342 | 343,289 |
| Perth | 33,888 | 11,635 | 22,253 | 4,908 | 17,345 | 140,865 |
| Adelaide | 17,997 | 7,380 | 10,617 | 2,899 | 7,718 | 94,981 |
| Coolangatta (Gold Coast) | 6,519 | 2,601 | 3,918 | 721 | 3,198 | 26,573 |
| Darwin | 5,495 | 3,004 | 2,491 | 3,189 | -699 | 45,233 |
| Canberra | 5,101 | 2,278 | 2,823 | 510 | 2,313 | 32,556 |
| Bankstown (Sydney) | 4,694 | 2,620 | 2,074 | 1,398 | 676 | 80,182 |
| Hobart | 3,493 | 1,788 | 1,705 | 623 | 1,082 | 8,750 |
| Townsville | 2,848 | 2,014 | 835 | 1,360 | -525 | 18,785 |
| Alice Springs | 2,841 | 1,813 | 1,028 | 1,430 | -402 | 17,044 |
| Launceston | 2,712 | 1,377 | 1,335 | 562 | 773 | 10,797 |
| Essendon (Melbourne) | 2,330 | 1,749 | 581 | 677 | -96 | 19,135 |
| Parafield (Adelaide) | 1,297 | 770 | 527 | 355 | 172 | 15,369 |
| Moorabbin (Melbourne) | 1,166 | 885 | 281 | 263 | 17 | 13,074 |
| Jandakot (Perth) | 746 | 1,061 | -315 | 281 | -596 | 8,757 |
| Archerfield (Brisbane) | 731 | 801 | -70 | 161 | -231 | 9,428 |
| Mount Isa | 455 | 388 | 66 | 379 | -313 | 7,189 |
| Total | 400,353 | 138,740 | 261,613 | 98,677 | 162,937 | 1,986,324 |

Notes: (1) Earnings before depreciation, interest, taxes; (2) Earnings before interest, taxes.
Source: Federal Airports Corporation, *Annual Report 1996/97*.

## The path from government department to private ownership

After World War II, a large number of aerodromes became available in Australia for civil aviation operations. As the volume of air traffic increased, most of the Federal Government's funds were directed towards the busiest airports serving larger aircraft. Local communities had to bear the financial burden of developing their own aerodromes until 1941 when maintenance grants were available for all aerodromes with regular passenger transport (RPT) services.

An Aerodrome Local Ownership Plan (ALOP) was introduced in 1958 under which all aerodromes that served a local rather than a national need were to be owned, developed, operated and maintained by the communities they served (Bureau of Transport Economics 1985). The Government offered to transfer its aerodromes to local authorities – free of charge, and with an agreement to pay half of future approved maintenance and development for an agreed period. The intent of this policy was that the Government would support a local aerodrome wherever an RPT service could be sustained.

Over the next two decades, the financial burden on the Government increased as responsibilities were broadened to include general aviation and aerodromes on mission stations. By 1981, there were 436 aerodromes eligible for assistance, the Government itself continuing to own 81 civil airports, including 12 operated by the Department of Defence. Successive governments in Australia had set themselves the objective of achieving full cost-recovery from the civil aviation sector, but an inquiry calculated that only 55% of costs were being covered through charges on the industry in 1982-83. Moreover, the inquiry found that there were significant problems with the system of administering civil aviation in Australia (Bosch et. al. 1984).

As a result, the local ownership programme was accelerated so that, by 1994, the Government had divested itself of all but the 23 airports vested in the newly-formed Federal Airports Corporation (FAC). The most significant transfer of ownership during this period was Cairns Airport which, under the ownership of the Cairns Port Authority, became Australia's fastest growing international gateway.

The FAC commenced with 17 airports and an asset base of US$0.8 billion on 1 January 1988, but another 6 airports were added in April 1989[5]. The formation of the FAC occurred against the background of a wide-ranging programme of microeconomic reform sweeping the Australian economy. The corporatisation model was intended to give the management of the airports greater commercial freedom and to emulate governance, management, and incentive systems employed in the private sector. The FAC was

[5] The additions in 1989 included airports shared with the Department of Defence - Canberra, Darwin and Townsville. The total of 23 airports was reduced in 1993 when Cambridge Airport was sold.

responsible for the operation of the airports, including terminal facilities[6] and other commercial services, but did not include air traffic control. It became liable for payroll taxes in 1998/99 and for income tax in 1991/92, and it had to earn a reasonable rate of return and pay dividends to the Government[7]. Residual powers lay with the Minister of Transport to direct the FAC to perform certain functions in the public interest[8].

It was intended that the FAC would operate the airports along commercial lines. Table 4 presents selected performance measures for 1991/92 and 1996/97 to document the situation during the early 1990's. The results for 1997/98 for Melbourne, Brisbane and Perth were taken from annual reports produced by their new owners and cover the first year of operation as privatised airports. The remaining results for 1997/98 in Table 4 were achieved by the FAC in its final year of operation.

For the group of airports, revenue per employee increased by more than 54% over the five years up to 1996/97, reflecting the combined effect of a 16% reduction in the number of employees and a 43% increase in real revenue. Despite the onset of the Asian economic crisis in the middle of 1997, there was a further improvement of 11.3% in revenue per employee across all of the airports in 1997/98. This was assisted by the strong improvement in performance between 1996/97 and 1997/98 at Melbourne, Brisbane and Perth airports under their new owners - 37%, 35% and 30%, respectively. Over the same period, Sydney Airport's revenue per employee increased by 21%. Much of this improvement is correlated with increases in the number of passengers and landed tonnes. However, Table 4 also shows that revenue-earning performance generally improved in real terms throughout the 1990's.

Despite a record of improved performance within a corporatised structure, there were continuing debates about the merits of fully privatising the airports (Mills 1995, White 1996). The distances between the main Australian airports places a limit on the amount of competition that can occur and it was recognised that privatisation would have to be accompanied by regulation. Price caps were the preferred approach, although the problem of creating workable incentives for the airport operator to improve quality and capacity had been observed (Rovizzi & Thompson 1992). The FAC had been criticised for its failure to use social cost-benefit analysis to justify capital expenditure works, but the incentive for private sector owners to do this would be considerably weaker (Forsyth 1993). Also, Australian airports were designed to cater for two major domestic carriers and new entrants to the airline industry after deregulation in 1990 complained about their access to terminal facilities. The question arose whether a private owner of the airport would ensure competitive access.

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[6] Prior to the FAC taking control of its airports, the Government negotiated long-term leases for terminals with the domestic airlines, Ansett and Australian (later merged into Qantas).

[7] The target rate of return was 7.5% on assets before taxes.

[8] For example, the FAC was directed to waive its landing charges for domestic airlines during the extended pilots' dispute in 1989, for which it was compensated.

One of the events that influenced attitudes to privatisation was a review of aeronautical pricing at Sydney International Airport. The FAC continued the practice of setting uniform, weight-based prices for aeronautical services for all of the airports. There was one exception – congestion charges were permissible at Sydney Airport as management device. As a result of continuing criticism of the way charges were being imposed, especially by airlines, the Government directed the Prices Surveillance Authority (PSA 1993)[9] to undertake a review.

**Table 4: Performance measures for selected years (expressed in 1998/99 US$ values)[1]**

| | Revenue per employee | | | Revenue per passenger | | | Revenue per landed tonne | | |
|---|---|---|---|---|---|---|---|---|---|
| Airport | 1991/92 | 1996/97 | 1997/98 | 1991/92 | 1996/97 | 1997/98 | 1991/92 | 1996/97 | 1997/98 |
| Sydney | 280,920 | 417,214 | 502,571 | 7.26 | 7.64 | 8.23 | 12.24 | 12.88 | 14.17 |
| Melbourne | 222,237 | 366,009 | 502,907 | 6.01 | 6.03 | 6.55 | 11.04 | 11.57 | 12.97 |
| Brisbane | 326,714 | 475,269 | 641,899 | 6.37 | 6.64 | 7.10 | 12.55 | 12.80 | 14.63 |
| Perth | 161,406 | 284,038 | 368,460 | 6.80 | 7.38 | 7.26 | 12.94 | 14.00 | 13.58 |
| Adelaide | 161,277 | 240,290 | 246,580 | 4.56 | 4.88 | n.a. | 10.09 | 11.27 | n.a. |
| Coolangatta (Gold Coast) | 193,378 | 199,238 | 232,378 | 3.65 | 3.36 | 3.99 | 9.07 | 8.81 | 10.20 |
| Darwin | 106,101 | 198,096 | 187,259 | 5.74 | 5.43 | 5.50 | 8.35 | 8.01 | 8.27 |
| Canberra | 124,743 | 208,700 | 219,861 | 2.87 | 2.89 | 3.28 | 6.20 | 6.55 | 7.74 |
| Bankstown (Sydney) | 105,109 | 180,092 | 211,095 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Hobart | 98,911 | 132,384 | 121,856 | 5.87 | 4.10 | 3.96 | 15.25 | 10.96 | 11.14 |
| Townsville | 89,272 | 147,674 | 132,674 | 3.90 | 4.17 | 4.72 | 7.07 | 8.87 | 9.80 |
| Alice Springs | 88,410 | 156,888 | 145,735 | 3.24 | 3.54 | 3.53 | 6.38 | 7.62 | 8.30 |
| Launceston | 96,675 | 110,852 | 114,297 | 6.03 | 4.62 | 4.20 | 13.18 | 10.37 | 9.35 |
| Essendon (Melbourne) | 70,296 | 104,031 | 116,885 | n.a. | n.a. | n.a. | 25.30 | 29.73 | 29.90 |
| Parafield (Adelaide) | 39,892 | 114,683 | 109,200 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Moorabbin (Melbourne) | 69,098 | 111,549 | 97,839 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Jandakot (Perth) | 30,189 | 71,102 | 57,939 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Archerfield (Brisbane) | 66,744 | 85,986 | 102,515 | n.a. | n.a. | n.a. | n.a. | n.a. | n.a. |
| Mount Isa | 75,112 | 127,790 | 150,259 | 4.41 | 4.77 | 4.73 | 6.10 | 9.00 | 8.33 |
| Total[2] | 201,141 | 310,270 | 345,300 | 6.39 | 6.73 | n.a. | 11.82 | 12.62 | n.a. |

Notes: (1) Melbourne, Brisbane and Perth airports were operated by their new owners throughout the 1997/98 financial year. The Phase 2 sales were effected at varying stages during 1997/98, but the data in the table were reported by the FAC in its *Annual Report* on a full-year basis; (2) Total results for 1997/98 do not include Melbourne, Brisbane and Perth airports.
Sources: Federal Airports Corporation, *Annual Reports 1991/92, 1996/97 and 1997/98*, Australia Pacific Airports Corporation, *Annual Report 1997/98*, Westralia Airport Corporation, *Annual Report 1997/98*, and Brisbane Airport Corporation Limited, *Annual Report 1997/98*.

The PSA believed that efficiency would be promoted if each airport set its own fees and that this form of cross-subsidisation should be removed. In addition, the PSA argued that aeronautical services should not be funded from non-aeronautical revenue and that congestion charges should be applied to fully manage demand at Sydney Airport. The PSA further recommended that the FAC and the PSA work jointly on a price-capping methodology.

[9] The PSA was absorbed into the Australian Competition and Consumer Commission.

The completion of this inquiry coincided with a shift in policy towards privatisation of government business enterprises with the proceeds being used to reduce government debt. After wide-ranging public debate, the ruling Australian Labor Party resolved its objections to privatisation. In April 1994, the Government announced that it intended to sell its airports and a scoping study was commenced to guide the Government's thinking on how best to proceed.

## The privatisation process

### Preparing for the sales

The Government had made an allowance of US$1.4 billion (1998/99 values) in its budget estimates for the sale of the FAC but its advisers, ANZ McCaughan and Salomon Brothers, proposed a higher net value in 1994 of US$1.8 billion (1998/99 values). In proceeding with the sale, it was clear that an important objective was the maximisation of the proceeds from the sale, but the Government announced that it had set a number of sales and ongoing objectives to be met by the winning bidder. Apart from net proceeds on a risk-adjusted basis to the Commonwealth, financial strength and management capabilities to operate and develop airports, extent of local participation, airport development plans and commitment to the effective development of airport services, environmental credentials and equitable treatment of FAC employees were to be included in the selection criteria.

The Government also set a limit of 49% foreign ownership and a requirement that the majority of directors of an airport lessee be Australian citizens or Australian residents. Restrictions were placed on cross-ownership of major airports and airlines were limited to a maximum share of 5% of the airport operators.

Privatisation of a single airport, let alone a system of airports, is a complex exercise. Four years were to pass between the announcement of a policy decision to privatise Australia's airports and the conclusion of two phases of the sale process. Even then the most valuable airport, Sydney, was put to one side pending resolution of uncertainties about the development of a second major airport in the Sydney region. Table 5 summarises the key milestones leading to the sale of the first set of airports.

Preliminary work took 16 months to complete, but key issues had to be addressed. A scoping study evaluated sale options and led to decisions to sell the FAC as a set of individual airports rather than as a system. This was to be achieved through trade sales in a public tender process rather than through a set of public floats. The initial intention was to retain the FAC as a public corporation providing airport management and technical services on a commercial consultancy basis, but later developments linked to the problems of Sydney Airport resulted in the Government's decision to exclude the FAC from the privatisation process (White 1996).

The structure of the FAC did not facilitate the sale as proposed since each airport had been operated as a cost centre with the Head Office providing a range of services that needed to be devolved to the airports. The FAC facilitated the sales process by undertaking the necessary reorganisation. This included a revision of the structure of the FAC's aeronautical charges. The previous practice of setting network-wide aeronautical charges was abandoned in favour of location and service specific charges. The new pricing system was effected for Sydney, Melbourne, Brisbane, Perth and Adelaide airports on 1 January 1997. Landing fees had been held constant since April 1991 and the new charges represented an increase of 10.8% in total aeronautical charges. In introducing the charges, the FAC claimed that its landing fees remained low by international standards. Further changes in tariffs for Sydney Airport were introduced in October 1998 with the effect that costs of landing smaller, domestic jet aircraft and freighter aircraft fell while charges rose for international passenger aircraft by up to 30%.

In addition, the assets vested in the FAC had to be transferred back to the Government and appropriate legislation was drawn up in the *Airports (Transitional) Act*. This also enabled the Government to grant long-term leases in airport land to "airport lessee companies". At the same time, it was necessary for the Government to pay off the FAC's debts of US$441 million. An additional piece of legislation, the *Airports Act* established the regulatory framework that would apply to airports after the sales were completed, including provisions dealing with foreign ownership. In particular, the Act nominated the Australian Competition and Consumer Commission (ACCC) as the body responsible for administering price-cap regulation, price surveillance and quality of service monitoring. The ACCC also was empowered to publish information that the airport operators were obliged to provide. The Minister for Transport also retained discretionary powers to introduce traffic management measures.

The passage of the Bills was delayed as a result of an election which resulted in the removal of the Australian Labor Party from power and its replacement by a Liberal/National Party Coalition. Although the new Government had opposed certain aspects of the airport Bills while in opposition, it moved ahead with privatisation. Although it had an estimated worth equal to half of the total value of the other 21 airports, the decision was made to defer the sale of Sydney International Airport and the general aviation airports in the Sydney region, Bankstown, Camden and Hoxton Park. The remaining 17 airport leases were to be sold in two tranches. The first was to include Melbourne, Brisbane, Perth and Adelaide. Subsequently, Adelaide's sale was delayed so that negotiations could continue with the State Government about a proposal to extend the runway[10].

### Phase 1 sales

The Government initially managed the sales process through the Department of Finance, but later passed this to a new body, the Office of Asset Sales and IT Outsourcing

[10] In July 1997, the Government injected US$16 million into the FAC to fund the runway extension. Another US$2 million was provided at a later date.

(OASITO). Input on transport policy and regulatory matters was provided by the Department of Transport and Regional Development. Expressions of interest were invited from interested parties in September of 1996 as a demanding schedule of information gathering, evaluation, proposal and assessment commenced. A total of 170 parties expressed initial interest, but only 60 of these participated in the first stage, and only 30 submissions were received by the due date of 10th October 1996. Twelve of these were selected for further consideration and their backers were invited to tender.

To assist the bidders undertake their "due diligence" investigations, the Government's task force had prepared relevant documentation indicating the potential value of the assets and presenting relevant data[11]. Since this involved confidential information, the Government only provided its Information Memoranda to the shortlisted consortia and then went to considerable length to ensure that the sales were conducted on a level playing field. Shortlisted consortia were given access to airport sites, to the FAC's managers, and to other key stakeholders. A data room was established and contained financial information and relevant documents, plans and drawings. The adequacy of these measures was criticised by the bidders and the ANAO later judged that the costs of the sale process had been increased for both the Government and the bidders (Australian National Audit Office 1998).

Other ground rules governing the sales were that the consortia were not permitted to use the media in a way that would influence valuations, and no negotiations were entered into about the tender documents themselves. The bidders had until the end of January to formalise their bids. At that stage, 9 consortia submitted 17 bids for the 3 airports. However, there were certain aspects of these bids that did not conform with the tender specifications and all parties were invited to re-submit. The Government selected the 3 winning bids from the 13 revised bids and announced its decisions in May 1997.

**Table 5: Milestones - Phase 1 of airport sales**

| Date | Event |
|---|---|
| April 1994 | Government publishes a White Paper on Employment and Growth in which it announces an intention, in principle, to sell the FAC's airports |
| May 1994 | Scoping study initiated to investigate feasibility of selling the FAC network and to report on post-sale regulatory requirements |
| June 1994 | BZW engaged to provide business advice to the scoping study task force to advise on sale options and strategies and the actions required to achieve the Government's timetable. |
| March 1995 | Scoping study completed |
| April 1995 | Decision to sell all 22 FAC airports in two phases in individual trade sales. First tranche to be Sydney (including Sydney West), Melbourne, Brisbane and Perth. Adelaide Airport was added later. |
| August 1995 | BZW appointed as Business Adviser to assist with marketing, due diligence, tendering and bid evaluation and bidder contract negotiations. |
| September 1995 | Bills introduced into Parliament. The *Airports Bill* established the regulatory framework for post-privatisation and the *Airports (Transitional) Bill 1995* facilitated the sale of the leases. |
| December 1995 | Appointment of legal advisers (AGS and Clayton Utz.) |
| March 1996 | New Government elected, but commitment to complete the first phase of sales (Melbourne, Brisbane and Perth) by 30 June 1997. Sydney was excluded from the Phase 1 sales pending the resolution of noise issues over Sydney and the completion of an environmental impact study for the proposed second Sydney Airport at Badgerys Creek (Sydney West Airport). Adelaide also was removed from Phase 1 sales in order to resolve issues in relation to a proposal to extend the international terminal.. Airport Sales Task Force within Department of Finance formed to manage and complete the sales. The |

[11] The preparation of the Information Memoranda occurred over a period of twelve months.

| | |
|---|---|
| | Department of Transport was reorganised as the Department of Transport and Regional Development. |
| September 1996 | Amended Bills passed in Parliament and effective from 9 October 1996. |
| 12 September 1996 | Call for expressions of interest in Phase 1 airports. The requirements for participating in the bid process and basis for shortlisting of consortia were issued. |
| October 1996 | Office of Asset Sales takes over the task of managing and completing the sales. The Department of Transport and Communications' role was to develop legislation and regulations, prepare leases, and evaluate bids from a transport policy perspective. |
| 10 October 1996 | Invitation for expressions of interest closed. 170 parties registered an interest and 60 of these participated in the bidding process. 30 lodged expressions of interest by the due date. |
| 18 October 1996 | 12 consortia were short-listed and were issued with a Request for Proposal. |
| 30 October 1996 | Tender documents were issued after the signing of confidentiality agreements. |
| November 1996 | Government's paper on Pricing Policy for airports released (developed by the Department of Transport and Regional Development in consultation with the Australian Competition and Consumer Commission and other stakeholders). |
| 30 January 1997 | 9 consortia submitted a total of 18 offers (5 for Melbourne, 6 for Brisbane and 7 for Perth) |
| February 1997 | The Office of Asset Sales and its Business Adviser evaluated the offers and concluded that a further round of bids was necessary to improve the offers in terms of their conditionality and conformity with tender requirements. Six of the consortia were invited to participate in this third stage.. |
| 10 April 1997 | 13 revised bids were submitted by the 6 consortia (3 for Melbourne, 5 for Brisbane, 5 for Perth) |
| 3 May 1997 | Decisions made about successful bids. |
| 7 May 1997 | Sale Agreements were signed for the airports for a total of US$2.1 billion. |
| 1 July 1997 | New airport operators take over control at Melbourne, Brisbane and Perth Airports and Phase 1 of the airport sales process completed. |

Given the initial expectation of a total net sales figure of US$1.4 billion in the budget estimates, the first tranche of sales netted US$2.0 billion alone[12]. On average, the amounts paid implied an earnings multiple[13] of 16.8 compared to multiples of 5 to 10 times earnings in sales of international airports in Europe (Australian National Audit Office 1998). Details about the winning bids are provided in Table 5.

- Melbourne/Tullamarine: Australia Pacific Airports Corporation (APAC) with its bid of US$0.8 billion (price-earnings ratio = 15.1)
- Brisbane: Brisbane Airport Corporation Limited (BACL) for US$0.9 billion (price-earnings ratio = 18.0)
- Perth: Airstralia Development Group (ADG) for US$0.4 billion (price-earnings ratio = 18.4)

**Table 6: First round of airport sales**

| Airport | Airport leasing company | Amount $US millions 1998/99 | Price Earnings Ratio | X Factor | Share by category of investor: Operator/ Manager | Local | Finance |
|---|---|---|---|---|---|---|---|
| Melbourne | Australia Pacific Airports Corporation | 827.5 | 15.1 | 4.0% | 15% | 0% | 85% |
| Brisbane | Brisbane Airport Corporation Ltd | 883.7 | 18.0 | 4.5% | 16% | 47% | 37% |
| Perth | Airstralia Development Group | 409.6 | 18.4 | 5.5% | 16% | 0% | 84% |
| Total Phase 1 | | 2,120.8 | 16.8 | | | | |

Sources: ANAO (1998), FAC *Annual Report 1996/97*, Australia Pacific Airports Corporation *Annual Report 1997/98*, Brisbane Airport Corporation Limited *Annual Report 1997/98*. Westralia Airport Corporation *Annual Report 1997/98*, and various Press Releases issued by the Minister of Transport.

[12] The gross proceeds were US$2,121 million, against which direct sale costs of US$98 million (including a payment to State governments in lieu of stamp duty) were incurred.

[13] Defined here as the sale price divided by earnings before depreciation, interest and taxes (EBDIT) as revealed in the FAC's Annual Report for 1996/97.

The Australian National Audit Office subsequently released a report that was critical of certain aspects of the sales process - notably the failure of the Commonwealth to indicate how it would weight assessment criteria and its contracting procedures for advisers during the sales process (ANAO 1998). One of the most contentious issues with the sale process was the way in which infrastructure bonds were taken into account in assessing the after-tax value of the bids to the Government[14]. The Government's financial adviser developed a specific model to evaluate the impact of infrastructure bonds, employing a different methodology embodied in the Department of Treasury's own model. The practical result of this was that the second-highest bid was awarded the sale of the lease for Melbourne Airport.

[14] The financial structures established by the various consortia all had tax implications. The ANAO reported that the Government should have earned US$1.0 billion in company tax from the airports over a period of 20 years. However, very high gearing levels and asset revaluations would ensure that the new airport owners would avoid paying any of this tax, even though the owners expected to earn a return of 13-14% before tax.

**Phase 2 sales**

The Government announced on 12 June 1997 that it would sell the remaining FAC airports with the exception of those in the Sydney region. A preliminary Information Brochure released by the Ministers for Finance and Transport & Regional Services on 12 August revealed that 8 core airports would be sold by long-term leasehold. The airports in this group were Adelaide, Alice Springs, Canberra, Coolangatta, Darwin, Hobart, Launceston and Townsville. The remaining 7 regional airports were to be sold on a freehold basis subject to agreement with State and Territory Governments.

On 10 October 1997, interested parties were invited to begin preparing their expressions of interest. More than 80 separate bids were lodged by 30 consortia before the closing date on 27 October. Following a review by the Office of Asset Sales and the Government's Business Adviser, BZW, 26 groups were advised on 6 November that they had been placed on a shortlist and that they should prepare detailed bids. The Government indicated that all 15 of the airports were to be sold on a leasehold basis, although it reserved the right to offer some of the smaller airports on a freehold basis provided the relevant State Governments introduced appropriate regulations[15].

All of the bidders were provided with relevant information on a CD-ROM package, eliminating the need for the data room used in the Phase 1 sales. Although the "Phase 2" airports were, in the main, much smaller than those sold previously, the task was nonetheless another demanding one. There was greater scope for local participation in the bidding and it was expected that there would be more inexperienced groups involved. The larger number of airports ranging from capital city international gateways (Adelaide and Darwin[16]) to airports that served only general aviation added to the dimensions of the task.

Winning bids for 11 of the airports were announced in March 1998 while continuing negotiations were occurring for the three airports in the Northern Territory, Darwin, Alice Springs and Tennant Creek. Only Essendon Airport in Melbourne failed to attract an acceptable offer. This airport was withdrawn from sale and subsequently has been set up as a stand-alone airport company, Essendon Airport Limited, with all of the share vested in the Australian Government. In the case of Darwin and Townsville airports, the runways and taxiways remained under the ownership of the Department of Defence. However, defence functions carried out at Canberra's Fairbairn Base are to be relocated over time. Accordingly, the lease agreement with the new owner includes the runways, the taxiways and the major part of the Fairbairn Base.

When the negotiations for the 3 airports in the Northern Territory were completed, the Government had received an additional US$468.4 million from 9 different consortia. Even though these sales occurred after the onset of the Asian economic crisis in July

[15] The outcome, though, was that none of the airports was sold on a freehold basis.

[16] Hobart, the capital of the State of Tasmania, has international services on an irregular basis.

1997, the prices were still relatively high in terms of an average price-earnings multiple of 18.6. Details about the winning consortia are summarised in Table 7.

**Table 7: Second round of airport sales**

| Airport | Airport leasing company | Amount $US millions 1998/99 | Price Earnings Ratio | X Factor |
|---|---|---|---|---|
| Adelaide & Parafield | MSUM | 232.1 | 20.8 | 4.0%[1] |
| Darwin, Alice Springs & Tennant Creek | Airport Development Group | 70.6 | 20.1 | 3.0%[2] |
| Coolangatta | Queensland Airports Ltd | 67.1 | 17.1 | 4.5% |
| Canberra | Capital Airports Group | 42.6 | 15.1 | 1.0% |
| Hobart | Hobart International Airports Corporation | 23.0 | 13.5 | 3.0% |
| Launceston | Australia Pacific Airports (Launceston) Pty Ltd | 11.1 | 8.3 | 2.5% |
| Townsville & Mount Isa | Australian Airports Pty Ltd | 10.2 | 11.3 | 1.0%[3] |
| Moorabbin | Moorabbin Airport Corporation Pty Ltd | 5.3 | 18.7 | 0.0% |
| Jandakot | Jandakot Airport Holdings | 4.3 | -13.6 | 0.0% |
| Archerfield | Archerfield Airport Corporation Pty Ltd | 2.0 | -28.4 | 0.0% |
| Total Phase 2 | | 468.4 | 18.6 | 16.0% |

Notes: (1) X-factor applies only to Adelaide; (2) X-factor applies only to Darwin and Alice Springs; (3) X-factor applies only to Townsville.

Source: Joint media releases by the Minister for Finance & Administration and the Minister for Transport and Regional Development.

Cross-ownership of airports was permitted in the Phase 2 sales and several combinations emerged. Infratil Australia Pty Limited became the majority shareholder in Perth International Airport in July 1997, and it took a 51% share of the Airport Development Group in its winning bid for Darwin, Alice Springs and Tennant Creek (Northern Territory) airports. Airport Group International also owned shares in these same airports – 16.5% of Perth International Airport and 49% of the Northern Territory airports, and 30% of Hobart Airport.

Australia Pacific Airports Corporation, the owner of Melbourne Airport, purchased 90% of Launceston Airport as Pacific Airports (Launceston) Pty Limited. The winning consortium for Adelaide Airport also was successful in acquiring Coolangatta. Manchester Airport Plc was involved in this consortium through a contractual agreement to provide management services[17].

## The regulatory framework

### On-going objectives and regulatory provisions

The Governments on-going objectives for privatisation were to:

- Establish sufficient diversity of ownership of the airports "in the interests of innovation and competitive benchmarking"
- Ensure that air service operators enjoy competitive access to airports on reasonable commercial terms

[17] This common members of the consortia for Adelaide and Coolangatta airports were financial institutions, Serco Investments Australia Limited, the Macquarie Bank, and Unisuper Limited.

- Maintain a commitment by airport leasing companies to the provision of quality airport services
- Sustain investments required for development of the region through appropriate pricing policies
- Promotion of economic development of the region consistent with sound environmental management and the interests of users.

In addition, the Government acknowledged concerns that airports had some degree of monopoly power in relation to aeronautical services and the need to control and monitor prices. The regulatory framework to apply after completion of the sales was set out in the *Airports Act 1996* with administration responsibilities for economic regulation falling mostly on the Australian Competition and Consumer Commission (ACCC)[18]. The Department of Transport and Regional Development has appointed Airport Environment Officers and Airport Building Controllers, at the expense of the airport operators, to ensure compliance with environmental and development requirements.

A condition of the sales was that the new owners could not sell their shares during the first two years without the consent of the Government and the ACCC has the necessary authority to prevent mergers and acquisitions deemed not to be in the public's interests. Though some cross-ownership arrangements occurred during the second phase of airport sales, the major airports are independently-owned.

The early experience with the Phase 1 airports has been that each of the new operators has brought new ideas to airport management based on their international experiences. Their annual reports, for example, reflect a strong marketing orientation, particularly in relation to non-aeronautical and property services. Emphasis also is given to organisational structures, cost control and management teams with strong links to the local community. The Australian approach to privatisation requires disclosure of financial and operating information to assist the ACCC in its on-going monitoring. The annual reports for Melbourne, Brisbane and Perth airports certainly have disclosed detailed information to the public about their plans and performances.

The ACCC and the airport operators already have been active in clarifying the terms of competitive access. Both Australia Pacific Airports Corporation (Melbourne) and Westralia Airport Limited (Perth) sought determinations from the ACCC on terms and conditions applying to a range of airport services and the procedures for dealing with negotiations and disputes. The ACCC did not, in the first instance, accept these proposals – largely on the grounds of enforceability. In the absence of a favourable determination of access undertakings, the party seeking access to the airport can appeal to the ACCC directly to arbitrate if a satisfactory agreement cannot be reached in the first instance with the airport operator. The ACCC was not satisfied with the provisions relating to the enforceability of the undertakings, pricing of services outside the price cap, the adequacy

[18] Details about the ACCC's interpretation of its responsibilities and its determinations in relation to privatised airports are available on its web site at http://www.accc.gov.au.

of information supplied to access seekers, and the negotiation and dispute resolution procedures. In addition, the ACCC has issued a draft determination in relation to rental car services, judging them to be a "declared" airport service under the *Airports Act 1996*. The ACCC's activity in these matters indicates clearly that competitive access will continue to be monitored carefully.

The Sale Agreements tied the bidders to specific amounts of capital expenditure on aeronautical infrastructure development for the initial ten years of the lease. Collectively, the new airport owners are obliged to spend almost US$450 million on continued development and major maintenance works over the next ten years. Lessees failing to live up to these commitments incur a liability to repay the difference to the Government. The leases also contain an undertaking on the part of the lessee to develop the airport site at its own expense consistent with a major international airport throughout the full term of the lease. The leases for the general aviation airports require continued operation as an airport, but place few other obligations on the new owners.

Furthermore, the new airport operators were required to submit airport master plans and major development proposals for the approval of the Minister for Transport and Regional Development following a minimum 90 day public comment process. This ensures that communities will be fully appraised of development proposals and that they will have a reasonable opportunity to comment on their impacts. The new airport operators already are active in establishing formal lines of communication with the local community and in pursuing joint development and tourism marketing initiatives.

**Price and quality of service regulation**

A distinction has been made to aeronautical services where the airport operator has a high degree of monopoly power and those services provided on airports that face competition from off-airport sites. The details of the price oversight arrangements are described in more detail by the ACCC (1997). The price caps apply to declared airport services for a period of five years, by which time the ACCC is to provide advice to the Government about the need for continuing oversight of prices.

Tables 6 and 7 specified the price cap commitments entered into by the new airport operators within a CPI-X formula approach. That is, an airport operator is not permitted to increase declared aeronautical charges by more than the Consumer Price Index less a pre-determined factor. The intent of this mechanism is to apply pressure on the airport operator to pursue efficiency improvements and to pass the benefits on to airport users.

The particular way the price cap is applied is on a weighted average of a basket of tariffs, using revenue shares from the previous period as weights. That is, prices are permitted to rise above the price cap for specific items provided there are compensating reductions elsewhere within the tariff basket. This allows the airport operator the flexibility to modify pricing structures. The operators also are permitted to over- or under-recover in each period, provided that the pricing commitment is met over the five-year period.

Under particular circumstances, the airport operators are permitted to increase their charges to recoup investments in infrastructure.

Regulation of charges other than those services declared to be within the price capping arrangements also is effected by the ACCC in its price-monitoring role. The Treasurer issued a direction to the ACCC specifically to monitor "aeronautical-related" charges at particular privatised airports. It is worth noting that the Government's Business Adviser made it clear to bidding consortia that there was scope to increase revenue by varying charges or introducing new charges outside the price cap. Levies, for example, have been imposed on taxis and other commercial passenger vehicles at Brisbane and Perth airports.

The most contentious issue to date, though, has been in relation to aircraft refuelling. These are not included in the price cap so that the airport operators are free to vary charges without formally notifying the ACCC. The FAC had made provisions within its contracts with oil companies for the introduction of a fuel throughput levy. Proposals to introduce such charges have been raised for Brisbane and Perth airports and the ACCC has made it clear that this is a designated aeronautical-related service that it is obliged to monitor formally in terms of prices, costs and profits. The ACCC expressed the view that the price reductions achieved over five years under the price cap should not be expected to be offset by increases in other charges not related to changes in costs in provision.

In addition to the commitments made under the sale agreements for continuing investments by the airport operators, the *Airport Act 1996* provides for monitoring of quality of services at the core airports. This monitoring is linked to pricing oversight arrangements and is administered again by the ACCC. The approach taken will be to analyse changes in service levels over time. The ACCC has indicated that it will use performance indicators such as aircraft delay, availability of aircraft gates and aerobridges, waiting times and crowding associated with passenger processing facilities, equipment availability and the standard of facilities. Results of the monitoring exercises will be published by the ACCC at least every two years.

## Concluding comments

The new airport owners for Melbourne, Brisbane and Perth airports purchased just prior to the onset of the Asian economic crisis. Although the impact of the economic downturn in Asia was moderated by strong growth in the Australian economy and by an expansion of the Australian outbound travel market, all of the new airport owners were affected. In particular, the high growth rates that had been experienced previously at Brisbane and Perth airports depended to a far greater degree on Asian tourism markets. Brisbane Airport Corporation Limited, for example, reported that its passenger movements declined by 10,000 in its first year. Nevertheless, the price-earnings ratios involved in the second phase of airport sales were equally high even though the downturn in Asia had become apparent.

There are various reasons why the winning bids for Australia's airports had high price-earnings ratios relative to the sales of airports in Europe. One explanation for this is that there have, to now, been limited opportunities to purchase international airports. This is especially the case in the Asia Pacific region where there was very strong growth in the aviation market until the middle of 1997.

Another factor is that most of the airports enjoy a significant degree of local monopoly power. All of the major airports are located at some distance from each other. For example, the distance between Sydney and Melbourne is 707 kilometres[19], and Perth is 2,120 kilometres from its closest state capital city, Adelaide. Although there is some scope for the airports to vie for a share of the international traffic, generally it is true that the major Australian airports do not compete with each other. Also, the nature of the airline networks does not lend itself to the type of competition seen at some airports in North America and Europe for hub transfer business.

Another factor that influenced the sale prices was the prospect that earnings could be improved. The Federal Airports Corporation claimed that studies proved it had low aeronautical charges by international standards and that it was an most efficient operator. The bidders appear to have believed that they would be able to increase earnings, if not improve efficiency at the same time. In their first year of operation, the phase 1 airports have demonstrated their zeal in marketing retail and property services and in improving their yields from non-aeronautical sources.

The difficulties in privatising airports is demonstrated in two ways. That it took between 3 to 4 years to sell the airports after first making a policy decision in favour of privatisation illustrates the complexity of the task. Even after five years have passed, though, Australia's major airport remains on the Government's books despite a very strong financial incentive to sell. Major airports are more than commercial undertakings and, in Sydney's case, on-going regional planning and environmental issues are difficult enough to resolve while the airport is owned by the Government.

Nevertheless, the Government has succeeded in realising higher than expected prices for its assets and it has used the funds to retire public debt. It is too early yet to decide whether the Government also has been successful in achieving its post-privatisation objectives, but the regulatory framework has been established. This framework ensures that there relevant information will be available to the regulators, airport users and the public. Researchers assessing the merits of airport privatisation will be able to draw useful lessons from the Australian case in years to come.

[19] Measured as a Great Circle distance (Department of Transport and Communications, *Australian Air Distances*.

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# Regulating Access to Airport Facilities

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Paper presented at the Air Transport Research Group Conference,
City University of Hong Kong, June 6-8 1999

## Abstract

### Regulating Access to Airport Facilities

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In the mid 1990s Australia privatised most of its major city airports. When it did, it imposed a system of price-caps to regulate aeronautical charges. At about the same time it instituted general changes in competition policy which included explicit regulation of access to essential facilities. Where a firm owns natural monopoly facilities, or facilities which are uneconomic to duplicate, such as electricity transmission grids or gas pipelines, it can be required to make these facilities available to its competitors at a regulated price. This access regime is also being applied to airports; something which is either unique to Australia or very rare. It may well result in extremely detailed regulation of airports. Where airport facilities or services are judged necessary for civil aviation and uneconomic to duplicate, they can be made subject to access regulation. Such facilities include runways and taxiways, aircraft parking areas, international passenger processing facilities, land for freight operations and landside vehicle facilities.

The objective of this access regime is to promote competition in the provision of airport services. The ways in which it applies to airports is described in this paper. This regulatory regime poses a number of difficult issues; these include the relationship between access regulation and price-cap regulation, the choice of airport price structures, new entry by airlines and access to terminals, choice of access pricing principles and measurement of costs. These are explored in the paper, which concludes with an overall assessment of access regulation in the airport context.

## Introduction

Airports typically possess considerable market power, and it is not unusual for them to be subjected to price regulation. When countries such as the UK and Australia privatised their airports, they instituted detailed systems of regulation of the prices that airports charge their customers, primarily airlines. Regulation has its costs, one of which is a reduction in the incentives facing firms to keep costs at a minimum; since firms may not be able to keep all the savings they make, they are less likely to make them. A system of privately owned airports, subjected to a form of regulation which is designed to be relatively positive in terms of incentives, is regarded in several countries as likely as any to produce efficient performance. Few countries take the regulatory approach further.

Australia has taken a further step in regulating its airports. It is applying regulation of access to essential facilities regulation to airports. Not many countries have explicit essential facilities regulation, and those which do, do not extend it to airports. This regulation is normally applied to significant natural monopolies, such as telecommunications local loops, electricity grids, rail track and gas pipelines. Its objective is to make competition in the final good or service, such as telephone calls or retail electricity, feasible by enabling many firms to obtain access to the bottleneck facility on equal terms.

Australia has created a general system of essential facilities regulation, and is applying it to airports. This means that a range of facilities and services, which make up an airport, such as runways, taxiways, aprons, passenger processing facilities in terminals, freight facilities and vehicle landside facilities are individually being subjected to access regulation. Thus it is possible for a firm which wishes to compete with the airport in providing passenger services or to handle freight can seek access to the airport's land and facilities, and if need be, get the competition regulator to regulate prices and conditions of access. In some cases, this could have large implications for the way airports are run; it may result in substantial unbundling of the airports. It may result in exceptionally detailed regulation of airports. Furthermore, depending on how it develops, it could have implications for entry into the domestic airline industry.

The background to these changes is discussed in the next section, and after this, the application of access regulation to airports is outlined. In the following section, a range of issues which arise from this are analysed. In the final section, a brief assessment is made of the new regulatory framework.

**Background: Airport Privatisation and Access Regulation**

The implementation of access regulation in the context of airports in Australia is the result of two policy shifts. Firstly there was the privatisation of most of the main airports. Secondly, there was the creation of a whole new system of access pricing regulation, applicable across a wide range of industries, designed to control monopoly power in bottleneck facilities.

Most of the large city airports in Australia were privatised in 1997 and 1998. Airports such as those at Melbourne, Perth and Brisbane were sold by the federal government to consortia, which included major airports overseas, such as BAA which owns the London airports, and Schiphol. There were exceptions, such as Sydney, the nation's largest airport, which has been retained in government ownership pending decisions about future expansion of capacity at a second airport, and because of environmental problems. Another exception is that of Cairns airport, which remains owned by local government authorities.

Airports in Australia are separated by large distances, and there is little scope for them to compete except for a limited amount of business. Thus they have considerable market power. In recognition of this, they are subjected to price regulation (strictly speaking, this is described as price surveillance, which is slightly less binding than regulation)(Forsyth,1997). The general competition regulator, the Australian Competition and Consumer Commission (ACCC), is charged with the price regulatory task. The preferred method of regulation in Australia is that of CPI-X regulation, or price-caps, which is also the preferred method in the United Kingdom. Price-caps have been imposed on a defined bundle of aeronautical services, though non aeronautical services are not price regulated. The problems associated with this method have been recognised by the ACCC, and to some extent addressed. For example, profit maximising firms facing price-caps have an incentive to save on costs by lowering quality; to this end, the ACCC monitors quality of service (ACCC,1998a).

The system of price regulation is now well established, but some problems have emerged. In particular, there has been a problem of fuel levies. Airports in Australia do not have a history of charging levies on fuel throughput, such as many European airports do. Thus such levies were not included in the original bundle of services to be price-capped. Soon after they were privatised, the new owners of Brisbane and Perth airports imposed fuel levies. Such levies are very difficult for airlines to avoid, and they constitute an effective means of circumventing the price-cap. While, for the present, such levies are accepted as outside the price-cap, the ACCC has argued for legislation to include them (ACCC,1998c).

Price regulation of the final outputs of private airports is not unusual, and it would normally be expected that it would be sufficient to limit the use of market power. However, in Australia, airports are also subject to access regulation which applies to any bottleneck facilities they own. Airport privatisation took place in the context of privatisation and restructuring of the utility and transport industries and an extensive review of competition policy.

It was recognised that many of these industries were not likely to be competitive as a whole, but that there was scope for competition in parts of them. An industry such as rail is constituted of natural monopoly sectors, such as the track system, and potentially competitive sectors, such as train operation. If the track owner also operates its own trains, it can discourage potential competitors in operating trains by refusing them access to its tracks, or by charging prohibitively high prices for access. Even if it is willing to allow them to use its tracks, it will at least charge them a price which preserves its monopoly profit. Since the objective of the reforms is to promote competition, this will be a less than satisfactory outcome.

The objective of access regulation is to ensure that competitors have access to the natural monopoly or bottleneck sectors on a basis which enables them to compete effectively. Sometimes this access regulation is applied to a vertically integrated firm which possesses both bottleneck and non bottleneck sectors (such as integrated rail systems) and at other times it is applied to specialist owners of the bottleneck facilities (such as rail track corporations). Access regulation involves both mandating that competitors have access to the facility, and setting prices at which this access is to take place.

Australia is now implementing a general system of access regulation (for a description, see King and Maddock,1996), but there are specific provisions for particular industries, such as airports. The legal structure of the access arrangements is complex (see ACCC, 1998b). It seeks to ensure access, but to give the access seeker and the facility owner scope to negotiate terms and prices of access. However, it contains provisions for arbitration of access prices by the ACCC, should negotiations fail. Clearly, in such an environment, the policies of the ACCC will be critical; sometimes it will directly regulate access prices, but even where it does not, its likely decisions will condition the prices at which the parties negotiate access. The ACCC has indicated, in other industries, that it prefers a cost based access price, to have the effect of promoting competition as much as possible, consistent with cost recovery by the facility owner. Thus, in the telecommunications industry, it has opted for total service long run incremental cost (TSLRIC), which it considers will be close to marginal cost but consistent with cost recovery.

This access regulation environment extends to airports. It makes a range of airport services potentially subject to price regulation. The only airport services left out are those which are not essential to operate air transport services, or which can be provided competitively. Runway services, passenger gates, land for refueling services, road access for car hire firms and land for freight handling services are all subject to access provisions, though retail facilities, sites for cargo terminals and flight catering facilities are not. A wide range of individual services, which together make up what an airport is, could be subject to regulation or to the threat of it. All in all, this constitutes a considerable unbundling of airports for regulatory purposes.

## Applying Access Regulation to Airports

The access regulation framework determines what services or facilities are to be subjected to regulation, and then sets out procedures for terms of access to be determined. The system as it applies to airports is a distinctly complex one. There are two separate sources of legislation, a general one and one specific to privatised airports; these sources overlap in their application. Furthermore, within both of these pathways there are complicated procedures to be followed in formulating the access arrangements to be applied to a specific airport.

The general approach to access regulation is encapsulated in Part IIIA of the Trade Practices Act, which was included when competition policy was extensively revised in 1995. It sets out several pathways to access regulation. A competition policy advisor, the National Competition Council (NCC) has the task of defining the access arrangements. If it considers that an effective access framework is in place, for example, because of regulation by a state government, it can approve that framework. This has not been relevant to airports so far. Alternatively, a facility owner, such as an airport can lodge an undertaking with the NCC, setting out terms and conditions under which it would grant access. If the NCC accepts this undertaking, it becomes enforceable, and no further regulation is imposed. Finally, if no undertaking has been accepted, an access seeker can apply to have the facility "declared" for access. The NCC evaluates the application in terms of various criteria, including whether the facility is uneconomic to duplicate, and may declare the facility. If it does, the owner is obliged to negotiate terms of access with the seeker, and if negotiations fail, the ACCC is called upon to arbitrate. Effectively this means that the ACCC regulates access prices and conditions.

This pathway was used by one access seeker in 1997. A freight handling company sought access to facilities at Melbourne and Sydney airports. The NCC concluded that the criteria were satisfied, and declared the facilities (NCC,1997).

The other pathway arises from the Airports Act, and applies specifically to the privatised airports. As is to be expected, it is a provision which is more specific to airports. Section 192 of this act gives the airports one year from time of privatisation to develop an access undertaking. Should such an undertaking be accepted by the ACCC, it becomes enforceable, and the facilities of the airport cannot be declared. If the undertaking is not accepted, the ACCC may declare certain services for access; if so it then regulates prices and conditions. The Act sets out two main criteria for the ACCC to be used: whether the services are "necessary for the purposes of operating and/or maintaining civil aviation services at the airport" and are "provided by means of significant facilities at the airport, being facilities that cannot be economically duplicated". The latter condition is similar to, though not identical to, one of whether the facility is a natural monopoly or not.

The major privatised airports, such as Melbourne and Perth produced undertakings for the ACCC to approve. It did not, mainly on grounds of the undertakings being too vague especially on issues such as price of access, arbitration arrangements, and because of the scope for the facility owner to delay providing access. On expire of the year since privatisation, a range of services were automatically declared. The list of services the ACC regards as declared is given in Table 1.

Some services were not declared because they are not necessary to operate aviation services- thus retail facilities were not judged essential. Other facilities were judged as essential but were not declared because it is possible to duplicate them economically- sites for cargo terminals and heavy maintenance are in this category. Finally, some services were determined as essential and uneconomic to duplicate- not surprisingly, runways fall into this category, as do international passenger processing areas and land for refueling.

These decisions set out the access regulation framework for airports in considerable detail, though there is still scope for refinement. For example, in late 1998, a car hire firm requested the ACCC to declare landside roads associated with passenger pick up to be declared. In 1999 the ACCC determined that the requested facilities, with some modification, be declared (ACCC,1999).

Declaration does not necessarily mean that facilities will be directly regulated by the ACCC. No access seekers may come along, and the ACCC will have not dispute to arbitrate. Alternatively, the airport and the access seeker may negotiate terms themselves, and the ACCC may not be called in. This is to be expected in several cases, especially when the parties have a clear idea of how the ACCC would go about regulating the facility. However, whether the ACCC has a direct role or not, it will have a critical impact on access prices, since the parties will negotiate prices close to those which they anticipate the ACCC will impose. Hence the ACCC's approach to access regulation will be a critical factor affecting the operation of the declared airports.

## Issues in Access Price Regulation

Imposing access regulation on airports which are already subject to price-cap regulation creates a number of issues to be resolved. In this section a range of these are considered:

(a) The expected benefits and costs of access regulation,
(b) The interaction between access and price-cap regulation,
(c) The bundling of prices,
(d) Access to terminal gates,
(e) Access pricing principles,
(f) Measuring costs, and
(g) Quality problems.

These are considered in turn.

Expected Benefits and Costs

The objective of access regulation is to promote competition in downstream services. An airport may own a bottleneck facility, such as land required for a freight service, and competition in the service depends on competitors being able to obtain access to the land at a price which is consistent with them competing. Left to itself, the airport would not offer access to its competitors at prices close to the cost of the land. If access regulation is in place, the market power that the airport possesses in the service will be constrained. Thus prices will be kept down, and it will be feasible for competitors which are productively efficient to operate. Access price regulation has the potential to increase allocative and productive efficiency. The extent to which this is the case depends on the nature of the bottleneck and service being considered. Some services may be essential inputs for very important products; for example, access to terminals and gates is critical for new competitor airlines. Other facilities may be of considerable significance to products which are not significant in the overall scheme of things, but which might as well be supplied efficiently; for example, drop off facilities for car hire firms.

Access regulation has its costs, as well. All forms of regulation have costs in terms of reduced incentives for efficiency- there are no first best regulatory systems. Regulated prices can give wrong signals, and induce overuse of facilities or underinvestment.

Another possible cost, specific to access regulation, is that it leads to unbundling of integrated firms, leading to a possible loss of economies of vertical integration. There may be costs to a firm from making facilities available to competitors which the regulator is unaware of. There could be good reasons why a single firm should sell a range of services and have control of upstream and downstream production. Having several users of a single facility can result in higher costs, for example as competitors get in each other's way. The costs of vertical disaggregation, forced by access regulation, could be significant, but they will not be obvious.

Price-Caps and Access Regulation

Access regulation in Australian airports involves superimposing one regulatory framework on another which is already in place. The airports are subject to overall price-caps on aeronautical services. The private airports are regulated by CPI-X regulation, and services such as aircraft landing fees, international terminal use (domestic terminals are normally leased on a long term basis by the airlines), aircraft parking charges and security services are included in the basket covered by the cap. The price index is a revenue weighted one.

This regulation is in place to limit the use of market power by the airports. It does not cover non aeronautical services, such as retail, even though there may be some market power present with these. While this regulation is not explicitly cost plus regulation, there was the intention in setting the price-caps that revenue would be close to overall costs. Within the price-cap, there is the scope for the airport to charge very high prices for a specific service, though if it does, it will be forced to charge low prices for other services.

The obvious question which arises is that of if price-cap regulation is in place, is detailed access price regulation really necessary? The airport may be able to exercise market power in selling a specific service, but its overall use of market power is tightly constrained. The answer to this question depends on how the firm behaves, and on how the two forms of regulation interact.

Consider first a profit maximising firm; privatisation can be expected to result in airports which are keenly interested in profits. Such firms will have an incentive to minimise costs, and where they are not capable of achieving minimum costs by production in-house, they will be willing to contract out to those firms which can. One possibility is that they will make bottleneck facilities available to those which can use them most efficiently, and they may allow such firms to sell the final output to the users; for example an airport may make land available for freight operators, rather than undertake all freight handling itself. In setting the price for access, it would be constrained by its own price-capped services.

Suppose that an airport is selling a service to users at $20. This service is included within the capped basket. Suppose further that the cost of using the bottleneck facility is $8 and that the cost of the add on services, which could be provided by competitors, is $12. If the airport charged more than $8 for the use of the bottleneck, competitors would only be able to compete if they had costs less than $12. If, for example, competitors were able to supply the downstream service for $11, the airport could charge them slightly less than $9 for the use of its facility, and it would increase its profits. Productive efficiency would be enhanced through more efficient competitors replacing the airport's in-house production, and prices would be no higher. As long as the overall price-cap limits the price of the service to $20, there would be no additional advantage from access regulation.

Whether price-caps really constrain access prices in this way depends on how the price-cap basket is constructed. Suppose that revenue weights are used in the price index of the airport's output (as is the case). Suppose there is a service which the airport could either supply directly, or allow other firms, accessing its facilities, to sell directly to users. It could set a high price for its own service, and also set a high access price for its facilities; however it could set this price such that the other firms could undercut its own prices. If it did this it would lose all its market to these other firms, and the weight in the price-cap basket would fall to zero. It would not be constrained by the price-cap to reduce prices of other services it supplies, but it would be able to exercise its market power at the access price level. In short, it would be able to circumvent the price-cap.

Short of moving to a fixed weight index, which creates its own problems, this problem can be corrected in two ways. One would be to include access prices within the price-cap. While this could be done, it would make the construction of the price-cap a good deal more complex. The basket of capped services would need to include all the facilities which other firms might seek access to in order to produce final services. Many or most of these facilities have not been opened up for access, and no prices for their use have been established. The regulator would need to set a whole range of prices for services which might never be used. Alternatively, the regulator could include facilities in the capped basket once their services began to be traded; this would be cumbersome and would involve ad hoc revisions of the price-cap basket.

The alternative is to have access price regulation. This would prevent airports from circumventing the price-cap in they way discussed above, and it would ensure that both the service itself, and the facility used in producing it, would be priced close to cost. Granted the Australian approach to access regulation, whereby the regulator only has to set a price if the access seeker and facility owner fail to agree on a price, this should be informationally efficient in that it does not involve the regulator setting a large range of prices for trades that may never take place.

Some airports may not be profit maximisers. (Even the private airports are subject to price regulation, which can lessen the incentives for cost minimisation). If access prices are not in the cap, and there is no access price regulation, such airports may discourage other suppliers from selling services even when they can produce at lower cost than the airport itself. They will set high access prices to lock out alternative suppliers, and may not contract out services when they could reduce costs by doing so. Access price regulation will ensure that efficient competitors can gain access to the facilities they need to offer their services. Some airports, such as Sydney, are not privately owned, and they cannot be assumed to be profit maximisers. These airports are subject to the general provisions on access in the Trade Practices Act, Part IIIA. Even privately owned airports seem to take a strongly negative view of allowing access to their facilities- the draft access undertakings, which the private airports submitted, seemed to be more designed to keep competitors out than to make profits out of them. This could be because the airports believe that economies of vertical integration are great, and that granting access, even at high prices, will detract from their profits.

An airport's behaviour with respect to non-capped services will be more straightforward. Where it possesses market power, it will use it. The market power an airport possesses in these services should be relatively small in most cases, since the price-cap is intended to cover all cases of market power in aeronautical services. The airport could use its market power at both the final service and access stages. Where the airport offers access at profit maximising prices it will be feasible for efficient suppliers to compete, and where these have lower costs than the airport itself, it will be in its interest to let them supply the market, but to cream off profits at the access stage. Thus, if the airport is a profit maximiser, productive efficiency will be guaranteed even if there is no access price regulation. There will be some cost in terms of allocative efficiency since there will be no way in which the competitors can put downward pressure on prices. Here, the case for access price regulation depends on its ability to assist competition and lead to lower prices. Were the airport is not a profit maximiser, it may not allow efficient competitors access, and thus productive efficiency could suffer. In such situations the case for access price regulation is stronger.

Price Bundling

It is common in Australia for airports to offer a package deal of bundled services to users. Individual services, such as runway use, taxiway use, apron use and some passenger facilities are not priced separately. When this is so, it is very difficult for other firms to compete in selling these services. Suppose a firm wished to compete in offering baggage handling at a terminal. It could gain access to the facilities it requires, and it would be able to offer a product at a price. However, if the airport is offering only a package deal of all the services an airline needs from a terminal, the firm would be unable to compete. A user would need to buy some services directly from the airport, and baggage services would be included in the all up price. Using the new competitor would add to its costs. Bundled pricing makes it difficult for competitors; access price regulation would not prove effective.

The price structure which is being implemented dates back many years, during which the private airports were operated by government departments and by public enterprise. In these days they did not have an imperative to maximise profits. In general, unbundling prices helps to achieve maximum profits, since prices for each service can be tailored to demand conditions and improves overall efficiency (though an airport may still offer a bundle of services for the users who prefer to buy on this basis). Thus, under private ownership, there may be a move towards unbundling services. However, the incentives for unbundling under price-caps are not very strong. While price-caps are consistent with price rebalancing and unbundling, the airport will not gain much by doing so. Every time it increases one price, it must lower another, to keep within the cap. Well designed price structures will maximise profits, but the difference in profits between a well designed and an average structure is not likely to be great.

A further difficulty is that access price regulation gives the private airport an incentive to bundle rather than unbundle prices. If it can escape the effects of access regulation by bundling its prices it may do so. Thus access regulation may hold up a move towards more efficient price structures at airports.

Access to Terminal Gates

The Australian domestic airline industry was deregulated in 1990. At the time there were two major airlines. In 1999, there are the same two airlines, and no independent competitors for them. In the early 1990s there were two attempts at entry. Both failed, for a variety of reasons (See Nyathi, Hooper and Hensher, 1993 and Trade Practices Commission, 1992). Prominent amongst the reasons was the inability to get access to terminal facilities on favourable terms.

Domestic terminals are leased to the two major airlines, Ansett and Qantas for very long periods. These airlines have little incentive to provide terminal facilities to their competitors, who will seek to compete their profits away. They will only willingly supply facilities when they can profit by doing so- as they might when allowing access to partner airlines which serve complementary rather than competitive routes. At the time of deregulation, the government imposed a requirement that these airlines make terminal facilities available to new entrants. However, this requirement was very vague and unenforceable. New entrant airlines did not always succeed in obtaining access to terminals. In some cases they had to operate from sheds outside the terminal, and when they did obtain gates in terminals these were inconvenient ones. Problems in obtaining access to terminal facilities have been a disincentive to those contemplating entry to the domestic market, which, with only two competitors, is less competitive than it might be.

New access arrangements could contribute significantly towards resolving this problem. Access seekers can seek for gates or terminal facilities to be declared, and if they were, they could negotiate with the incumbent airlines. If negotiations fail, the ACCC would arbitrate. It is likely that the ACCC, which seeks to promote competition, would set access prices which are as close to (its estimate of) cost as is possible. If so, new airlines would be obtaining terminal facilities on as close as feasible to equal terms to the incumbents, and a significant barrier to entry would be eliminated.

It is unclear at this stage whether this scenario will come about. Airport services have been declared for access, but precisely which services are declared is still being resolved, and domestic passenger handling facilities have been set aside for further consideration on a case by case basis. To be declared, services must met two criteria, discussed in the section above. Terminal facilities clearly meet the first criterion, of being essential for the operation of aviation services. However there are questions surrounding whether they are "uneconomic to duplicate'.

There are different ways in which this criterion can be interpreted. On one interpretation, they can be said to be not uneconomic to duplicate. They are not a natural monopoly, and in fact there are at least two domestic terminals at most airports in Australia- both Ansett and Qantas have their own terminals. In the past, it has been economically feasible to "duplicate" them. Another interpretation of the criterion stresses whether it would be economically feasible for them to be duplicated in the sense of another airline building a new facility. If existing facilities have some excess capacity, it may be uneconomic for additional capacity to be added. The ACCC has indicated that it accepts the latter interpretation. Thus there is the possibility that domestic terminals could be declared. The ACCC has already declared international passenger processing facilities, and these are similar, though not identical, to domestic facilities. The ACCC has reserved its decision and states that it will consider applications for declaration on a case by case basis (ACCC,1998b). (Domestic airport terminals are not affected by price caps, since they are operated by the airlines, not the airports).

The application of access regulation to terminals and passenger processing facilities is potentially the most significant application of access regulation in the airport context. This is because terminals are an essential input into a much larger industry, the domestic passenger industry. This industry is of far greater economic significance than, say, freight handling or off airport car hire. If access regulation is applied to terminals, it could remove one of the most serious obstacles to entry to domestic aviation. In turn, granted that there are only two major airlines, a few additional competitors could make a large difference to the performance of the industry.

Access Pricing Principles

In setting access prices, the regulator will need to rely on pricing principles. Three options are usually suggested. The regulator could

(a) set prices at marginal cost,
(b) set prices at the minimum consistent with cost recovery (average cost in the single product case), or
(c) set prices which do not impose a loss on the incumbent (the efficient components pricing rule (ECPR), or the Baumol Willig rule).

The first of these may seem appealing on efficiency grounds, but it will normally be inconsistent with long run cost recovery. The purpose of access regulation is to impose limits on pricing of facilities which cannot be economically duplicated; effectively, involve a natural monopoly element. Marginal cost pricing where there are economies of scale or scope yield losses for the facility owner, and thus it poses problems for privately owned facilities.

The lowest possible price consistent with cost recovery in the single product case is average cost. Such a price, if regulated, will maximise the chance of competition from new firms accessing the facility and selling in the downstream market. It will, however, give rise to the possibility of inefficient entry, for example if the downstream market is an oligopolistic one.

This approach becomes more complex when the firm sells multiple outputs, as airports do. Average cost is undefined, since total cost is spread amongst several outputs. However, if efficiency maximisation is the criterion, a Ramsey price structure will ensure cost recovery at minimum cost in terms of efficiency. Ramsey prices involve a mark-up above marginal cost which is in inverse proportion to the elasticity of demand for each product. This approach is well known in the context of final products, however it can also be applied to access pricing (Laffont and Tirole,1996). Mark-ups are charged for each facility such that, when additional costs of production are added, the resultant price for the final product is the Ramsey price. (Alternatively, the access price for the facility equals marginal cost plus the implicit Ramsey mark-up).

While straightforward in theory, implementing this would be difficult in practice. Effectively it requires information about derived demand elasticities for the facilities- such information would rarely be available. There are many patterns of prices which would be consistent with cost recovery, but it would be impossible to distinguish between then on efficiency grounds. Prices should be above marginal cost, perhaps significantly so if scale economies are large and there are many joint and common costs. How high they should be would be difficult for the regulator to determine. Granted this, the regulator has considerable discretion over the access price it chooses, and when the airport is price capped, it is unlikely to be forced into deficit, since lower prices for one service can be made up for by higher prices elsewhere. The precise choice of access price probably does not make a lot of difference so far as efficiency and viability are concerned.

The third approach would be to opt for the ECPR (Baumol and Sidak, 1994). The facility owner would not lose from this price as an access price, and it will be either equal to, or close to, the price that the owner would negotiate itself. Its advantage is that it eliminates the possibility of inefficient entry- only efficient entrants can compete with the owner given the high access price. It can also be approximated by free negotiation, obverting the need for explicit regulation. Its disadvantage is that it preserves the market power that the facility owner possesses, and it gives minimal scope for competition to bring prices down. It also risks the inefficient duplication of the facility by entrants who cannot obtain cheap access to a facility with spare capacity.

If the final product market is contestable (very unlikely in the airport case) or effectively regulated, the ECPR access prices will equal or approximate average cost (in the single product case) or Ramsey prices. If the form of regulation effectively constrains revenues to be equal to costs, and effectively constrains each price to no more than the Ramsey price, it will result in the firm negotiating prices which are equal to the Ramsey access prices. In this situation, it would be sufficient to allow a profit maximising airport to negotiate its own access prices, since final product prices constrain access prices. However, as has been noted earlier, the regulation actually imposed on Australian airports is not as perfect as this supposes, and there is scope for airports to circumvent the price-cap through their access pricing strategies.

Overall, access pricing principles give the regulator guidance, but they do not give precise measures of the access prices which are the best feasible. At best, the regulator will have information about marginal costs (though see below), and the total costs to be recovered (plus, perhaps some information about the cost structure). It must convert these into a structure of access prices. It has considerable discretion over the level of prices for individual facilities, and it will be difficult to determine which price is most efficient. With efficient final product regulation it may be able to leave the setting of prices to the airport, at least for facilities which are used in the production of services whose prices are regulated. If it sets prices different from the (unknown) optimum prices, the efficiency losses are likely to be small since demand elasticities are likely to be low, and there is not too much danger of imposing deficits on the airport, since it can rebalance its charges.

Measuring Costs

Access pricing presupposes that the regulator has good information about costs. This is unlikely to be so in the airport situation. Firstly, cost information about parts of the airport system is likely to be difficult to obtain. Secondly, marginal costs, or opportunity costs, of capital intensive facilities are likely to vary considerably over short periods of time.

The regulator is likely to have information about the overall costs of the airport, but for access regulation, it needs information about marginal costs of the various facilities or services that it is attempting to regulate. It will need to know the marginal cost of using a particular piece of land, or of some specific terminal facilities. Even the airport itself, which has the task of setting prices for final services, may not have good cost information about the intermediate inputs which go into these services. There is no market price which it can rely on. There is some risk that the regulator could, for example, seriously underestimate the marginal cost of a service and set an access price which imposes a loss on the airport and forces it to subsidise its competitors.

The problem is compounded by the variability of costs. For many facilities in airports, costs, and especially marginal costs, vary considerably over short periods of time. Facilities have fixed capacities, and for part of the day or hour they can be in excess supply, and the marginal cost of using them can be quite low. At other times they can be in excess demand, and perhaps subject to severe congestion, and the opportunity cost of using them can be high. Efficient pricing should take these cost variations into account, setting low prices in the off-peak, and high prices in the peak. There can be other sources of variation in cost which should be taken into account, such as the location of facilities.

This variation in cost poses a major problem for a regulator, because regulation tends to be inflexible. It is unlikely to be feasible to have different regulated prices at different times of the day or hour. The regulator could set access prices which are constant over time; prices which are, on average, right. However this is not good enough, since prices which are on average right will be too high sometimes and too low at other times. A single price will result in the facility being overused when it is most congested. At a time when it would most like to use its own facility, the airport will be forced to make it available at a low price to its competitors.

In principle it might be possible to get around this problem by setting a price cap rather than specifying each price. Thus the airport could set different prices for a facility at different times of the day subject to the average of these prices not exceeding the cap. For some larger facilities, such as terminals or gates, this may be feasible, though it would require considerable monitoring on the part of the regulator, and it would probably require that the facility be used widely throughout the time period.

The reality of costs which are both difficult to estimate, and which vary considerably over time, means that price regulation must be inaccurate. To the extent that it is inaccurate, it can be inefficient.

## Quality Problems

It is becoming increasingly recognised that when firms are subjected to regulation of the price-cap form they have an incentive to downgrade the quality of the product they are selling. Quality reductions can usually lead to cost reductions, and as long as these do not lead to big falls in demand, the firm can gain additional profit, since the price allowed by the regulator remains unchanged. For this reason, price regulators such as the ACCC are now monitoring quality of service in the industries they regulate.

The same sorts of incentives are present when access prices for facilities are regulated. However, in this context, there is an additional incentive to reduce quality. This occurs because the firm that is purchasing the access is also the firm with which the regulated firm is competing. By reducing the quality of the service it provides, it can lessen the effectiveness of its competitor. This could happen to the extent that access regulation is ineffective as a means of promoting competition. The regulator can seek to monitor quality, though in doing so it will need very detailed information about the ways the firm operates its facilities. Most of ways in which a firm may hobble its competitor are less than transparent, and unsuitable for measurement according to standard indices of performance. The regulator may be drawn into the detail of the relationships between the firms and be unable to rely on established rules.

## Assessment and Conclusions

This review has examined a number of issues which arise from applying access regulation to airports. Overall, the objective of access regulation is to promote competition in a range of airport services, with the potential to increase allocative and productive efficiency. A number of problems have been highlighted, and one can question how effective this regulation will be, and whether it will increase efficiency. The answers to a number of questions can be suggested.

### Is Access Regulation Necessary?

If there is an efficient and effective system of regulation of final product prices, or these products are sold in competitive markets, access regulation of services and facilities used in producing the final products would be superfluous. As it is, this is not the case, for several reasons:

(a) The effectiveness of price regulation of airports is limited, and there may be ways of circumventing it,
(b) Not all airports will behave as profit maximisers, and
(c) Not all final services are price regulated- an important exception would be domestic passenger terminal services.

### Are the Potential Gains Significant?

Many airport services are, in themselves, not very significant, though it is desirable that they be produced and priced efficiently. If simple regulation can improve things, at little cost, it will be desirable. Some services, especially domestic passenger processing services, are potentially very important, because of the impact they can have on competition in the domestic airline industry. It has yet to be seen whether the access regime being implemented will address this problem area. Final product regulation, albeit imperfect, along with private ownership and profit oriented behaviour, may be sufficient to achieve a feasibly high level of efficiency for most airport services.

Will the Access Regime prove Effective?

Some factors will work to diminish the effectiveness of the access regime. Current price bundling will limit its effectiveness, since competitors will not be able to match the airport's mix of services and will not be able to sell individual services. Furthermore, the implementation of the access regime could have a cost in creating a disincentive for airports to reform their price structures. Another factor which will reduce access regulation's effectiveness is the reduction of quality. Facility owners can reduce the quality of price regulated facilities supplied to their competitors, thus weakening them; it would be very difficult for the regulator to control this.

Will Regulation be Implemented Efficiently?

The Australian access regulation system is quite cumbersome, however its mix of negotiation followed by possible arbitration may result in reducing direct and costly intervention by the regulator. For this to be so, ideally negotiators need to know what the ACCC will do, and at what level it is likely to set prices. Given the difficulties of choosing efficient access prices, the ACCC's choice of prices may be unpredictable, and parties may gamble on arbitration.

Can the ACCC set Efficient Prices?

There is a considerable risk of prices being set at inefficient levels. Given that there are scale economies and cost recovery problems, joint and common costs, cost variability and information about the costs of individual services is difficult to obtain, one cannot presume that regulated prices will be efficient. It is quite possible that efficiency is not very sensitive to the actual precise price set, but if this is so, it would also be true that the benefits of access price regulation would be small anyway.

Where to from Here?

As access prices are implemented, the answers to some of the questions raised here will become evident. It may well be that access price regulation of services or facilities that are indirectly regulated through final product regulation will prove superfluous (especially if the design of this regulation is improved). Access regulation can then concentrate on making regulation of a few services, such as domestic passenger processing services, which can really matter, more effective and efficient. It can also be directed to some less important services, for which efficiency gains are possible, but which can be handled with minimal direct intervention by the regulator.

**TABLE 1**

**DECLARATION OF AIRPORT SERVICES**

| Service | Necessary for Aviation Services? | Uneconomic to duplicate? | Likely to be declared? |
|---|---|---|---|
| Airside Facilities (runways, Taxiways etc) | Yes | Yes | Yes |
| International Passenger Processing Areas (gates etc) | Yes | Yes | Yes |
| Domestic Passenger Processing areas (gates etc) | Yes | Case by Case | Case by Case |
| Administrative Office Space | Yes | No | No |
| Commercial/Retail Facilities | No | No | No |
| Flight Catering Facilities | Case by Case | No | No |
| Refueling facilities | Yes | Case by Case | Case by Case |
| Land for Refueling services | Yes | Yes | Yes |
| Land for Freight services | Yes | Yes | Yes |
| Ground Handling and Freight Handling Equipment Storage | Yes | Case by Case | Case by Case |
| Sites for Cargo Terminals | Yes | No | No |
| Sites for Emergency Maintenance | Yes | No | No |
| Sites for Heavy Maintenance | Yes | Yes | Yes |
| Landside Vehicle Facilities | Yes | Yes | Yes |
| Waste Disposal Facilities | Yes | No | No |

*Source:* ACCC, 1998b, p. ix

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# The Impacts of the Asian Economic Crises on Asian Airlines:
## Short-run Responses and Long-run Effects

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*Tae Hoon Oum would like to acknowledge the research grant support of the Center for Korean Research, University of British Columbia.

# The Impacts of the Asian Economic Crises on Asian Airlines: Short–run Responses and Long-run Effects

## Introduction

Throughout the 1980's and 1990's, rising per capita incomes in Asia Pacific resulted in an expansion in intra-regional trade and the emergence of a sizeable "middle income" class with the resources to travel. As a result, the demand for air travel sustained annual growth rates in excess of 10% and there were expectations that Asia Pacific would be the engine of growth for the world's travel industry well into the 21st Century. The Air Transport Action Group (1997), for example, predicted that the demand for air travel in Asia Pacific would grow by 7.4% per annum between 1995 and 2010, twice the rate it forecast for the rest of the world. This optimism was shared by IATA with its prediction that over half of all passenger movements by air by the year 2014 would be associated with travel to, from or within Asia.

In 1992-93, 8 of the world's 15 most profitable airlines were from the Asia Pacific and their low input prices, especially for labour and "materials", gave them a competitive advantage. The prospects for the aviation sector appeared to be excellent and confident airlines and airports embarked on expansion plans. "Growth" was the driving force setting the agenda for policy makers and governments allowed the private sector broader scope to participate in aviation through privatisation and the formation of new airlines.

Nevertheless, there were some emerging problems for the airlines. Yields were falling in highly competitive markets where capacity grew more quickly than demand and profits were being squeezed by rising costs. Currency appreciations eroded competitive advantage, especially for Japan, but a host of new challenges emerged early in 1997. The predicted "bubble" in the demand for travel to Hong Kong prior to the handover did not eventuate. Concerns about the arrival of the Peoples Liberation Army in Hong Kong and possible changes to freedoms and liberties once under Chinese rule were beginning to have an impact. The bird flu scare, in particular, deterred tourists and the Hong Kong travel market began to decline from June 1997. Smog from the forest fires in Indonesia affected tourism demand throughout South East Asia, but the main factor affecting demand was that the Japanese market had lost its momentum.

Then came the events of the second half of 1997 that led to the currency crises and the need for IMF assistance in Thailand, Indonesia and South Korea. Collectively, the Asian economies had accumulated over US$240 billion in short-term debts. When the Government of Thailand could no longer afford to support its currency against the attacks of speculators it floated the Baht on 2 July 1997. The ensuing crash reverberated through the Philippines, Indonesia and Malaysia. Confidence was undermined as the extent of non-performing loans became clear. Within a very short period of time, capital flowed out of the region, and Asia's wealth fell sharply.

The IMF provided US$1 billion in assistance to Thailand on 19 July and followed this up with another US$17.2 billion on 11 August, but the contagion continued to spread and there were sharp falls on stock exchanges late in October. The IMF offered US$40 billion in a bail-out package to Indonesia on 31 October and then negotiated a record amount of assistance (US$58 billion) with South Korea on 3 December. Some major corporations were in serious financial difficulty, governments were adopting austere economic measures, unemployment was rising and job security was threatened. Even a fiscal stimulus of US$128 billion introduced by the Government of Japan to its own economy failed to satisfy financial markets and downward pressure on the Yen continued.

With the resulting drop in consumer confidence and fall in international purchasing power, Asia's travel markets slumped. In Japan, young office workers who previously made up an important segment of the travel market now were the target of plans of corporations to reduce their labour costs. The crisis of confidence in South Korea was sudden and deep and airline traffic fell by as much as 80% on some routes in the month following the IMF bail-out package. As a result some important players in the travel sales and distribution system have gone out of business and it will take time and resources to rebuild these systems.

The airlines were highly exposed with commitments to purchase aircraft and spares in hard currency. The value of their debt escalated rapidly, interest rates and fuel costs (expressed in domestic currencies) increased, and traffic fell sharply. Profit projections for the region's carriers were written down immediately and some made losses of several hundreds of millions of dollars (US) during 1997/98. The newer carriers that relied on domestic and intra-Asian business have been the worst affected. Some airlines have gone out of business or have suspended their operations. Other responses have included selling aircraft, partly to reduce capacity and partly to finance deliveries of new aircraft. Sale-and-leaseback deals have been common and aircraft orders are being deferred where possible. Airlines are reallocating capacity to stronger routes connecting Asia with Europe and North America.

The currency devaluations ultimately should help to stimulate travel demand and there will be winners and losers as destinations compete for their share of a smaller market. Also, as some airlines pull out of routes the remaining carriers have opportunities to increase their revenue. Depending on the ability of the airlines to maintain their yields, Asia's carriers will keep their attention firmly on reducing their costs and on re-financing their fleets. However, the restructuring process has been and will continue to be painful even under the most optimistic scenarios. There is speculation that some airlines will merge in order to create one or more mega carriers in Asia and that major European and North American carriers may become part-owners of Asian carriers.

This paper examines the impacts of the economic crises on the airlines and the responses being pursued by management and governments. Given the trend towards liberalization, an important question is whether the current circumstances are likely to lead to a return to more protectionist attitudes. The temptation to shield carriers from competition are being balanced against the need to open up markets, to forge alliances and to attract investment. Though we illustrate the impact of the economic crisis with examples of recent developments, our focus is on long-term impacts of the Asian economic crises on cost competitiveness of Asian carriers and on the regulatory environment.

## Asia's airlines and the competitive environment in the early 1990's

For the present purposes, Asia's airlines can be categorised broadly into two groups. The first set began to make its presence felt in international markets in the 1970's as wide-bodied aircraft were reducing the costs of long-haul travel. Traffic between Japan and North America had grown because of the USA's military presence during and after the conflict in Korea. At the same time, growth on the Kangaroo Route from Australasia to Europe was creating opportunities for aggressive airlines based in South East Asia (Rimmer, 1996). Singapore Airlines and Thai Airways, for example, are located advantageously at interchange points and are convenient and attractive stopover airports. Furthermore, Asia's emerging airlines of the 1970's possessed a significant competitive advantage through their low input prices (Findlay, 1985) and they were able to capture a growing share of the market.

As the Asian economies began to prosper during the 1980's, these carriers expanded and the network of intra-Asian airline services entered into a period of rapid development (Rimmer, 1996). In aggregate, traffic in Asia was averaging growth of more than 10% each year while some routes were sustaining growth rates of over 20% for several years in succession (Air Transport Action Group, 1997). For various reasons, the established Asian airlines were having difficulty coping with this growth and governments began to relax their regulations to permit new, private-sector airlines to emerge (Nuutinen, 1991; Bailey, 1993; Bowen & Leinbach, 1995). This accelerated the liberalisation of airline competition through multiple designation and the development of new intra-Asian routes as the new entrants pursued international ambitions (Bowen, 1997; Hooper, 1997).

In developed airline markets, the most successful entry strategy for new airlines has been based to a large extent on cost leadership. The source of the cost advantage can come from high productivity levels, say, through high aircraft and manpower utilisation (eg. Southwest Airlines in the USA) or through low input prices (eg. by paying less to employees and for "materials and services" and by operating older aircraft). The first group of Asian airlines did enjoy a significant advantage in terms of input prices. For example, in 1976 Pakistan, Malaysia, Korea, Indonesia and Thailand all had input costs that were less than half those for the US carriers (Brunker et. al., 1989). Though the Asian carriers had relatively low productivity levels, their unit costs remained competitive.

The situation was different for the emerging Asian carriers of the 1990's because they operated new aircraft and offered high levels of service. In addition, they often had to pay premium rates to attract staff. They did not have the scale of their established opponents, but a more important problem was that many of the opportunities for them were on thin, developmental routes. In short, Asia's new international airlines were unable to reap economies of traffic density and they lacked a strong cost advantage while operating in highly competitive and price-sensitive markets (Oum & Taylor, 1995). In some cases, governments believed that, by allowing new airlines to enter international service, they would be able to cross-subsidise unprofitable domestic services (Hooper, 1997).

The common factor creating the opportunities for the new airlines was the rapid rate of growth in the region's air traffic. Forecasting groups looked at the high economic growth rates in Asia and believed these were sustainable for several reasons. In particular, Asia has a large workforce that has been improving its skill levels while industries can continue to adapt proven technologies (McDonnell Douglas, 1995). Governments had provided necessary infrastructure and had pursued economic policies promoting exports. Foreign investment was available, especially from North East Asia, and this was facilitating technology transfers. Rising per capita incomes, the emergence of a large middle class and the continuous microeconomic, institutional, social and political reform (Bowen & Leinbach, 1995; Chin, 1997) were considered likely to stimulate continued growth of air travel demand in the long run.

The rapid expansion in traffic provided ample opportunities for Asia's airlines to enter new routes and add capacity, but the imperative to increase efficiency levels was becoming stronger. Windle (1991) estimated that Asian carriers had a 21% cost advantage over airlines from the USA in 1983. However, some of this was attributable to factors beyond the control of management and was not a source of competitive advantage. For example, the longer stage lengths of the Asian airlines reduced relative costs by 10%, but the lower input price for labour was the key reason why costs were lower in Asia.

Maintaining a competitive position based on geographic differences in input prices is difficult because international airlines practice global sourcing. Also, rising GDP per capita levels in Asia have been associated with higher labour prices. For example, wages in South Korea in 1992 were 12.8 times higher than they were in 1975 when expressed in US dollar terms while the corresponding ratio in Japan was 5.3 (Forsyth, 1996). At the same time, trade surpluses led to currency appreciations, especially for Japan, further undermining cost competitiveness[1]. Japan Airlines would have had an 8% higher unit cost than American Airlines in 1993 had the Yen maintained parity with the US dollar [illegible] 1986 level (Oum and Yu, 1997). In fact, the actual level of cost disadvantage was [illegible]%. Singapore Airlines, Korean Air, Cathay Pacific and Thai Airways were cost competitive compared to American by factors of 16%, 23%, 4% and 9%, respectively, primarily as a result of lower input prices. These Asian carriers' unit cost advantages wou[illegible] have been higher had they achieved same level of efficiency as the U.S. mega carrier[illegible]

In summary, the challenges facing Asia's airlines in the mid-1990's were [illegible] balance their growth ambitions while improving productivity levels and controlling inpu[illegible] prices

[1] Cost competitiveness is defined as lower costs resulting from input prices and productive efficiency after removing the effects of stage length and output mix.

through global sourcing. Access to markets and membership of alliances also were key issues and governments liberalised competition in domestic markets and gave new airlines access to some international routes (Hooper, 1997), although the approach was cautious and pragmatic (Bowen & Leinbach, 1995). In addition, there were pressures from outside the region to increase the level of competition. In particular, the US Government was turning its attention to Asia after its successful negotiation of "open skies" air services agreements in Europe and Latin America (Jennings, 1996; Ballantyne, 1997; Chin, 1997). Subsequently, Singapore, Brunei, Malaysia, Taiwan and South Korea all signed open skies air services agreements.

As the Asian economies need to rely more on the IMF and the U.S. in order to get their economies back on track, it is likely that the U.S open skies effort will gain momentum. In addition, Asian nations have considered various regional initiatives to promote more competitive markets for air services, but generally the approach to regulatory reform has been cautious. This has been especially the case for the exchange of fifth freedom rights with the result that the Asian airline industry remains relatively fragmented.

## The impact of the economic crisis on traffic levels

Informal business networks, close relationships between financial institutions and their borrowers were mechanisms that facilitated rapid growth in Asia, but the financial sector became exposed to risky investments. A lack of control over lending practices and inadequate disclosure and reporting requirements have been pin-pointed as fundamental weaknesses of the Asian economies. When the weaknesses of the financial sector began to emerge, currencies began to enter a free-fall. Table 1 shows that the Thai Baht fell to almost half of its value against the US dollar in the second half of 1997, although it has improved during 1998.

Were the price of an overseas holiday to be set in US dollars, the Thai consumer now would have to pay 44% more in terms of Bahts. The Indonesian Rupiah became so unstable that trade in it was suspended and the Indonesian consumer has to offer almost 4.5 times as many Rupiah now to purchase goods and services sold in US dollars compared to one year ago. Clearly, the affordability of overseas travel outside of Asia has suffered.

**Table 1: Changes in exchange rates for selected Asian economies (local currency per U.S. dollar)**

| Economy | Currency | June 97 | Dec. 97 | June 98 | Dec.98 | %devalue |
|---|---|---|---|---|---|---|
| China | Yuan | 8.3 | 8.3 | 8.3 | 8.3 | 0% |
| Hong Kong | Dollar | 7.8 | 7.8 | 7.8 | 7.8 | 0% |
| Indonesia | Rupiah | 2,600 | 5,450 | 9,800 | 11,000 | 76% |
| Japan | Yen | 114 | 139 | 146 | 116 | 2% |
| Malaysia | Ringgit | 2.5 | 3.9 | 3.9 | 3.8 | 34% |
| Philippines | Peso | 26.4 | 39.5 | 38.4 | 38.8 | 32% |
| Singapore | Dollar | 1.43 | 1.65 | 1.69 | 1.66 | 14% |
| South Korea | Won | 881 | 1,695 | 1,383 | 1,206 | 27% |
| Taiwan | Dollar | 27.8 | 32.2 | 34.5 | 32.2 | 14% |
| Thailand | Baht | 25 | 47 | 40 | 36 | 31% |

To make matters worse, Asia's wealth devalued overnight through sharp falls in property prices and share values. Table 2 illustrates the extent of this effect. A consumer in Malaysia, South Korea or Thailand who had invested in shares in June 1997 would be able to sell them for less than half of their previous value in June 1998. Coupled with this, the list of business failures includes merchant banks through to steel producers. All businesses are seeking to reduce their labour costs and consumer confidence has slumped with the loss of job security.

**Table 2: Changes in share price indexes for selected Asian economies – June 1997, December 1997 and June 1998**

| Economy | Share Price Index | | | Loss in value relative to period 6 months before (%) | |
|---|---|---|---|---|---|
| | Jun 97 | Dec 97 | Jun 98 | Dec 97 | Jun 98 |
| China - Shanghai | 2,743 | 2,971 | 3,220 | -8% | -17% |
| China - Shenzhen | 4,550 | 3,963 | 3,864 | 13% | 15% |
| Hong Kong | 15,,056 | 10,723 | 8,543 | 29% | 43% |
| Indonesia | 732 | 402 | 446 | 45% | 39% |
| Japan | 20,176 | 15,259 | 15,830 | 24% | 22% |
| Malaysia | 1,079 | 594 | 456 | 45% | 58% |
| Philippines | 2,816 | 1869 | 1,760 | 34% | 38% |
| South Korea | 758 | 376 | 298 | 50% | 61% |
| Taiwan | 8,997 | 8187 | 7,549 | 9% | 16% |
| Thailand | 569 | 373 | 267 | 34% | 53% |

Domestic demand and imports fell by more than 20% in real terms in 1998 in Indonesia, Malaysia, South Korea and Thailand (Camdessus, 1999). The lower exchange rates improved international competitiveness and the Philippines, South Korea and Thailand all succeeded in selling more exports. Indonesia fared the worst overall with its GDP declining by 15% in real terms in 1998 (IMF estimate). In the same year, the economies of Malaysia, South Korea and Thailand contracted by 7-8%.

Consumers in those economies that remained relatively strong, or those in countries with fixed exchange rates, were able to afford more travel. For example, the number of visitors to Singapore from Australia, China and India was up by 10.6%, 7.2% and 2.6%, respectively, in the first quarter of 1998. However, the general pattern was one of decline. The number of arrivals in Singapore from Japan was 31% lower in the first quarter of 1998 compared to the same period one year before and the total number of visitors to Singapore declined by 20%.

In June of 1998, Airports Council International reported that the overall number of passenger movements for all of Asia's main airports fell by 5.1% compared to the same month in the previous year. Nevertheless, there are signs that the market might be about to enter the recovery phase. Thai Airlines and Singapore Airlines both increased passengers carried marginally in the first three quarters of 1998. The Association of Asia Pacific Airlines reported that its members had a 2.3% growth in passengers for the month of September in 1998 and that the average load factor increased from 68% to 72%. Notably, revenue passenger kilometres increased by 4.3%, reflecting the greater importance to the airlines of long-haul, international flights. Thailand, for example, has succeeded in attracting more tourists from outside the region, especially Europe. It appears, though, that yields are suffering and that the market growth is driven largely by low prices.

Prior to the financial crises, IATA predicted that air traffic in the Asian region would grow by 7.7% a year to 2001, but it has revised this to 4.4% per annum and 5-6% on international routes. Boeing, in its most recent issue of *Current Market Outlook*, argues that economic growth in Asia will resume and, over the next ten years, will average between 2% and 3%. As consumer confidence returns, and as economic growth strengthens, the prospect is that Asia will again be one of the main driving forces of air traffic growth globally. Over the period between 1998 and 2007, Boeing predicts the growth in revenue passenger kilometres will average 5% across all markets. However, annual growth rates in Asia will be 8.4% for China, 6.9% for Southwest Asia and Northeast Asia and 6.1% for Southeast Asia. Airbus is similarly optimistic that growth will re-emerge in Asia's travel markets after a 2-3 year period.

Uncertainty about the future of Asian travel markets reflects underlying questions about the prospects for an economic recovery. Some economists point out that the fundamental strengths of Asia are its plentiful supply of labour with increasingly high skill levels, the capability to leverage growth with proven technology, government policies that supported export activity and that provided necessary infrastructure. A less optimistic view is that there are major political and institutional barriers in Asia inhibiting further development and that it will take time to resolve these problems (Walton, 1997).

## Airline responses to the economic crisis

### The scope for action by airline managers

The economic crisis immediately placed Asia's airlines under severe financial stress. Airlines that relied on domestic and intra-regional traffic were the most exposed, but several carriers were making losses even before July 1997. Garuda Indonesia and Korean Air, for example, had accumulated large operating losses. Korean's net loss for 1996/97 was US$280.7 million while Asiana Airlines recorded a loss of US$281.4 million. The costs of servicing loans and leases mostly were in hard currencies so that the devaluations escalated debt levels. Korean Air had more than 90% of its debt in foreign currencies and it debt rose to US$5.5 billion, more than six times its equity. Korean Air revealed in February 1998 that it had a "paper" loss of US$900 million as a result of the devaluation of the Won, although subsequent strengthening of the Won improved the situation.

Philippine Airlines had embarked upon a fleet renewal and expansion programme prior to the onset of the economic crisis and found itself committed to financing costs of US$29 million each month. By the middle of 1998, the airline's management had decided to down-size, triggering a costly dispute with its pilots that led to 5,000 employees being sacked or laid-off. In September, 1998, Philippine Airlines went into "protected bankruptcy" after making a loss of US$157 million in the previous six months. In its attempts to restructure its finances, PAL attracted the interests of Northwest Airlines, Lufthansa and EVA. The most serious proposal was for Cathay Pacific to take a 40% stake in PAL, but this floundered on the issue of control. In January 1999, PAL claimed it would be able to attract sufficient capital to continue operating

Sempati Air, a new entrant in Indonesia, went into liquidation in June of 1998. One month later, Merpati Nusantara suspended its services. In total, 9 airlines went out of business across Asia (including South Asia) in the first twelve months of the economic crisis (Bonassies 1998). Several more carriers continue to operate with large debt burdens, but the IMF's guidelines make it difficult for governments to rescue their airlines within the strict budgetary conditions of the bail-out packages.

Few airline managers in Asia have had to deal with falling traffic levels let alone financial problems of this magnitude. The airlines clearly needed to restructure their finances and rid themselves of excess capacity, but they also needed to develop broader strategies to take them through the remainder of this deep recession. It is to these strategies that we now turn.

### Capacity decisions

One of the first actions in any industry suffering a downturn in demand is to reduce capacity. This response is difficult in the airline business because canceling flights can damage long-term marketing prospects while not resulting in significant savings. Much depends on whether capacity can be allocated elsewhere on the airline's network or whether aircraft can be leased or sold to other airlines. In any case, labour costs are difficult to adjust in the short-run and airlines have to be ready to resume services once the market improves. If the service involves a congested airport, airlines also are concerned about losing access to valuable slots.

Most airline costs cannot be avoided once the schedule is set and, since this tends to occur twice a year, the scope for managerial action is limited for a period of up to six months. Under "normal" circumstances, the typical response to a temporary fall in traffic is to increase marketing expenditure and to use promotional prices more aggressively. For example, Qantas and British Airways have offered deep discounts of up to two-thirds off their fares to London, Frankfurt or Rome. Qantas provided an additional bonus of a free domestic round-trip to any one of 10 Australian cities. Singapore Airlines gave its passengers the first night's accommodation on a stopover in Singapore for US$1 and additional nights have been priced as low as US$30.

In the current situation, though, demand has fallen by as much as 80% in some markets and the prospects of a quick recovery are poor. The airlines have no alternative but to reduce their services on the worst-affected routes and to pull out of some routes completely, relying on code-share partnerships to maintain a presence. Where possible, the capacity is being diverted to other routes, but those airlines that are most exposed to intra-Asian routes recognised that they needed to reduce the size of their fleets.

The most immediate decision has been to cancel orders for new aircraft or to defer deliveries. In March 1998, the airlines in Asia Pacific had orders for 179 narrow-bodied aircraft valued at US$7.5 billion and 254 wide-bodied aircraft valued at US$33 billion. Korean Air and Asiana alone had orders for 76 new aircraft. Taking account of the orders placed by leasing companies that are attributable to Asia, it was estimated that the Asian carriers were accountable for one-quarter of all orders for wide-bodied aircraft in 1998 (Williamson 1998). Close to half of all orders for B747-400 and B777 aircraft have been made by Asia's carriers. Boeing indicated that the Asian economic crisis will have an impact on deliveries of 150 aircraft, including 60 wide-bodied aircraft.

Those airlines in the most difficult situations have put aircraft up for sale either to reduce capacity or to make way for deliveries of new aircraft. In many cases, the sale of older aircraft has helped to provide the necessary finance to pay for new aircraft, while in others the sale-and-leaseback option has been necessary to reduce debt levels. In total, 91 aircraft were sold or leased by Asia's airlines to outside Asia during 1998, but seat capacity increased by 1.3% overall as 140 new aircraft were delivered (*Air Transport World*, December 1998 issue, page 14). The prediction is that net capacity will increase by another 1% in 1999. Even with the depressed market conditions it seems likely that capacity growth will fall behind demand. Since load factors are already high on many routes, this will give airlines the opportunity to improve their yield.

**The Asian economic crisis and cost competitiveness of Asian carriers**

What impact does the current economic crisis have on the Asian airlines' cost competitiveness? In order to answer this question properly, it is necessary to discuss the factors determining cost competitiveness. Airline cost competitiveness depends on input price levels and productive efficiency - lower input prices and/or improved efficiency enhance cost competitiveness. Oum and Yu (1998) found that except for the Japanese carriers, other Asian airlines have unit cost advantage relative to their North American or European competitors mainly because of their lower input prices.

In particular, before the Asian economic crisis, Singapore Airlines and Korean Air had unit cost advantage relative to American Airlines by about 16% and 23%, respectively, although both of these Asian carriers have slightly lower productive efficiency than American Airlines. Most of the Asian carriers' unit cost advantage come from the lower labour and other purchased materials and services input prices in terms of international currency. Thai Airways had only about a 9% unit cost advantage relative to American Airlines although they enjoy extremely low input prices. This is because Thai Airways' productive efficiency is very low. Cathay Pacific has lost unit cost advantage relative to American Airlines because it no longer enjoys any input price advantage relative to those in the U.S.

As shown in Table 1, since June 1997 Asian currencies were subject to varying degree of devaluation. For example, between June, 1997 and December, 1998 the currencies of Indonesia, Malaysia, Philippines, Thailand and Korea are devalued by 76%, 34%, 32%, 31% and 27%, respectively. The immediate effect of these currency devaluations is to increase unit cost advantages of the Asian carriers. Although aircraft financing cost and fuel prices are not likely to change in U.S. dollar terms, labour and purchased materials and services prices in terms of U.S. dollar are likely to decrease due to the currency devaluation. As stated earlier, because of the currency devaluation and the depressed travel demands in Asia, the Asian carriers have lowered their air fares substantially in terms of U.S. currency. In the medium to long term it is clear that currencies of these Asian countries are likely to be revalued to their previous levels while inflationary pressure which will follow their economic recovery will increase labour and other input prices in those countries. This implies that, unless the carriers improve productivity, cost competitiveness in the medium to long term for these carriers are not likely to improve beyond the levels they enjoyed prior to the economic crisis.

However, the current economic crisis has been and will continue to force Asian airlines to restructure their networks and operations for improved efficiency while forcing their governments to open up markets for competition. These changes are likely to bring two positive outcomes to the Asia's air transport industry. First, the procompetitive changes are likely to induce Asian carriers to improve productive efficiency to the level the major carriers in North America enjoy. Second, in the process of restructuring the industry, one or two mega carriers may emerge in Asia. For example, Singapore Airlines may be able to participate in the ownership of one or more major Asian carriers (Thai Airlines and/or China Airlines).

JAL, ANA or Cathay Pacific may use this opportunity to expand their markets into one of multiple hub networks by acquiring equity stakes in other Asian carriers. Because of these positive changes anticipated in the industry (and not because of their currency devaluation), in the medium to long term the Asian economic crisis is likely to help Asia's air transport industry. In the very short run, the sudden collapse of tourism air travel demand in the region has harmed severely the bottom line of all Asian airlines. In the short run, the devalued Asian currencies will prolong the period in which Asian carriers enjoy unit cost competitiveness relative to the North American or European carriers. Although it will take several years for getting their economies back to the pre-crisis level, air travel demands are expected to increase very rapidly as the economic recovery begins in earnest (see Boeing, 1998).

As Asian carriers cope with the sudden reduction of air travel demand, the average prices (yield per passenger mile) decreased substantially even in domestic currencies. For example, Singapore Airlines' average yield per passenger miles (in Singapore dollars) during the six months period ending September 30, 1998 decreased by 9.1% as compared to the same period a year ago. Cathay's average yield per passenger mile decreased by 5.9% during the six months ending June 30, 1998 as compared to the same period in the previous year. The passenger load factors of Asian carriers were also reduced substantially after the Asian economic crises. Obviously, the lower load factor has significant negative effects on the productivity of Asian carriers. For example, Singapore Airlines' labour productivity was reduced by 3.5% in the six months ending September 30, 1998 as compared to the same period a year ago.

**Alliances**

Alliance formation can be a tactical response or it can be part of a longer-term strategy. Since the onset of the Asian economic crisis, there has been widespread alliance activity. For example, when Qantas Airways ceased operation to Seoul, it turned to its code-share partner, Asiana Airlines, to carry its passengers. As Qantas enters the Australia-Argentina market, it intends to use its own aircraft while benefiting by making use of the code-share agreement with Aerolineas Argentinas. This provides Qantas with an opportunity to use its capacity while also benefiting Aerolineas Argentinas as the latter can use the aircraft released from the Australian market to meet a growing demand for the Argentina-Europe services.

While the economic crises in Asia have placed the carriers based in the region under financial stress, the process of globalisation of the airline industry has taken a major step forward. The Star Alliance built around United Airlines and Lufthansa has gained momentum with the addition of Air Canada, Varig, Thai Airways, Air New Zealand, All Nippon, and Ansett Airlines with a likelihood that Singapore Airlines will become a member during 1999.

The formation of **one**world between American Airlines, British Airways, Cathay Pacific, Canadian Airlines, Iberia and Qantas in September of 1998 was presented as a brand name for a global network. Among other measures, the partners have code share agreements with each other and share frequent flier plans. Cathay's dominance at the new Chek Lap Kok Airport in Hong Kong gives that "alliance" a strong position in Asia. Asiana code shares with Qantas to Cairns and with American to Los Angeles, New York, San Francisco and Seattle.

A third major global group has coalesced around KLM, Northwest Airlines and Continental Airlines and includes Malaysian Airlines. Key members of these global groups have been active in signing up partners in Asia. Korean Air is linked to Delta Air Lines, which in turn is allied with Air France, Austrian, Sabena and Swissair.

Some of these alliances will help the Asian carriers in the short-term, in some cases, with injections of capital, through sharing the use of resources, by consolidating traffic and improving utilisation of aircraft and by strengthening market positions. However, they clearly have long-term significance. For example, Thai Airways is a member of the Star Alliance, but Singapore Airlines' realignment with Star led to an announcement by Lufthansa that it would shift its South East Asian focus from Bangkok to Singapore. The subsequent decision by the Government of Thailand to privatise Thai Airways has attracted major world airlines as potential bidders. The current wave of alliance formation in Asia will help the region's airlines rationalise services, to consolidate traffic and to improve their finances, but they also will play a role in deciding the competitive strength of the major global alliances at key Asian hubs.

**Service decisions**

The key service decisions that managers have taken are to change frequencies, to suspend services and to withdraw from routes. Other dimensions of service are difficult to target at particular routes in the short and medium term. For example, Indonesia's airlines made an application to increase domestic fares from 11 to 16 cents (US) per seat kilometre. When the Minister for Transport and Communications refused to grant permission, Sempati Air immediately cancelled services on 10 domestic and 4 regional routes (including to Taiwan). The Minister intervened to stop Merpati Nusantara, one of the Government's airlines, taking similar actions on 80 of its routes. Instead, the Minister agreed it could phase out routes with load factors under 30%. Garuda Indonesia then cut its international flights by 30% and domestic flights by 26%.

Qantas Airways, Ansett International and Air New Zealand were among a number of airlines to suspend services to South Korea early in 1998 when the number of Korean residents travelling abroad fell sharply. Asiana Airlines ceased 15 flights on 6 international routes and Korean Air dropped 48 flights on 21 international routes.

Airlines also have been seeking opportunities to re-deploy their capacity. Singapore Airlines and Cathay Pacific Airways both implemented plans to increase the frequency of flights to Australia. All Nippon Airways was quick to take advantage of its improved access to the USA market under the new air services agreement concluded between the USA and Japan early in 1998. After South Korea entered an open skies agreement with the USA, Korean Air was able to increase its frequency to San Francisco, Chicago and Los Angeles.

**Regulatory responses to the economic crisis**

The airlines clearly are realigning their capacity while setting themselves up to take best advantage of global airline groups and to pursue sustainable productivity improvements. Nevertheless, the impacts of the economic crisis are so great there will be a temptation for at least some governments to provide their airlines with direct financial support and to protect them from competition. It seems likely that some of the financiers backing the airlines in their sale-and-leaseback deals believe that, ultimately, the governments of Asia will ensure their airlines remain solvent (Williamson, 1998). In addition, equipment suppliers and their governments will be supportive of distressed airlines as appears evident with the success Korean Air has had in securing a low interest loan of US$254 million (Mann, 1998). The Government of Indonesia already has given sovereign guarantees in order for Garuda Indonesia to complete purchases of aircraft.

Governments also could step in to protect their airlines from competition, setting back the pace of liberalisation in Asia. However, there are good reasons to believe these options will not be favoured in general and that the pressure to liberalise will grow even stronger. One force working in this direction is that the governments of Asia have larger problems to solve and their ability to support airlines making large, on-going losses is limited. For Indonesia, Thailand and South Korea, the International Monetary Fund has imposed conditions on its support programmes that further constrain actions of these types. The IMF's prescription is to open up markets, to allow foreign investment and to privatise government business undertakings. Furthermore, airlines are eager to gain access to stronger markets in Europe and North America, they need injections of funds, and they want to take part in global alliances.

Table 3 documents recent regulatory responses. Though the airlines continue to suffer financial stress, the picture that is emerging is that the governments of Asia are accelerating regulatory reform in the direction of liberalisation. For example, South Korea signed an open skies agreement with the USA in June, 1998. The Japan's new liberalized agreement with the USA is restricted to incumbent airlines and is constrained because of slot restrictions. South Korea was looking to expand access for its airlines in the USA-Korea market, but it also valued the greater access to beyond flights to Latin America. The USA-Korea agreement also will place pressure on Japan to proceed further down the liberalisation path.

At the same time, the Government of Thailand decided to allow private airlines to fly on domestic routes without limitations and to liberalise its international markets progressively. In addition, there have been renewed attempts to privatise Thai Airways, prompting several large international airlines to express interest in taking an equity position. In June 1998, the Government of Thailand amended the 1954 Aviation Act to allow for up to 49% ownership of Thai carriers by foreign investors. The Government of

South Korea also lifted the restriction on foreign ownership of its airlines to 50%. Many other countries in Asia have been active renegotiating air services agreements in order to give their airlines flexibility to adjust their networks.

Governments in Taiwan and the Philippines have become concerned about safety standards in the wake of the economic crises. In June 1997, a Boeing 737 operated by China Southern Airlines crashed at Shenzhen killing 35 passengers. Sempati Air had a crash in the next month with 30 fatalities. In August, a Korean Air B747 crashed into a mountain-side in Guam with 228 people losing their lives and, in the next month, a Garuda Indonesia A300 crashed at Medan during poor visibility associated with forest fires. In that case, 234 people died, but this was followed in December by another 104 fatalities with another airline crash in Sumatra. This time it was Silk Air. February was a difficult period with crashes involving Cebu Pacific (104 dead) and China Airlines (205 dead).

Two more airline crashes in Taiwan prompted the government of that country to encourage its airlines to merge to improve their economic and safety position. The situation reached the stage in the Philippines where the Government suspended Grand Air's operating licence after repeated violations of the regulations and indicated it was increasing its surveillance of all carriers, including Philippine Airlines. The exact causes of some of these crashes still are not known and it would be unreasonable to attribute them all to economic factors, but the publicity given to safety has posed further challenges for the airlines and regulators alike.

**Table 3: Regulatory responses in Asia Pacific 1997-98**

| Economy | Decision |
|---|---|
| China | Considering raising the limit on foreign ownership of airlines to 40% from 35% equity and 25% voting rights in an attempt to attract more capital |
| China & Malaysia | Memorandum of Understanding to allow Malaysian Airlines and any other Malaysian carriers to operate 64 flights each week to six cities in China and Chinese airlines can fly 64 flights a week to 3 Malaysian cities |
| China & the Philippines | Memorandum of Understanding to allow airlines from Philippines to fly to Guanghzhou and Shenzhen in addition to Beijing, Shanghai and Xiamen. China's airlines now permitted to fly to Manila and one other airport |
| China & Rep. Korea | Agreement for increase from 42 flights each week on 11 routes to 111 flights on 27 routes to take effect in first half of 1998 |
| Japan & Taiwan | Agreement on increased airline services after 10 years of negotiation, increasing capacity and access to Osaka for EVA Airways. |
| Japan & USA | Agrees to limited open skies agreement with USA to give ANA greater access to USA |
| Japan | Continues to deregulate its domestic airline industry in the first half of 1998. Restrictions on pricing removed and new entrants given slots at Haneda Airport |
| New Zealand & Singapore | Enter a liberal open skies agreement with no foreign ownership restrictions and free capacity on fifth freedom |
| Pakistan | Announces a new limited open skies policy and a restructuring of Pakistan International Airlines |
| Rep. Korea | 5th freedom flights beyond Seoul provided they originate in or terminate in the USA. Gives Korea's airlines access to Latin America via the USA; |
| | Korea increases the foreign ownership of airlines to 50%. |
| Rep. Korea & USA | Open skies agreement allows airlines from the USA to change gauge |
| Taiwan | Civil Aeronautics Administration puts pressure on airlines to merge to achieve greater stability and improvement in safety |
| Taiwan & USA | Open skies agreement gives greater access to USA and beyond for China Airlines and EVA and alliances emerging with American and Continental |
| Thailand | Transport and Communications Minister announces new |

| | |
|---|---|
| | policy to deregulate domestic market and to allow multiple designation on international routes, commencing with regional services (eg Indonesia). Restrictions on charter flights by Thai and foreign airlines to be lifted. |
| Thailand | Government increases foreign ownership limit in Thai by 10% to 30% and announces intention to reduce its own stake in Thai Airways from 79.5% to 49% or lower (pressures from IMF) |

## Conclusions

The Asian economic crisis has generated a considerable amount of pessimism about the prospects for the region's airlines. The carriers were highly exposed to currency risks and to a slowdown in traffic growth. While the economic crisis is reducing the amount of intra-regional traffic, the currency devaluations will stimulate more trips to Asia from North America and Europe. By virtue of the reduced costs of employing labour and other local inputs, the cost competitiveness of Asia's airlines has improved. The immediate problem facing the carriers is to refinance their debt, to realign their services and to match capacity to the weaker demand conditions. As this adjustment process continues, the world's mega-alliances are consolidating their position so that Asia's airlines are faced with difficult choices from a weakened position.

It seems likely that the end result will be fundamental changes in the way Asia Pacific aviation markets operate in terms of alliances, hubs, ownership, and regulation. Given the depth of the economic crisis in some Asian economies, a desire to protect national airlines would be understandable. However, the longer-term challenge for the Asian carriers is to turn the economic crisis into an opportunity to develop strategies that give them a sustainable competitive advantage. This will come about through productivity improvements that would be pursued most aggressively under competitive conditions. At the same time, competitive airlines need access to markets. Attempts to protect airlines could have negative consequences including pressure from the IMF and international financial community

The evidence is mounting that the airlines themselves want the flexibility to adjust capacity, to enter new routes, to enter into alliances and to attract investment from the world's major carriers. Some governments have shown a willingness to liberalise competition, to privatise and to relax foreign ownership restrictions. Far from being a flight back to protection, the Asian economic crisis appears to have shifted air transport policies of Asian governments far more in the direction of liberalisation.

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# ASIA-PACIFIC AIRLINES AMIDST THE ASIAN ECONOMIC CRISIS (*)

**To be presented at**
**ATRG International Conference on Air Transportation and Policy**
**City University of Hong Kong, Hong Kong**
**June 6 – 8, 1999**

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**Abstract**

The Asian economic crisis started in July 1997 and has since affected most businesses in the region, including airline companies. The aim of this report is to identify the major influences of the crisis on the financial and operating performances of key airlines in the Asia-Pacific regions. We will cover 11 carriers in Asia-Pacific region, together with British Airways as a benchmark carrier for the period of 5 years from 1994 to 1998. Five financial measures and five operating measures are used to uncover the source of pain. We find that high exchange losses, inflated operating and financing costs and an overall drop in traffic are the main causes for the financial stresses experienced by several Asian carriers.

(*) I want to thank Ho Hean Chan, Quek Sze Quan and Chris Tan Seng Kita for their assistance in data collection.

# I. INTRODUCTION

The Asian economic crisis sparked in Thailand in July 1997 and had since spread throughout the region. Prior to that, Asia had been enjoying high economic growths. The crisis came as an unpleasant surprise and many were caught off-guard. Serious currency devaluation in countries like Indonesia, Malaysia, Philippine and Thailand has greatly pushed up currency-related costs, forcing many companies to undertake cost-saving measures. Asian airlines are no exception. Debt costs, lease costs as well as operating costs have increased, causing serious financial problems. Due to high operating leverage, profits for airlines are more sensitive to economic and market conditions. In general, due to pro-cyclical nature of the airline businesses, the airline industry will most likely experience a greater pain during economic recessions as compared to other industries. On the other hand, during the boom times, airlines tend to reap relatively greater rewards.

The nature of this study is explorative. Its main purpose is to analyse the impact of Asia's economic crisis on major airlines in the Asia-Pacific region. Various performance indicators will be used to highlight the nature and magnitude of impact on different airlines. Their performances, inferred from relevant financial data and traffic statistics, will be analyzed over a period of five years from the year 1994 to 1998.[1]

The rest of the paper is organized as follows. Section II uses ten commonly used comparative measures to highlight overall impact of the crisis to various carriers. Section III uses statistical methods to analyze the impact of crisis and the relationships among the measures. Section IV attempts to pinpoint each airline's problems relating to the recession. The last section presents a summary with a few recommendations.

# II. PERFORMANCE MEASURES AND COMPARISONS

The financial crisis may influence different carriers in different areas. In this section, we will use 10 commonly used performance and exposure measures to find the source of the pain. It aims to provide a broad and general descriptive view of the economic turmoil's effect on 11 key airlines in Asia-Pacific, together with British Airways (BA) that serves as a benchmark carrier. The choice of BA is in part due to its reputation and strength as a market player and in part due to data availability. Table 1 summaries the inclusion of these carries.

Time-series data used in the research were collected from 1994 to 1998. Data before 1994 is excluded, as the purpose of this study is to investigate the short-term impact of the economic crisis. The 1998 data, as of the period this research is conducted, is the most up-to-date data available. The bulk of the operation statistics is taken from the *Digest of Statistics* series published by the International Civil Aviation Organization (ICAO). Data in the annual reports of airline companies, whenever possible, are used to cross-examine the data or fulfil the missing records. For the same purpose, relevant reports and databases published by various investment organisations, such as Moody's

[1] As Garuda Indonesia and Philippine Airlines, two key carriers in ASEAN, are not listed companies, relevant data are limited. Bearing this limitation in mind, they will be covered, whenever enough information is available, only in the later part of this report.

and Goldman Sachs, are also used. All data are standardised in order to achieve a uniform basis for comparison.

**Table 1: Carriers Selected In This Study**

| Carrier | Economy | Year-end |
|---|---|---|
| Air New Zealand (ANZ) | New Zealand | June 30 |
| British Airways (BA) | UK | March 31 |
| Cathay Pacific (CX) | Hong Kong | December 31 |
| China Airlines (CAL) | Taiwan | December 31 |
| Garuda Indonesia (Garuda) | Indonesia | N/A |
| Japan Airlines (JAL) | Japan | March 31 |
| Korean Airlines (KAL) | Korea | December 31 |
| Malaysian Airlines (MAS) | Malaysia | March 31 |
| Qantas Airways (QAN) | Australia | June 30 |
| Philippine Airlines (PAL) | Philippine | N/A |
| Singapore Airlines (SIA) | Singapore | March 31 |
| That Airways Int'l (THAI) | Thailand | 30 September |

When monetary figures need to be converted into US dollars, we will use the US dollar interbank exchange rates as at the respective balance sheet dates. Since not all airlines disclose the rates employed in translating foreign currency, the interbank exchange rates will act as surrogates to facilitate comparison. These exchange rates, consistent with the year-end month of the carrier in each economy, are summarized in Table 2.

**Table 2: Historical USD Interbank Rates**

| Currency | Month | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|---|
| Australian Dollar | Jun | 0.729500 | 0.703000 | 0.787000 | 0.746700 | 0.615500 |
| British Pound | Mar | 1.483400 | 1.614100 | 1.525400 | 1.638600 | 1.676500 |
| Hong Kong Dollar | Dec | 0.129200 | 0.129300 | 0.129300 | 0.129100 | 0.129100 |
| Japanese Yen | Jun | 0.009728 | 0.011330 | 0.009308 | 0.008076 | 0.007519 |
| Korean Won | Dec | 0.001268 | 0.001289 | 0.001183 | 0.000619 | 0.000837 |
| Malaysian Ringgit | Mar | 0.373500 | 0.394400 | 0.394400 | 0.403400 | 0.273200 |
| New Zealand Dollar | Jun | 0.594800 | 0.667900 | 0.684400 | 0.677900 | 0.514500 |
| Singapore Dollar | Mar | 0.637100 | 0.705000 | 0.709500 | 0.691900 | 0.619600 |
| Taiwan Dollar | Dec | 0.038090 | 0.036650 | 0.036360 | 0.030660 | 0.030990 |
| THAI Baht | Sep | 0.040030 | 0.039900 | 0.039340 | 0.027700 | 0.025410 |

## FINANCIAL MEASURES

1. **PROFIT BEFORE TAX.** The profit before tax (PBT) margin is profit before tax expressed as a percentage of total revenue. It is commonly used to measure the profitability of a business organisation. By comparing the margin over the years, we will be able to assess how well the company is doing. For instance, the margin might have increased while the revenue and profit decreased in dollar terms. This would indicate that the airline was managed more efficiently. Conversely, if the margin was

on a downward trend, it would indicate that costs are rising faster than revenue, and the causes should be looked into.

**Table 3: PBT Margin (%)**

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| ANZ | 7.66 | 9.91 | 8.46 | 5.87 | 4.20 |
| BA | 4.24 | 4.56 | 7.54 | 7.66 | 6.71 |
| CAL* | 0.62 | 2.71 | 3.68 | 6.17 | 3.46 |
| CX* | 10.95 | 11.66 | 11.94 | 7.74 | 6.40 |
| JAL* | -3.45 | -1.43 | -0.59 | -1.22 | -1.56 |
| KAL* | 0.68 | 4.29 | -6.21 | -9.26 | 2.02 |
| MAS | 0.40 | 1.49 | 4.39 | 5.40 | -3.20 |
| QAN | 3.63 | 4.47 | 5.28 | 5.16 | 5.88 |
| SIA | 13.97 | 14.61 | 15.70 | 14.90 | 15.17 |
| THAI* | 6.15 | 6.31 | 6.26 | -35.27 | -20.76 |

(*) Forecast figure for 1998.

From Table 3, it is evident that SIA has seen constantly outperforming the rest. JAL has been making before-tax losses since 1994. THAI seems to have taken a hard blow from the crisis – it took a deep plunge in its 1997 fiscal year even though it had stable PBT margins prior to 1997. KAL, too, has suffered losses since 1996 but is expected to recover in 1998. MAS has been improving over the years but may fall into the red at the end of its 1998 fiscal year. The other airlines are experiencing a falling margin from 1996 onwards, except for the improving CAL before it dipped in 1998. The main factors for the weakening PBT are the depressing airfares and the substantial reduction in air travel demand, a typical symptom of economic recessions.

**2. EBITDA MARGIN.** EBITDA refers to earnings before interest charges, tax, depreciation and amortization expenses. The margin is obtained by dividing EBITDA with total revenue, which are summarized in Table 4. This measure eliminates two major non-cash expenses – depreciation and amortization. Firstly, the treatment of depreciation and amortization is subjective due to different accounting policies adopted by the airlines. For example, JAL recently switched its depreciation life assumptions from a declining balance basis to a straight-line basis. Secondly, interest expenses include charges to be paid in US dollars and are vulnerable to exchange rate risk, which varies from country to country. Therefore, the absence of these expenses will result in a better comparison of each airline's operating performance.

From Table 4, it is evident that BA does not seem to do well in this area compared to the rest. THAI's margin has been in declining since 1994. Both CX and ANZ are generally moving downwards while the margins of other airlines have been fluctuating with biggest movers being THAI and MAS. On average, SIA has been leading the pack with the catching-up efforts by KAL and MAS. QAN, like SIA, has been experiencing stable margins from 1994 to 1998. JAL is consistently below the rest with margins between 5% and 9%.

On average, the EBITDA margin has been turned downward since 1996, a sign of depressing profitability for Asia-Pacific carriers during the current economic recession.

Table 4: EBITDA Margin (%)

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| ANZ | 15.0 | 15.7 | 13.5 | 11.3 | 9.7 |
| BA | 13.9 | 15.0 | 15.3 | 12.6 | 12.2 |
| CAL* | 18.2 | 13.9 | 10.7 | 11.0 | 13.8 |
| CX* | 22.6 | 20.2 | 21.0 | 17.0 | 17.1 |
| JAL* | 5.8 | 5.8 | 8.9 | 7.9 | 6.3 |
| KAL* | 20.8 | 21.7 | 19.0 | 24.6 | 20.1 |
| MAS | 17.2 | 22.8 | 27.7 | 25.6 | 20.4 |
| QAN | 12.9 | 12.1 | 12.2 | 12.5 | 13.7 |
| SIA | 25.9 | 27.0 | 27.4 | 24.9 | 26.7 |
| THAI* | 28.6 | 25.3 | 25.1 | 18.7 | 14.7 |
| **Average** | 18.1 | 18.0 | 18.1 | 16.6 | 15.5 |

(*) Forecast figure for 1998.

3. **Return on Equity (ROE).** The return on equity (ROE) measures the rate of return on shareholders' investment, which is the net profit for the year divided by the total shareholders' equity (Table 5). It measures how well the resources are managed to generate profits; it is a critical measure of a company's overall success. The ROE trends to mirror the trends of the PBT margin.

**Table 5: ROE (%)**

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| ANZ | 16.5 | 21.0 | 16.8 | 9.8 | 7.9 |
| BA | 15.8 | 20.0 | 19.0 | 18.5 | 15.0 |
| CAL* | 0.3 | 4.0 | 5.0 | 5.9 | 5.0 |
| CX* | 15.5 | 17.5 | 12.9 | 7.8 | 6.3 |
| JAL | -12.4 | -5.2 | -3.4 | -5.9 | -34.0 |
| KAL* | 5.9 | 14.1 | -22.6 | -54.0 | 9.0 |
| MAS | 0.2 | 3.9 | 6.0 | 7.2 | -6.1 |
| QAN | 9.2 | 7.9 | 10.1 | 9.5 | 10.3 |
| SIA | 9.7 | 10.2 | 10.5 | 9.8 | 9.1 |
| THAI* | 9.1 | 10.0 | 11.2 | -13.4 | NA |

(*) Forecast figure for 1998.

It is evident that all airlines except MAS experienced the pressure in 1997, while the impact on MAS was finally felt in 1998. Among the individual carriers, BA tops the others in this area with the highest average ROE from 1994 to 1998. JAL, on the other hand, has consistently been in the negative zone and has fallen sharply in 1998 to –34.0%. SIA and QAN are comparable with each other averaging around the same percentage point. CX and ANZ peaked in 1995 but has been gradually weakening since then.

The most prominent trend in Table 5 belongs to KAL. Its performance improved slightly in 1995 but dropped drastically in 1996 followed by a much deeper plunge in 1997. However, it is expected to recover in 1998. THAI's performance in this area took a sudden turn in 1997. By 1998, it is reported that it has a negative equity. In fact, the reported impact in Table 5 on KAL, MAS and THAI provides clear evidence of serious impact of the financial crisis on these carriers as their home economies has gone through large contractions since 1997. As Japan was also in recession during 1998, JAL had obviously felt the deep pain too.

4. **NET DEBT/EQUITY RATIO.** Net debt is the sum of loans, finance leases, hire purchases arrangements plus convertible capital bonds net of short-term loans, overdrafts and net cash. Equity refers to the value of total shareholder funds. Net debt is expressed as a percentage of total equity to arrive at the above measures in Table 6 that provide information on each company's leverage.

**Table 6: Net D/E Ratio (%)**

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| ANZ* | 72.4 | 81.5 | 49.8 | 65.6 | 62.9 |
| BA | 69.4 | 63.9 | 59.8 | 57.0 | 58.1 |
| CAL* | 60.0 | 68.5 | 91.3 | 105.0 | 192.1 |
| CX | 47.1 | 47.1 | 23.0 | 34.0 | 61.0 |
| JAL* | 376.5 | 420.3 | 450.1 | 490.1 | 696.9 |
| KAL* | 529.0 | 452.3 | 467.2 | 905.4 | 941.9 |
| MAS* | 181.4 | 198.3 | 184.9 | 156.3 | 231.2 |
| QAN* | 291.6 | 289.9 | 225.2 | 170.0 | 160.7 |
| SIA | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| THAI | 241.6 | 270.6 | 292.8 | 7994.0 | -875.4 ♦ |

(*) Forecast figure for 1998.

(♦) This figure was a result of the ratio of net debt to negative equity.

SIA has a very favorable debt structure that is fully supported by its cash reserve. On the other hand, as the domestic currency is weakening, it is expected that the financial leverage will substantially undermine Asian airlines' ability to service their US dollar debts. THAI, in particular, experienced a drastic increase in its leverage in 1997 and 1998. In 1997, THAI's value of equity dropped significantly as a result of the decrease in asset value together with the increase in liabilities. This is mainly attributed to currency devaluation. At the same time, its net debt increased and all these factors caused its ratio's jump to 7994.0%. In 1998, THAI's liabilities are expected to exceed its assets and this will give rise to a peculiar situation where its equity value falls below zero. Consequently, its Net D/E Ratio becomes negative, a clear sign of financial stress. Japanese and Korean carriers have very high ratios due to high debt financing activities; while BA, CX and ANZ, on the other hand, have much healthier ratios.

5. **FOREIGN EXCHANGE GAIN OR LOSS.** Foreign exchange gain or loss arises from the translation of foreign currency loans, and the translation of monetary assets and liabilities denominated in foreign currency. It is directly related to the strength of the local currency against other currencies. We expressed the foreign exchange gain (or loss) as a percentage of the total operating revenue for each airline in order to understand the related financial burden posed on them. By converting the absolute monetary figures into percentages, we will have a more meaningful comparison.

For the years 1994 to 1995, it is evident that most of the carriers have minimal foreign exchange exposures. The percentage gain or loss was around zero percent, with the main exceptions of CX (negative) and KAL (positive). In fact, except CX, KAL and MAS, other airlines have rather stable performances in the area of foreign exchange.

It is interesting to notice that ANZ and QAN virtually have no foreign exchange gains or losses for the years concerned, which should indicate both airlines have been very successful in managing their exposures to foreign exchange risk, even in the face of the present economic turbulence. CX, even though improving in this aspect, has been a consistent under-performer and its poor performance has only bettered KAL and

MAS, especially in the midst of the currency crisis. Both carriers raked in huge foreign exchange losses as a result of the recession. It was expected that THAI would suffer a big foreign exchange loss in 1998. The damage of the currency crisis to KAL, MAS and THAI is evident.

**Table 7: Foreign Exchange Gain Margin (%)**

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| ANZ* | 0.23 | 0.10 | 0.07 | 0.00 | 0.00 |
| BA | -0.18 | -0.71 | 0.64 | 0.73 | -0.21 |
| CAL | 0.25 | -0.44 | -0.15 | 0.00 | 0.00 |
| CX | -3.53 | -1.61 | -1.51 | -1.47 | -0.03 |
| JAL | -0.46 | -0.29 | 0.31 | 0.21 | -0.03 |
| KAL* | 1.37 | 2.22 | -3.06 | -10.92 | 1.04 |
| MAS | 0.39 | 0.61 | -0.23 | 0.15 | -10.19 |
| QAN | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SIA | 0.00 | 0.00 | 0.00 | -0.19 | 1.05 |
| THAI | 0.01 | -0.15 | -0.86 | -1.33 | NA |

(*) Forecast figure for 1998.

## Operating Measures

**1. Overall Load Factor.** The overall load factor takes into account two components – passenger and cargo. It is the ratio of revenue tonne-kilometers (RTK) to available tonne-kilometers (ATK) and a key indicator of capacity utilization. An airline's load factor is usually affected by many elements including competition, fares, seasonal variations, economic conditions and the effectiveness of marketing programs.

**Table 8: Overall Load Factor (%)**

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 | Mean |
|---|---|---|---|---|---|---|
| ANZ | 68.1 | 65.3 | 65.4 | 67.7 | 67.5 | 66.8 |
| BA | 66.5 | 68.2 | 70.7 | 70.3 | 69.2 | 69.0 |
| CAL* | 77.9 | 78.0 | 80.2 | 81.1 | 83.5 | 80.1 |
| CX* | 69.0 | 69.5 | 72.6 | 69.5 | 68.3 | 69.8 |
| JAL* | 64.9 | 65.9 | 65.6 | 67.0 | 67.5 | 66.2 |
| KAL* | 69.7 | 71.7 | 72.8 | 72.3 | 66.7 | 70.6 |
| MAS | 63.9 | 63.9 | 62.3 | 60.3 | 60.6 | 62.2 |
| QAN | 63.3 | 65.9 | 64.3 | 64.6 | 63.2 | 64.3 |
| SIA | 69.5 | 69.8 | 69.4 | 70.5 | 69.1 | 69.7 |
| THAI* | 69.2 | 68.7 | 68.1 | 69.0 | 67.0 | 68.4 |
| Average | 68.2 | 68.7 | 69.1 | 69.2 | 68.3 | |

(*) Forecast figure for 1998.

According to Table 8, the overall load factor of each carrier is rather similar to one another except for CAL, which has registered a much superior performance over the others through the years 1994 to 1998.

The direct effects of the recession on the carriers' overall load factors seem not clearly observable from the Table 8. In fact, there seems to have no observable trend that could indicate any adverse effects that could result from the recession. In fact, the individual overall load factors of the carriers seem to fluctuate around an average, suggesting that the airlines' performances in this area appears to be "normal".

But the fact the average load factor was declined by almost one percentage point from 1997 to 1998 gives some evident of an adverse impact of the crisis. In particular, MAS experienced a dip of 2 percentage points in 1997; KAL and THAI had a drop of 5.5 percentage points and 2 percentage points in 1998, respectively. It is hard to ignore the negative impact of the crisis.

2. **BREAK-EVEN LOAD FACTOR.** The break-even load factor is the theoretical load factor when operating revenue equals operating expenses, implying that all the operating expenses are covered by revenue and no profits or losses are made. In order to reap profits and operate successfully in the long run, airlines have to operate at load factors higher than their respective break-even levels. A low break-even load factor would be preferred, as it would be relatively easier to achieve high profit margins.

**Table 9: Break-even Load Factor (%)**

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 | Mean |
|---|---|---|---|---|---|---|
| ANZ* | 72.8 | 67.8 | 69.7 | 74.3 | 78.8 | 72.7 |
| BA | 61.4 | 61.5 | 62.9 | 63.6 | 64.4 | 62.8 |
| CAL* | 76.1 | 77.0 | 77.8 | 78.4 | 81.2 | 78.1 |
| CX* | 58.5 | 59.8 | 63.1 | 66.1 | 64.8 | 62.5 |
| JAL* | 72.5 | 74.1 | 71.7 | 74.1 | 75.1 | 73.5 |
| KAL* | 67.1 | 68.6 | 76.8 | 69.6 | 69.4 | 70.3 |
| MAS* | 69.1 | 65.7 | 61.8 | 61.6 | 67.9 | 65.2 |
| QAN* | 67.0 | 68.9 | 67.5 | 68.7 | 68.4 | 68.1 |
| SIA | 65.5 | 62.5 | 62.6 | 65.9 | 65.2 | 64.3 |
| THAI* | 62.5 | 61.9 | 62.2 | 63.0 | 64.3 | 62.8 |
| **Average** | 67.3 | 66.8 | 67.6 | 68.5 | 70.0 | |

(*) Forecast figure for 1998.

Looking at Table 9, we can see that CAL has the highest break-even load factor, at 78.1%, while CX registers the lowest, at 62.8%, followed by BA and THAI at 62.8%. Even though different cost structures could be the primary reason for this obvious difference, but the fact that the average break-even load factor has been increasing since 1995 should indicate that not enough effort has been put in place to control the operating expenses, even during current economic crisis. With the overall load factor being declining and the break-even load factor being increasing, it does not portrait the promising picture for the industry. It is hoped that we will see a declining trend across the board in 1999 since many Asian carriers, CX and KAL in particular, have made serious effort to rationalize their operations. Without the reversal of this upward trend, Asian carriers would have missed a golden opportunity to enhance their competitiveness during the current crisis.

3. **YIELD.** Yield is one of the most commonly used measures in the airline industry. It is the ratio of the total operating revenue and the revenue tonne-kilometres (RTK), taking into account of both passenger and cargo operations (Table 10). It measures the amount of revenue earned from passengers and freight per kilometre flown. Yield is usually expressed in cents per RTK, but in our case, it will be expressed in US dollars per RTK for easier comparison.

Table 10: Overall Yield (USD)

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 | Mean |
|---|---|---|---|---|---|---|
| ANZ | 0.69 | 0.76 | 0.71 | 0.65 | 0.51 | 0.66 |
| BA | 0.78 | 0.85 | 0.81 | 0.87 | 0.86 | 0.83 |
| CAL* | 0.46 | 0.44 | 0.45 | 0.36 | 0.35 | 0.41 |
| CX* | 0.60 | 0.60 | 0.56 | 0.52 | 0.50 | 0.56 |
| JAL | 1.02 | 1.13 | 0.92 | 0.80 | 0.73 | 0.92 |
| KAL* | 0.48 | 0.50 | 0.44 | 0.26 | 0.35 | 0.41 |
| MAS | 0.61 | 0.64 | 0.60 | 0.61 | 0.43 | 0.58 |
| QAN* | 0.67 | 0.66 | 0.75 | 0.67 | 0.54 | 0.66 |
| SIA | 0.48 | 0.52 | 0.49 | 0.46 | 0.42 | 0.47 |
| THAI* | 0.63 | 0.65 | 0.65 | 0.45 | 0.44 | 0.56 |
| **Average** | 0.64 | 0.68 | 0.64 | 0.57 | 0.51 | |

(*) Forecast figure for 1998

Yields of European airlines, represented here by BA, are the highest in the world without considering the Japanese carriers. Not surprisingly, BA is seen performing well above the average, only overshadowed by JAL, which has been deteriorating since 1995. Japanese airlines have been traditionally enjoying one of the highest yields in the world due to its protected market and the strength of its currency. It is evident that a gradual decrease of the yields seems to be the trend in the industry, especially from 1996 to 1998 indicating that the Asia economic crisis has seriously affected the overall yields of carriers in the region.

In particular, THAI and KAL's yields dropped sharply in 1997, which was in part due to the increased competition in a weak demand market for air transport but also as a result of the drastic currency depreciation. MAS's worst yield came in 1998 when the effects of the Asian crisis were finally felt in Malaysia.

4. **Staff Cost Margin.** Staff cost margin is the staff expenses expressed as a percentage of the total operating expenses. Staff costs constitute a major portion of total operating costs and therefore justify our attention, since the recession is very likely to affect the costs.

According to Table 11, QAN, BA and CX have the highest margins among all airlines in the study, with means of 29.82%, 28.54% and 27.56% respectively, which is due to relatively higher labour costs. We can also see that KAL has the lowest average margin of 10.09% in the period from 1994 to 1998. The closest comparison is THAI with a mean of 18.70%. The main reason for KAL's low average margin is attributed to relatively lower labour input costs. All other airlines, including THAI, are quite close and fall into a narrow range 18.70% to 21.75%. We expected the staff cost margins of JAL to be higher due to high labour input costs in Japan, but it turned out otherwise. Except for JAL and SIA, the margins for all other carriers dipped in 1998. This, in part, should be due to the regional crisis that has caused airlines to downsize in order to cut costs and remain competitive. Another reason could be the fact that total operating expenses are expected to rise faster than staff costs in 1998 for all Asian airlines. In particular, SIA and THAI have been experiencing rising trends recently while others are on the decreasing trend.

Table 11: Staff Cost Margin (%)

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 | Mean |
|---|---|---|---|---|---|---|
| ANZ* | 21.25 | 20.48 | 20.66 | 20.41 | 18.07 | 20.17 |
| BA | 28.59 | 28.94 | 29.25 | 28.77 | 27.17 | 28.54 |
| CAL | NA | NA | NA | NA | NA | NA |
| CX* | 27.19 | 27.31 | 27.37 | 28.92 | 26.99 | 27.56 |
| JAL* | 22.39 | 22.66 | 22.12 | 20.64 | 20.93 | 21.75 |
| KAL* | 10.67 | 11.39 | 10.34 | 9.36 | 8.69 | 10.09 |
| MAS* | 20.85 | 21.33 | 21.30 | 19.92 | 19.12 | 20.50 |
| QAN* | 30.23 | 30.79 | 30.29 | 29.45 | 28.34 | 29.82 |
| SIA | 17.73 | 19.29 | 17.60 | 18.60 | 18.90 | 18.42 |
| THAI* | 17.24 | 18.60 | 18.91 | 19.98 | 18.77 | 18.70 |
| **Average** | 21.79 | 22.31 | 21.98 | 21.78 | 20.78 | |

(*) Forecast figure for 1998.

From Tables 9 and 11, we may say that the staff costs, which, on average, have been decreasing since 1995, are not the main reason leading to the upward trend of break-even load factor. Airlines need to pay attention to other components of the operating costs to revert the problem.

5. **FUEL COST MARGIN.** Fuel costs, together with staff costs, are major cost items for airline companies. Fuel cost margin, calculated similarly to the staff cost margin, is expressed as a percentage of total operating expenses.

**Table 12: Fuel Cost Margin (%)**

| Airline | 1994 | 1995 | 1996 | 1997 | 1998 | Mean |
|---|---|---|---|---|---|---|
| ANZ* | 11.74 | 11.43 | 11.64 | 12.97 | 12.22 | 12.00 |
| BA | 10.86 | 9.48 | 9.31 | 10.78 | 9.71 | 10.03 |
| CAL | NA | NA | NA | NA | NA | NA |
| CX* | 14.07 | 14.37 | 15.81 | 16.77 | 17.08 | 15.62 |
| JAL* | 11.50 | 11.11 | 11.09 | 12.91 | 12.92 | 11.91 |
| KAL* | 15.03 | 14.89 | 17.01 | 19.26 | 19.47 | 17.13 |
| MAS* | 15.52 | 14.30 | 15.14 | 18.13 | 18.12 | 16.24 |
| QAN* | 11.32 | 10.59 | 11.10 | 12.25 | 11.85 | 11.42 |
| SIA | 18.28 | 16.44 | 14.80 | 17.10 | 17.10 | 16.74 |
| THAI* | 11.92 | 11.45 | 12.90 | 14.49 | 15.45 | 13.24 |
| **Average** | 13.36 | 12.67 | 13.20 | 14.96 | 14.88 | |

(*) Forecast figure for 1998.

According to Bonnassies (1998), many Asian airlines had stocked a considerable amount of fuel. This could in part explain the expected drop in fuel cost margins in 1998, as fuel expenses remain relatively stable while operating costs increase. Furthermore, the Asian economic crisis has depressed oil prices down to levels below pre-Gulf War levels. Even though many Asian carriers are expected to purchase more fuel in 1998 when their reserve fuels are mostly depleted, the depressed oil prices would still most probably keep the margin low. CX would benefit much from the low jet fuel prices due to the HK$/US$ peg.

On average, KAL has the highest fuel cost margin, BA has the lowest. The margin movements also tend to move in the same direction for all the above airlines each year. The rise and fall of international jet fuel prices play an important role in this aspect, which dictates the broad trend of change in fuel cost margin across the industry. .

## III. ANALYSIS AND RESULTS

We now move on some formal analysis by using the data summarized in the previous section. In summary, we have the following measures:

| Financial Measures | Operating Measures |
|---|---|
| PBT Margin (PBT) | Overall Load Factor (OLF) |
| EBITDA Margin (EBITDA) | Break-even Load Factor (BE_LF) |
| Return on Equity (ROE) | Yield (YIELD) |
| Net D/E Ratio (NDE_Ratio) | Staff Cost Margin (Staff) |
| Foreign Exchange Net (FX) | Fuel Cost Margin (Fuel) |

Note: The symbol in the bracket is the variable name to be used for the discussions in this section.

From the discussions in the last section, there are some evidences, even though non-statistically, to indicate that

- The economic crisis will adversely affect all five of the financial measures;
- The crisis seems to have a serious "pushing-up" effect on the Break-even Load Factor and a sizable downward pressure on the overall Yield;
- The crisis has a mild negative impact on the Overall Load Factor, while no visible impact on staff and fuel cost margins (at least not yet).

These observations are useful when we attempt to further pinpoint the impact of the crisis, which is the focus of this section.

### ANALYSIS OF VARIANCE

Due to the diversity among the airlines, the variability for each measure is intrinsically dominated by the difference among the airlines. In order to properly measure the variability over the years, we must "filter out" heterogeneity effect of carriers. With this in mind, we can apply the standard two-way ANOVA, where we treat carriers as the blocking effect. This leads to the results summarized in Table 13.

From Table 13, we can make the following observations:

- The financial measures are truly dominated by the airline effect. And relatively speaking, the time effect, in part capturing the impact of the crisis, has bigger impact on EBITDA than on any other financial measures.
- Both the airline effect and the time effect do not have significant impact on the Net D/E Ratio and the Foreign Exchange Gain/Loss.
- For the operating measures, both the airline effect and the time effect will make a significant impact with an only exception of the Overall Load Factor (a non-significant time effect).

**Table 13: Two-Way ANOVA Results**

| Variable | *P*-value for *F*-Test |
|---|---|

| | Airline Effect | Time Effect |
|---|---|---|
| PBT | 0.000 | 0.314 |
| EBITDA | 0.000 | 0.143 |
| ROE | 0.001 | 0.209 |
| NDE_Ratio | 0.151 | 0.379 |
| FX | 0.764 | 0.768 |
| OLF | 0.000 | 0.479 |
| BE_LF | 0.000 | 0.040 |
| YIELD | 0.000 | 0.000 |
| STAFF | 0.000 | 0.004 |
| FUEL | 0.000 | 0.000 |

## CORRELATION ANALYSIS

As all measures used are comparable across the carriers, for each of the measures, we will pool all the observations together to create a single variable. This is equivalent to crash a small panel data into a single variable without the time dimension. The main reason for this pooling of a panel data is to further analyze any relationships among these variables.[2] We start with a simple correlation analysis by generating the correlation coefficient matrix (Table 14).

**Table 14: Correlation Coefficient Matrix of Performance Measures**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1 PBT | 1 | 0.254 | ***0.635*** | **0.300** | 0.053 | -0.185 | 0.084 | 0.233 | -0.056 |
| 2 EBITDA | 0.254 | 1 | 0.111 | -0.174 | -0.031 | ***-0.595*** | ***-0.503*** | ***-0.412*** | ***0.592*** |
| 3 ROE | ***0.635*** | 0.111 | 1 | ***0.557*** | -0.060 | ***-0.383*** | 0.193 | ***0.427*** | **-0.345** |
| 4 FX | **0.300** | -0.174 | ***0.557*** | 1 | 0.045 | 0.038 | **0.289** | 0.166 | **-0.375** |
| 5 OLF | 0.053 | -0.031 | -0.060 | 0.045 | 1 | ***0.446*** | ***-0.436*** | -0.252 | 0.128 |
| 6 BE_LF | -0.185 | ***-0.595*** | ***-0.383*** | 0.038 | ***0.446*** | 1 | -0.130 | **-0.292** | -0.062 |
| 7 YIELD | 0.084 | ***-0.503*** | 0.193 | **0.289** | ***-0.436*** | -0.130 | 1 | ***0.521*** | ***-0.794*** |
| 8 STAFF | 0.233 | ***-0.412*** | ***0.427*** | 0.166 | -0.252 | **-0.292** | ***0.521*** | 1 | **-0.575** |
| 9 FUEL | -0.056 | ***0.592*** | **-0.345** | **-0.375** | 0.128 | -0.062 | ***-0.794*** | **-0.575** | 1 |

Note: Numbers in bold and italic are significant at 1% and numbers in bold are significant at 5%. Some variables have missing values. ($n = 50$)

From the above table, we can make the following observations:

- Among the remaining four financial measures, EBITDA does not significantly correlate with another other three. The highest correlation among any two of them is between PBT and ROE.
- PBT does not significantly correlate any of the five operating measures, which is a bit of surprising.
- It is equally surprising to see that the OLF is not significantly correlated with any of the four financial measures.
- EBITDA is highly correlated with four of the five operating measures (the exception is OLF).

[2] After a preliminary check-up, we found that the Net D/E Ratio is very unstable in sense that it is very skewed to the right, we decided to drop this variable in the rest of our discussion in this section. This does not imply that this variable is not important. It simply says that we are encountered with a serious measurement problem.

- Among the operating measures, the highest correlation belongs to FUEL and YIELD, which is at –0.794.
- It seems to be counter-intuitive to see a positive correlation between Staff Cost Margin and ROE, between Staff Cost Margin and YIELD, and between Fuel Cost Margin and EBITDA.

## CAUSALITY ANALYSIS

In this part, we will investigate possible causal relationship among the variables. In particular, when analyzing the financial measures, we will treat PBT, EBITDA and ROE as dependent variables and all operating measures plus the Foreign Exchange Gain/Loss (FX) as the explanatory (independent) variables.

**1. DETERMINANTS OF PBT.** We first look into the role of the operating measures on profit before tax (PBT). Multiple regression model is used and led to the following estimated equation:

$$\begin{aligned} PBT = &-20.654 + \underset{(2.238)^{3}}{1.219FX} + \underset{(0.896)}{0.386OLF} - \underset{(-1.046)}{0.294BE\_LF} + \underset{(0.056)}{0.655Yield} \\ &+ \underset{(0.423)}{0.401Staff} + \underset{(0.996)}{0.762Fuel} \\ &(R^2 = 0.229, \text{Adjusted } R^2 = 0.104) \end{aligned}$$

The model is insignificant. Only FX has a very limited role in explaining PBT. And none of the operating measures is significant, indicating that the operating measures do not explain PBT very well. This implies that PBT may not be a good performance measure if the primary focus is to analyze the impact of operating measures, as the ones used in this study.

**2. DETERMINANTS OF EBITDA.** To avoid over-fitting, we have used a stepwise procedure for variable selection and generated the following model:

$$\begin{aligned} EBITDA = 101.945 - \underset{(-11.078)}{0.973BE\_LF} - \underset{(-4.82)}{12.963Yield} - \underset{(-6.071)}{0.499Staff} \\ (R^2 = 0.865, \text{Adjusted } R^2 = 0.854, DW = 1.684^{4}) \end{aligned}$$

The negative impacts of Break-even Load Factor and Staff Cost Margin on EBITDA are expected. But it is puzzling to also see a negative role of Yield on EBITDA. This counter-intuitive result is mainly caused by the conversion of the yield on local currency into US dollar, which is subject to currency fluctuation. In the midst of the current crisis, majority of Asian currencies have been depreciated substantially (Table 2), while changes in EBITDA were in a much lesser extend.

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[3] The number in the bracket is the corresponding $t$-test statistic for the variable.

[4] DW is the Durbin-Waston statistic, which is to test serial correlation of the residuals. With $n = 50$, the acceptance range for a two-sided DW test is as follows: $1.54 < DW < 2.62$ for two independent variables; $1.59 < DW < 2.66$ for three independent variables; $1.64 < DW < 2.70$ for four independent variables. For more detail, refer to Studenmund (1997, p.346).

**3. DETERMINANTS OF ROE.** Using similar procedure as for EBITDA, we have the following regression model that highlights its relationship with the operating measures and the foreign exchange gain/loss:

$$ROE = 113.65 + 2.933FX - 1.392BE\_LF - 0.957Fuel$$
$$(4.29) \quad (-4.421) \quad (-1.644^{5})$$
$$(R^2 = 0.555, \text{ Adjusted } R^2 = 0.522, DW = 2.185)$$

The estimated relationship between ROE and independent variables is intuitively correct. From the discussions in the last section, we know that on average, carriers incur losses in foreign exchange. The above relationship tells us that better management of the foreign exchange risk will significantly improve the return on equity. As for the break-even load factor, it will adversely affect ROE during the current crisis, as the break-even load factor has been in an upward trend in recent years.

**4. DETERMINANTS OF YIELD.** As the last part of the casual analysis, we want to how the basic operating measures affect the overall yield. This leads to the following equation:

$$YIELD = 1.902 - 0.0089OLF - 0.0487Fuel$$
$$(-1.644^{6}) \quad (-8.455)$$
$$(R^2 = 0.653, \text{ Adjusted } R^2 = 0.636, DW = 2.012)$$

The above relationship is plausible even though the Overall Load Factor is insignificant at 5%. It is evident that the Fuel Cost Margin has a major role in affecting the overall yield.[7]

# IV. PROBLEMS RECONCILED

After looking through various performance measures in Section III and quantitative analysis in the previous section, we now turn to specific financial troubles faced by the airlines as a result of the economic crisis. It is well known that the airline industry is extremely sensitive to the economic environment due to the high operating leverage. The extent to which a country's economy performs largely affects the carrier's overall performance. In this section, we look into three main areas that have been largely influenced by the financial crisis, namely (a) foreign exchange losses due to transaction exposure; (b) inflated operating and financing costs; and (c) decrease in demand for air travel. We will include Garuda Indonesia and Philippine Airlines (PAL) in our discussions in this section.

[5] The *p*-value for variable FUEL in this equation is 10.8%, indicating that it is insignificant at 5%. We included this variable to improve the model fit and to generate an acceptable DW statistic.

[6] The *p*-value for variable OLF in this equation is 10.5%; so it is insignificant at 5%. We included this variable to improve the model fit and to generate a better DW statistic.

[7] On the other hand, we should be cautious when we interpret this relationship as the overall yield has been converted to US Dollar, which is subject to exchange rate fluctuations.

## FOREIGN EXCHANGE LOSSES

Transactional exposures arise out of changes in the value of foreign currencies underlying *outstanding* contracts. The prevailing exchange rates will determine the actual amount (in home currency) that has to be paid when the unsettled contracts are due, resulting in exchange gains and losses. Examples include aircraft purchase instalments that are usually denominated in US dollars, and obligations to repay a Japanese yen debt.

There are several airlines in our study which have incurred relatively large foreign exchange losses due to the weakening of their respective domestic currencies. These airlines include THAI, PAL, MAS, KAL and Garuda. According to our findings in Section III,[8] THAI is so far the most severely affected airline. Since July 1997, the value of baht has declined by approximately 33%. THAI's foreign exchange loss almost doubled in the 1997 fiscal year compared to the 1996 fiscal year. This was the largest increase among all the expense items. In addition, its net debt to equity ratio reached a staggering 7,994% in 1997 after translating all debts into THAI baht. It is safe to say that the foreign exchange loss contributed largely to the increase in THAI's overall expenses, resulting in a plunge in its 1997 PBT margin (Table 3) to a *negative* 35.27%. Previous year's PBT margin was a positive 6.26%.

PAL has been burdened by huge debts, which totalled around US$2.0 billion owing to over 9,000 creditors and suppliers. The main contributing factor is PAL's ambitious fleet expansion and modernisation plan in recent years, resulting serious financial obligations adversely affected by the untimely economic crisis which has weakened the Philippine peso by around 30% against the US dollar since mid 1997.

In the midst of the crisis, MAS has a relatively higher foreign exchange loss margins among other airlines in the study. Before the monetary board intervened in an attempt to stabilise the economy in September 1997, the Malaysian ringgit has already depreciated approximately 34% against the US dollar. This severe devaluation of the ringgit dealt a significant blow to the financial standing of MAS, which has a comparably high average net debt to equity ratio (Table 6). Higher leverage would imply higher transaction exposure risk. In 1998, the carrier's foreign exchange *loss* margin was negative 10.19%, compared to a *gain* margin of 0.15% the previous fiscal year (Table 7). Effective debt repayments in ringgit have increased by a large margin, resulting in the increase in foreign exchange loss.

At the end of KAL's 1997 fiscal year, the Korean won fell by about 48% against the US dollar. Its 1997 PBT margin fell deeper into the negative zone while its foreign exchange loss margin increased from *negative* 3.06% to *negative* 10.92%. Its financial reports revealed an increase in total operating expenses over the same period. Therefore, the increase in foreign exchange loss margin could not have been caused by a decrease in operating costs. Rather, the increase in foreign exchange losses was a result of currency devaluation.

Comparatively, the Indonesian rupiah fell the most against the US dollar. In 1998, the rupiah averaged around 80% weaker than the average rates existing before the crisis. In this respect, Garuda has been reported to be in critical condition. Garuda's foreign debt amounted to nearly US$300 million, of which $100 million was already

[8] The findings exclude Garuda and PAL.

due. According to Indonisian Minister for State Enterprises, major restructuring is needed for the airline, otherwise "Garuda planes which fly overseas will be confiscated". It is evident that the basis for the confiscation is attributable to the non-repayment of debts.

### INFLATED OPERATING AND FINANCING COSTS

Operating costs include aircraft lease payments and fuel costs, which are two of the major cost components for airline companies. Financing costs include debt interest payments, on which we would focus our attention since many airlines have heavy debt burdens. All the Asia-Pacific airlines included in this study, with the exception of Cathay Pacific[9], are experiencing rising operating costs, mainly as a result of weakened home currencies. From Table 9, it is clear that the average break-even load factor has been increasing in recent years, signifying increasing costs. Debt-ridden airlines are faced with high debt costs, in addition to rising operating costs. Rising operating and financing costs have significantly affected the carriers like THAI, MAS, KAL, PAL and Garuda.

Based on Table 3 (PBT Margin) and Table 4 (EBITDA Margin), we observe that in 1997, KAL's PBT decreased despite an increase in EBITDA. This would signify a significant increase in interest as well as amortization expense. Depreciation expense has decreased due to a revision in KAL's accounting policy[10]. Tax expense is out of the picture for both indicators (PBT and EBITDA). Therefore, interest and amortization expenses must have increased. A further inquiry into KAL's financial statements revealed a 40% increase in the item "Interest and guarantee charges". Nothing was said regarding "guarantee charges" in the financial report. With relevance to interest charges however, we do see a large increase in debts (after all foreign debts are translated into Korean won). Consequently, interest charges have increased substantially. From Table 12, it shows that KAL's fuel cost margin has increased from 17.01% in 1996 to 19.26% in 1997. The increase is significant because fuel costs have risen at a faster rate relative to total operating costs. In addition, the airline's fuel costs increased by about 17.3% in 1997 while its seat capacity rose by only 8.4%.

### DECREASE IN DEMAND FOR AIR TRAVEL

The third factor that has been largely affected by currency devaluation, and the subsequent economic recession, is the drastic decrease of demand in air services, mainly passenger demand. The weakening home currencies have made travelling for locals more expensive, thereby adversely affecting outbound traffic. We would expect inbound traffic to increase, as Asian countries have become cheaper destinations. However, reports in traffic statistics have indicated a general fall in inbound traffic too. Reasons cited include the 1997 haze from burning forests in Indonesia, and political and social unrest in the region. The already declining Japanese economy has also

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[9] Operating costs of CX did increase, but it was due mainly to increased flights and not to currency devaluation.

[10] The useful life of aircraft was increased from 10 years to 13 years, resulting therefore in a decrease in depreciation expense of W197,000 million for the period. The salvage value of aircraft, property and equipment are depreciated for a change, causing an increase in depreciation expense of W4,653 million. The net effect is a fall in depreciation expense of W192,347 million.

affected intra-Asia travel, adding to the decline in air travel because Japan has been the main origin market in Asia-Pacific. The net effect is over-capacity during recession, which is experienced in different severity by all of the Asian airlines in this study.

The overall yield (Table 10) has been falling since 1995, in part due to a prolonged economic downturn in Japan. The falling yield is further compounded by weaker currency and steeper price discounts during the current recession. Overall load factor (Table 8) had also dipped in 1998, reflecting the problem of over-capacity amidst falling traffic.

While other airlines are hit with falling demand due largely to currency devaluation, CX's decline in demand is notably because of their now relatively strong Hong Kong dollar that is pegged to the US dollar. CX's fares became more expensive to Asian travellers and this lowered overall demand for CX even with aggressive discounting. This, in turn, adversely affected the carrier's earnings; the impact is greater on the carrier's revenue rather than on its costs, as opposed to the situation faced by other Asian carriers.

## Other Issues

The Japanese airlines have high inherent costs which resulted in relative weaker cost-competitiveness. Before the crisis, this situation was compensated by high yields as Japanese carriers have the highest average yields among the airlines studied. However during the crisis, overall yields fell while costs of these airlines, which were already high, increased further. This added to the erosion of profits, and for the case of JAL, added to further losses. Deregulation and the new US bilateral, too, will likely cause the yields to decline further, leaving JAL in the midst of increased competition and high unit costs. Although its widely spread network provides exposure to the strong European and U.S. markets, JAL remains leveraged to Japanese outbound market trends. A prolonged recession in Japan has certainly depressed the domestic demand, thus causing further downward pressure on its performance.

So far, Taiwan seems to one of few economies that are least affected in the region by the Asian crisis. The New Taiwan dollar devalued only slightly when compared to many other Asian currencies. In this respect, CAL is relatively better off than most other carriers. But a poor safety record in recent years (two air crashes – one in Nagoya (1994) and one in Taipei (1998)) has seriously tarnished the carrier's image. Its recovery would take considerable time to materialize. On top of this, CAL has to coupe with increased competition from the new entrants such as EVA Air.

In Indonesia, the social unrest and political uncertainty crushed the investors' confidence in the country and certainly affected air traffic. In 1998, passenger load factors reached as low as 43%. Inbound flights had experienced near zero load factors due to unrest. Another worrying issue is one concerning the millennium bug. Garuda is presently the only airline in the region which is not Y2K compliant.

The misfortune of a temporary closure of PAL in September 1998 was a result of a strike staged by the pilots' union in protest of the enforcement of a contractual term that allows the airline's management to "retire pilots with 20 years experience or 20,000 flight hours". The system-wide strike paralysed operations and amassed losses; it worsened PAL's condition in midst of the crisis. After talks broke down between the management and the union, operations were ceased to mitigate losses and "preserve assets". Although PAL resumed operations in October 1998, its financial viability is still hanging on the balance. It is still looking for a white knight to bail the company out of the dire situation.

At this point of time, the recession seems to be bottoming out and Asian economies are on the way to recover. Many of the Asia-Pacific airlines still have a considerable way to go before their financial problems are resolved. Suitable strategies are needed to aid the carriers ride out the economic downturn.

# IV. CONCLUSIONS

Asia's economic boom came to an abrupt end in the middle of 1997. All airlines in the region have been adversely affected in one way or the other. The main source of financial trouble in this period of economic downturn, as experienced by most airlines in out study, is currency devaluation. This in turn created heavy financial burdens in 3 main areas: (a) foreign exchange losses due to transaction exposure, (b) inflated operating and financing costs, and (c) decrease in demand for air travel. Airlines which have suffered huge exchange losses include THAI, PAL, KAL, MAS and Garuda. This group of airlines is suffering from high operating and financing costs, in particular, in aircraft lease payments, debt interest payments and the erosion of the benefits that could have been enjoyed if not for unfavourable exchange rates. All Asia-Pacific airlines in our study are also affected by falling air traffic. Outbound traffic decreased as expected while inbound traffic took a surprising decline. The reasons for the latter are the regional haze, and social and political unrest. Another major factor to the overall decline in air traffic is attributable to the deterioration of Japan as an origin market in the Asia-Pacific region.

There are other issues that compounded the effects of the recession on the airlines. Some of these were already existing before the downturn – several airlines were already in financial trouble before the crisis started. The crisis worsened their situation and made the need to resolve the prevailing problems more pressing. Japan's prolonged recession has directly affected the performance of JAL. CAL has a poor reputation for safety while Garuda was plagued with institutional burdens and the millennium bug. PAL was in the middle of an ambitious fleet expansion and modernisation plan when the recession struck. To make things worse, its operations were severely affected by a system-wide strike, which eventually led to the temporary cessation of operations.

We have found that the Foreign Exchange Gain or Loss has a significant role in influencing an airline's performance. Therefore proper hedging of foreign exchange rate risk through the use of financial instruments is a good way to reduce exposure in this area, especially when the economy takes a downturn. QAN has demonstrated that it could still reap profits despite having a high average net debt to equity ratio. Although the Australian dollar depreciated against the US dollar, and that US debts make up the majority of QAN's large debts, QAN did not seem to suffer a heavy financial blow in this aspect. Airlines should pay more attentions on risk management, especially during aggressive fleet modernization and capacity expansion.

There should be an appropriate balance between acquiring and leasing aircraft, which should be integral part of risk management strategy for any carrier. Aggressive capacity expansion through acquisition would considerably strain an airline's bottom line during an economic downturn. Aircraft leases do increase costs in short run; but the benefits of being able to better control its capacity usually over-weigh the penalty of terminating leases. The sale-and-lease-back strategy is also a good mechanism to survive the financial storms. But this option may not be feasible for carriers with ageing fleet, like Thai Airways.

For debt-ridden carriers, it could consider converting its debts into equity/shares by implementing major restructuring plans and cost-cutting measures. But such an exercise is usually a tough sale to creditors. Furthermore, institutional constraints, such as, foreign ownership, may make such as rescue plan infeasible for trouble carriers.

It is clear that the full impact of the crisis still has not been fully reflected at this point of time. A similar research could be conducted at a time when Asia's economy has recovered so that a better picture of how the airlines are affected by the crisis could be obtained. In addition, since the scope of this study is limited to 11 key carriers in Asia Pacific, a future study may be needed to have a much broader coverage of carriers in the region.

Additional research is still needed in the area of airline financial management, especially concrete risk management models. New capacity planning models must weigh in the financial risks of the aircraft ownership.

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# The Reform and Performance of Air Transportation Industry of China

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**Abstract** This paper presents an integrated picture of the reform and development of China's air transportation industry in recent twenty years. According to the difference of its characteristics, we divide the period into three states. In the first stage, the civil aviation sector was separated from control of army so as to bring some business aspects to it. The operating power of air transportation began to be separated from administrative bureau in the second stage. Six trunk air carriers as well as more than a dozen of small airlines were established to seek profit on the rapid growing market. In the third stage, the enterprises in the industry were given more operating power and regulation of the market was somewhat loose. Meanwhile, the growth of demand for air transportation slows down, and air carriers compete intensely. Faced with the tendency of deregulation and globalization of the industry in the world, China's government begins to transfer its policy implication from pro-competition to consolidation. A wave of merger and acquisition in the industry of China is coming.

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## I. INTRODUCTION

As China moves from a centrally planned economy to a market economy, many sectors have witnessed, for the last 19 years, either policy liberalization or a shift in decision-making power from central to local government. By 1993 China's economy had become essentially a market economy in the sense that some two-thirds or more of national output was produced by profit-seeking economic units. Although rural reforms turned out to be very successful, the industrial reform proved to be much more difficult. Industry is the largest sector of the Chinese economy, accounting for 50 percent of total output and 80 percent of exports, and employing more than 100 million workers in 1992.

The core of China's industrial reform has been the reform of thousands of large- and medium-size state-owned enterprises (SOEs). Most of the existing literature on the SOE reform is based on cross-section studies of many industries. In a comprehensive survey of Chinese enterprise reform, however, Jefferson and Rawski (1994, p. 50) pointed out: "The problem is complex: the population of state-owned enterprises is large and diverse; the reforms are partial and uneven; they consist of measures that permit (rather than mandate) new course of action; and outcomes are ambiguous. A full analysis must penetrate to the enterprise level and transcend the evidence available from anecdotes, small samples, and fragile statistical aggregates." This suggests an industry-case-study approach.

This article describes the process of regulatory and enterprise reform in the Chinese airline industry and its impact on the industry's performance. China's transport sector is one of the largest sectors of the Chinese economy while aviation has been the fastest growing mode since the early 1980s. Table 1 shows the composition of non-urban transport activities (passenger kilometers) in recent years. The average annual growth rate of civil aviation in China was 20.7% during the 1980-94 period - 4.3 times the world average, while the average annual growth rate of all modes of transportation was 9.9% in the same period. Air transport has also become more important in intercity transport: its proportion of passenger kilometres of all modes has increased from 1.7% in 1980 to 6.4% in 1994. In 1994 China ranked 8th in the world in terms of total air passenger-kilometers performed, compared with its 33th place in 1980, while its domestic passenger-kilometers ranked 4th, just behind the U.S., Russia and Japan.

**TABLE 1: Modal Split in Non-Urban Transport in China (Billion passenger-kms)**

| Modes | 1980 | Ratio (%) | 1985 | 1990 | 1996 | Ratio (%) | Annual Growth 1980-96 |
|---|---|---|---|---|---|---|---|
| Rail | 138.3 | 60.6 | 241.6 | 261.3 | 332.5 | 36.4 | 5.6 |
| Road | 73.0 | 32.0 | 172.5 | 262.1 | 490.9 | 53.7 | 12.7 |
| Water | 12.9 | 5.7 | 17.9 | 16.5 | 16.1 | 1.8 | 1.4 |
| Air | 4.0 | 1.7 | 11.7 | 23.0 | 74.8 | 8.2 | 20.2 |
| Total | 228.1 | 100.0 | 443.6 | 562.9 | 914.3 | 100.0 | 9.1 |

Sources: Transport (1997).

This tremendous growth is due to both the reform of the industry and the rapid national economic expansion. We divide the process of the reform into three stages. The first stage started the early 80's when China's economic reform began and the central government transfered its attention to economic development, and ended in 1987, when the civil aviation reforming programme issued. In the period of preliminary reform, CAAC separated from the army and some basic operating power gave to regional administrative bureaus, which stimulated a tremendous growth of 25.8% per year during the stage. The second stage went through the process of building six trunk airlines, from the establishment of China Southwestern Airlines in the end of 1987 to the departure of both the China Southern Airlines and the Baiyun International Airport (in Guangzhou city) from the Guangzhou civil aviation bureau in the end of 1991. In this period, the CAAC monopoly was broken. Six commercial-orianted, trunk airlines bagen to be built and many other new air carriers invested by local governments and large enterprises also entered to seek big profit in the rapid growing market. The industry formed a situation of oligopoly in which six trunk airlines share 75-80% of the market while the other air carriers of more than a dozen fight for the rest. The third stage began in 1993, when more operating power was released to the enterprises in aviation sector. The tremendous growth of air transportation (say, more than 25% of annual growth) seems to cease in this period. Load factor decreases and some inefficient air carriers loss money, airlines are competing intensly in the imperfect regulated inviroment. China's airline industry offers an interesting and prominent example of profound changes in a state industry caused by a historic reform experiment. Taken together, these two observations suggest that an examination of this industry may be particularly useful to study China's SOE reform and to further draw implications for the general process of completing transition from a centrally planned economy to a market economy.

Our second objective in this article is to better understand the development of China's air transport and its aviation policy. The airline industry is currently undergoing major structural changes throughout the world. There is a world wide tendency to deregulate/liberalize the airline industry and promote competition in both domestic and international markets. Globalization of the industry seems increasingly likely; experts predict that a small number (5-10) of global carrier networks are to be formed within the next decade. The rapid growth of China's economy, size of its population, and geopolitical importance of its location in Asia, all, point that China will likely play a key role in shaping the pattern of airline networks in Asia and the linkage with other continents. Despite its importance little has been written on the Chinese airline industry. This article is a step towards filling that void.

The article is organized as follows. Section II contains a brief description of the history of China's air transportation. Section III-V describes three stages of regulatory and enterprise reforms in the air transport sector respetively. The analysis goes with the mathodology of industrial organization, focusing on the impact of change of government's regulation and policies to enterprises' behaviors and market performance. Section VI contains concluding remarks.

## II. HISTORY (1949-1980)

China's airline industry was founded during the early 1950s when the country was established and needed airlines as a national instrument to carry out its policy for government administration, trade and tourism. Prior to 1980, the industry was a semi-military organization with the Civil Aviation Administration of China (CAAC) as a department of army (firstly the Air Force, then the Military Commission) for most of the years. The "chain of commend" within CAAC was a four-level administration system: CAAC, six regional civil aviation bureaus, twenty-three provincial civil aviation bureaus, and seventy-eight civil aviation stations. CAAC combined control of flight operations, airport management and administration of the industry (such as traffic rights and other regulations) under the umbrella of a single operation. The lower-level operation units could not make important operational decisions and were not independent economic entities responsible for their own profits and losses. The industry was regulated in every aspect of air services provision including market entry, route entry, frequency, aircraft buying and leasing , pricing and even passenger eligibility for air travel and was, therefore, a CAAC monopoly.

Prior to the reform, China's air transportation industry suffered its unsatisfactory performances of the traditional central planned system. First, the airline industry had been bearing persistent financial losses. From 1953 to 1978, the industry had witnessed fourteen years of financial losses even after taking account the central government's subsidy to the industry. Of the fourteen years, the 1968-74 period produced seven consecutive years of losses totaling 360 million yuan (Shen, 1992).

Second, demand for air services was severely suppressed under the old system and as a result, the development of the airline industry was stagnant. The air share of domestic intercity traffic volume remained largely constant at about 1 percent over the 1950-80 period. The volume of air transportation in whole country in 1975 was only 1,538 million RPKs, less than 1% compared that of top three airlines in the United States in 1997. The main task of air transportation was for government administration: most passenger travel by air was for administrative affairs for various levels of governments and large state-owned enterprises rather than doing business. The lack of commercial demand made the airline market rather small. Moreover, the military management of airlines and airports created no competition in the market and resulted in inefficient and low quality services, further stifling demand. In fact, it took 24 years (after 1950) for CAAC to reach the highest traffic level in the Chinese aviation history (Wang, 1989).

## III. PRELIMINARY REFORM (1980-87)

The reform of airline industry in China was started from the end of 70's, which was mainly due to the China's economic reform. The central government began to focus its attention on economic development and expected to rebuild its economic structure and regulatory system through economic reform, transferring a centralized planning economy to a relatively decentralized market economy gradually. As a result, the National Income in China has increased 2.5 times during 80's, with an average annual growth rate of 8.6%, compared with that of 5.8% in 70's and 4.0% in 60% (CSSB,1992).This strongly stimulated the demand for air transportation and requested the reform of the industry.

On the eve of the Third Plenum of the Party Central Committee in October 1978, Mr. Deng Xiaoping stated that civil aviation should follow a similar direction as a modern enterprise. Since 1980, The administrative structure was reformed first in 1980 and then again in 1982 which effectively separated civil aviation from the army. This offered the industry the opportunity to bring back business aspects. At the beginning of 1981 the central government adopted the policy of 'self-responsible for losses and extra-profit retention' towards the airline sector. The policy was further simplified to a one-nine division of airline revenue between the state and CAAC. Within CAAC, six regional civil aviation bureaus were given the responsibility of managing their own revenues and costs in 1979. The practice was further extended to twenty-three provincial civil aviation bureaus a year later. Furthermore, CAAC in 1982 extended the profit-retention system to six regional civil aviation bureaus and gave them more autonomy in making operational decisions.

In spite of the fact that key decisions power were still left in central government, these preliminary reform made the industry expand from 1.8 billion passenger-kms in 1977 to 18.2 billion passenger kms in 1987, with average annual growth reaching 25.8% (compared to that of 8.5% from 1949-77). The labor productivity increased twice from 1980 to 1984 (Wang, 1989).

Moreover, it had no opportunity to improve its competitive ability in practice, as CAAC still held most decision power for management of air aviation and there was no room to form the competitive mechanism.

## IV. REFORM OF RELATIONSHIP BETWEEN ADMINISTRATIVE BUREAUS AND ENTERPRISES IN CIVIL AVIATION (1987-92)

### Reforming program

Though departing from the army, the airline industry could not meet the demands of China's rapid economic expansion in the traditional strictly centralized administration. Meanwhile, central government could not afford the immense investment on developing the industry. According to the principles of departure business from administration, reduction of administrative levels, simplification of governmental functions and decentralization, a comprehensive reforming program, "Report on Civil Aviation Reform Measures and Implementation" issued by the State Council in January 1987. The main goal of this reform program is to separate the regulator from also being the operator and to break the CAAC monopoly. The major ideas in the program included : (1) simplifying the traditional four-level administration system to a two-level system: the national administration and the local bureaus. (2) establishing six state-owned trunk airlines (Eastern China, North China, South China, North-eastern, South-western and North-western) were to establish their own airlines which graduallly would be accountable for their own revenues and costs under the 'complete responsibility system'. (3) separating airports operations from airway administration and making them become independent businesses to serve for all the airlines. (4) easing the market entry of the industry. (Wang, 1989):

**Building of trunk airlines**

The new program was implemented initially within the Chengdu and Shanghai regional civil aviation bureaus, respectively. As a result, China Southwestern Airlines, based in Chengdu, was established in December 1987. In the following June, China Eastern Airlines, based in Shanghai, was established. With the success of the Chengdu and Shanghai "test-run," the other four airlines were established, though the process lasted for five years: Air China (based in Beijing) in late 1988, China Northwestern Airlines (based in Xi'an) and China Northern Airlines (based in Shenyang) in 1989, and China Southern Airlines (based in Guangzhou) in 1992. These air carriers are profit-seeking units and are directly responsible for air services provision. Each decides its flight frequency and sales outlets, selects inputs (e.g., crew members, flight attendants and their employment and compensation contracts), proposes aircraft purchase and route entry, and makes other operational decisions.

With the establishment of these independent, commercially-oriented airlines, the main task of CAAC is of regulation and coordination, such as issuing airline license, approving route entry and exit, pricing, designing strategic plans for the industry, issuing policies and regulations to maintain safety and to improve competition and efficiency, and negotiating bilateral air services agreements with foreign countries. CAAC was expected no longer the operator of air transportation, and the new role allows it to focus on designing efficient mechanisms to fulfill its regulatory function in adjusting and regulating the market. Similarly, the main mandate of regional civil aviation bureaus is administrative, such as coordinating air traffic control and regional airport development. However, in fact, CAAC still kept the power in appointing and removing chief managers in those trunk airlines and indirectly influenced their operation.

**Market entry**

With the easing entry of the market, many new air carriers was built and sought profit in air transportation. There were 41 airlines established in China, of which 28 provided both passenger and cargo services in the early of 90's. Besides those trunk airlines under CAAC, second type of those carriers was funded by local government - Shanghai Airlines, Xiamen Airlines and Sichuan Airlines are the largest and most profitable among them. The third type of them was jointly owned by CAAC, local government or large corporations e.g. Zhejiang Airlines which was owned by China Eastern Airlines and the Government of Zhejiang Province.

As for route entry, CAAC simplified its approval procedure and in general encouraged air carriers to open new routes. Here airlines, in consultation with airports, proposes their new routing plans and CAAC holds meetings every year to coordinate route entry among airlines.

Although CAAC's approval is required for route entry, most of the airlines' requests seemed to get approved without much trouble.

**Unexpected tremendous demand**

The growth of air transportation was so dramatic that not only foreign experts but also China's government officials and experts could not expect it. In 1985, the Research Center for Development of the State Council, an economic brain trust of the central government, proposed its estimates for the capacity of the China's air transportation till the year 2000 (DRCSC, 1988): The total tonne-kilometers performed, the passenger-kilometers performed and the passengers carried in air transportation in China in 2000 will reach 5-5.5 billions, 45-50 billions and 30-35 millions respectively, with an average annual growth rate of 13.1-13.6%, 12.9-13.5% and 11.5-12.3% during the last fifteen years of this century.

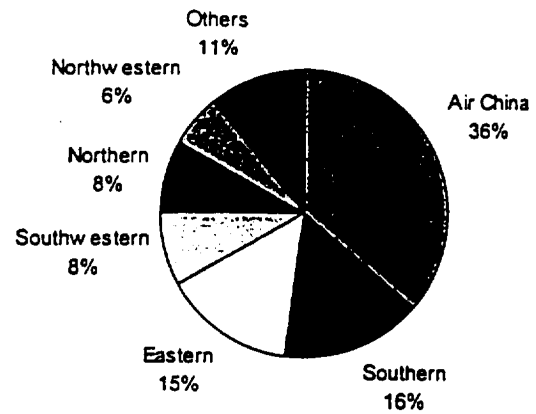
However, the actual figure exceeded the estimate by far. The China State Statistical Bureau (1992) reported that the actual average annual growth rate of air transportation during the 80's was nearly 20%, mainly due to the rapid economic development and the deregulation in the airline industry.

Therefore, when 'the Ten-Year Program and the Eighth Five-Year Plan of Development for Civil Aviation' was designed in 1990, almost all the important indicators were lifted from the original estimation presented five years ago (CCTA, 1992). The total volume of traffic and the passenger traffic in air transportation in 1995 were planned to reach 4.4 billion tonne-kms and 30 million passengers, with an average annual growth of 12.0% and 12.6% respectively. The figure for 2000 was estimated as 6.5 billion tonne-kms and 45 million passengers.

The revised estimate for 2000 is more than 20 percent over the original one in 1985. However, it can still be considered conservative, facing the roaring increase during the early 90's. The growth rate of air transportation reached 30 percent in 1991 and 1992. The total volume of traffic reached 4.26 billion tonne-kilometers in 1992, almost catching up the estimate for 1995. Meanwhile, the load factor in the whole industry in that year was raised to 78.4, in which domestic load factor being 86.9, implying that much potential demand of around 10 million passengers failed to be served.

**Market concentration**

Figure 1 Distribution of Market Share in RPKs in 1991




The roaring expansion on demand made the average profit was not accompanied with the market concentration decrease.

There often happens somewhat dramatic thing in history. When the government worried about that the capacity of air transportation can't match the growing demand and all the China's airlines were eager to order more aircraft, the peak of the growth of air transportation appears to have gone.

## V. REFORM OF ENTERPRISES AND MARKET (1992 till now)

The airline industry has developed very fast since the end of 70's and is becoming a critical transportation mode in national economic growth. It has changed from the sector which government needs to subsidize to the one with large profit ( the average profit rate in the industry was 30% in 1990). However, there were still some problems worried with the government. The first thing is that the air carriers, especially the trunk airlines under the CAAC had not enough operating power to become independent economic entities, their lower labor productivity and poor service quality made them cripple in competition with foreign airlines in the international market. Survey shows that on the most international routes served both by domestic and foreign air carriers, the former usually share only one third of the market with lower price and higher cost.

The second is that, after annual growth rate of more than 25% in 80's and early 90's, the roaring growth of air transportation seems to have ceased since 1993. Some inefficient airlines were faced with high costs, excess capacity and low load factors, leading to heavy losses. In fact, the average load factor in the industry dropped down from 78% in 1992 to 69% in 1994, and the load factors on some routes even reduced to 20%.

The third thing is that the structure of investment in 80's did not meet the demand, too much on aircraft and less on airport and other infrastructure. All the problems should be solved through pushing the reform forward.

### 5.1 Change of Regulation and Policy

**Releasing more power to airlines**

By the end of 1992, the State Council had authorized the formation of 55 corporate groups that would form a vanguard of the next phase of China's economic development. These groups were given increased freedoms including special rights to manage their finances through a corporate holding structure that held interests subsidiary companies. The top three airlines, Air China, China Eastern Airlines and China Southern Airlines, all of which shared the market around 60%, were among them. This offered the top three airlines a key opportunity to diversify its interests and to obtain more operating freedom. For example, in the China Eastern Air Group (CEAG), the China Eastern Airlines (CEA) accounts for half of the seats on the Group Board (including that of Chairman). The remainder of the Group is made up of 16 subsidiaries operating in real estate, imports and exports, advertising, hotels and tourism, air catering, and the China Eastern Air Group Finance Co. – a non-banking financial organization approved by the headquarters of the Bank of China. CEA controls the majority of the voting stock in most of these companies.

After the formation of corporate groups, the three airlines were awarded the following special rights: (1) to buy or lease aircraft and other transport equipment (after consultation with CAAC); (2) to borrow money from domestic or international markets as an independent legal entity; (3) to appoint managers to most of the key posts ( with the exception of the presidents and vice presidents of CEAG and its major subsidiaries); (4) to set pricing levels in accordance to market demand conditions, subject to maintaining a 'base price' on average; (5) to approve overseas postings for its staff (a discretion normally restricted to senior administrative levels such as provincial governments).

**Opening domestic market**

In 1994, the CAAC announced to allow foreign investors to make joint venture on airport in China (less than 50% of capital share) and to make joint venture or buy stock of China's airlines (no more than 35% of capital share and 25% of voting stock). The first case of the joint venture in the industry is Hainan Airlines, into which American Aviation injected some US$25 millions to acquire its 25% of stock in 1995. China Eastern Airlines and China Southern Airlines issued their stock in Hong Kong Stock Exchange in the following year. The government prefer more foreign investment on airport and other infrastructure, but the pace to open domestic market of air transportation seems not fast.

Meanwhile, CAAC raised entry barrier by forbidding new entry and re-examining the qualification of existing air carriers in 1993. This implies the CAAC begin to change its policy, from pro-competitive policy to consolidation policy.

**Investment mechanism and structure change**

In order to encourage local governments to invest on airport and other infrastructure, CAAC speeds up the decentralization of airport administration. As an experiment to the efficiency of decentralization, CAAC transferred the administrative power of the airport in Xiamen City to the Xiamen municipal government in 1988, including all the fixed and working capital of the airport and personnel. This stimulated local government to invest on airport. During 1986-92, 46 airports in the country were built, upgraded or expanded, in which 31 were invested totally or mainly from local governments. For the total investment of 4.4 billion yuan for 46 airports' construction, local government shared 3 billions yuan.

In 1993, the Hongqiao Airport in Shanghai, the third largest airport in China, followed the suit. Other airports were decentralized gradually over the next several years while new airports were managed by local governments from inauguration. Shanghai municipal government, for example, is encouraged to build another airport so as to meet the growing demand. A new airport located in Pudong region is under construction. Its designed capacity is 60 million passengers and its first runway will be in operation in the end of 1999, the local government affords the 10.7 billion yuan (US$ 1.3 billion) for the project of first period.

Besides that, CAAC established the Fund of Infrastructure Construction for Civil Aviation in 1993. Domestic airlines should pay the with 10% of domestic revenue and 4-6% of international revenue. Meanwhile, the corporate' income tax rate was reduced. The structure of source of investment on infrastructure has been changed (see Table 2) and the sum of firm's own capital and the input from the fund has increased and shared nearly half in the investment on infrastructure. This new mechanism stimulates the investment on infrastructure to grow as an annual rate of 53% during 1992-96 (see Table 7).

Table 2 Distribution of Sources of Investment on Infrastructure of Air Transport (million yuan)

| | 1992 | % | 1993 | % | 1994 | % | 1996 | % |
|---|---|---|---|---|---|---|---|---|
| Gov. Capital | 32 | 3.09 | 132 | 5.66 | 32 | 0.92 | 269 | 4.16 |
| Loan from Fund. | 266 | 25.71 | 272 | 11.66 | 261 | 7.50 | 329 | 5.08 |
| Loan from Bank | 389 | 37.60 | 910 | 39.03 | 1334 | 38.40 | 2067 | 31.90 |
| Firms' Capital | 220 | 21.29 | 355 | 15.23 | 691 | 19.90 | 1565 | 24.14 |
| Fund of Construction | 0 | 0 | 470 | 20.16 | 782 | 22.51 | 1330 | 20.52 |
| Charge on Airports | 25 | 2.38 | 73 | 3.11 | 174 | 5.01 | 720 | 11.11 |
| Bond | 103 | 9.93 | | | N.A. | | N.A. | |
| Foreign Loan | N.A. | | 50 | 2.14 | 200 | 5.76 | 200 | 3.09 |
| Others | N.A. | | 70 | 3.00 | N.A. | | N.A. | |
| Total | 1035 | 100.00 | 2331 | 100.00 | 3474 | 100.00 | 6480 | 100.00 |

Data sources: Transport (1993-97)

### 5.2 Market Concentration

The breakup of CAAC into independent airlines and the entry of new carriers have significantly changed market structure. Before 1987 (the second-stage airline reform), the industry was a CAAC monopoly. Now the Chinese airline industry may be characterized as an "oligopoly." The market participants include ten CAAC carriers (carriers under CAAC) and more than a dozen non-CAAC carriers. Table 3 shows passenger traffic (including both domestic and international traffic) performed by the Chinese airlines from 1992 to 1996. As can be seen, the six CAAC trunk airlines controlled the majority of the market share. In 1992 the top three airlines, namely, Air China, China Southern and China Eastern, together had a 66% of the total revenue passengers performed while the other three trunk airlines had 21% market share. The remaining 13% traffic was supplied by four other CAAC carriers and more than a dozen local airlines. The dominance of the top three carriers was weakened however: their combined market share fell from 66% in 1992 to 56% in 1996. The decline is due mainly to the growth of local, non-CAAC carriers: their market share rose from 6.3% in 1992 to 13.8% in 1996.

Table 3 Market Share and Market Concentration of Air Transportation (% in RTKs)

| Air Carriers | 1992 | 1993 | 1994 | 1996 |
|---|---|---|---|---|
| Air China | 32.1 | 30.5 | 28.2 | 25.3 |
| Eastern | 16.9 | 16.9 | 15.3 | 13.5 |
| Southern | 16.9 | 15.6 | 17.2 | 16.8 |
| South Western | 7.1 | 8.3 | 9.1 | 8.9 |
| North Western | 5.0 | 5.0 | 4.0 | 4.9 |
| Northern | 9.0 | 8.8 | 8.3 | 8.1 |
| Others under CAAC | 6.7 | 7.6 | 7.6 | 8.7 |
| Local air carriers | 6.3 | 7.3 | 10.3 | 13.8 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |
| R3 | 65.9 | 63.0 | 60.7 | 55.6 |
| R6 | 87.0 | 85.1 | 82.1 | 77.6 |

Data sources: Transport (1993-97)

In fact, the rise of local carriers in China has been dramatic. local carriers started to serve domestic routes in 1986 and regional routes (routes connecting Hong Kong and a city in the mainland of China) in 1987. After entry they grew quickly, average growth rate reached 42% during 1992-96 in spite of the slowing down of demand and some disadvantages in competing with the air carriers under CAAC which was much higher than the growth rate for CAAC carriers. Note that services on the international routes are reserved only for the top three CAAC carriers.

It is often argued in the airline research that the markets at the city-pair level are more relevant for the purpose of competition and consumer welfare than the markets at the national level. Table 4 thus examines concentration at the 30 largest domestic city-pair markets in China, in descending order of market size. An equivalent number of firms is reported for each route. (The equivalent number of firms is the inverted Herfindahl index, calculated using each carrier's market share on the route). In 1993 there were, on average, 2.06 firms on one of the top 30 domestic routes. The number increased to 2.40 in 1994 (a 20% increase). The increase also occurred for both the top 10 and top 20 city pairs. These observations suggest that there were two or three "equivalent" carriers operating on busiest domestic routes and that concentration declined at the route level between 1993 and 1994.

**Table 4: Concentration at the 30 Largest Chinese City-pair Markets, 1993 and 1994**

| 1993 | | | 1994 | | |
|---|---|---|---|---|---|
| City-pair | Passengers | Equivalent Number of Firms | City-pair | Passengers | Equivalent Number of Firms |
| Beijing-Guangzhou | 907420 | 2.87 | Beijing-Guangzhou | 969751 | 2.52 |
| Guangzhou-Shanghai | 859876 | 2.86 | Guangzhou-Shanghai | 840961 | 3.49 |
| Beijing-Shanghai | 742683 | 2.11 | Beijing-Shanghai | 677707 | 2.40 |

| | | | | | |
|---|---|---|---|---|---|
| Guangzhou-Haikou | 521693 | 1.27 | Guangzhou-Haikou | 515944 | 2.15 |
| Guangzhou-Guilin | 503810 | 1.05 | Beijing-Xian | 501146 | 1.61 |
| Beijing-Xian | 476154 | 1.62 | Guangzhou-Chengdu | 493649 | 2.66 |
| Guangzhou-Chengdu | 439011 | 2.12 | Guangzhou-Hangzhou | 450909 | 2.83 |
| Guangzhou-Hangzhou | 418078 | 2.82 | Guangzhou-Chongqing | 438454 | 3.34 |
| Beijing-Shenzhen | 379833 | 1.80 | Beijing-Shenzhen | 419293 | 3.19 |
| Beijing-Chengdu | 344531 | 1.55 | Beijing-Chengdu | 406779 | 2.25 |
| Shanghai-Xiamen | 330272 | 2.41 | Guangzhou-Wuhan | 365573 | 2.00 |
| Shanghai-Shenzhen | 328973 | 3.54 | Guangzhou-Shantou | 353735 | 1.05 |
| Guangzhou-Shantou | 315867 | 1.00 | Nanjing-Beijing | 353004 | 2.17 |
| Guangzhou-Xiamen | 308342 | 2.43 | Guangzhou-Guilin | 334228 | 1.00 |
| Beijing-Nanjing | 306411 | 1.82 | Shanghai-Shenzhen | 331711 | 3.81 |
| Guangzhou-Chongqing | 300982 | 3.26 | Dalian-Beijing | 331418 | 1.89 |
| Guangzhou-Kunming | 293841 | 1.72 | Hangzhou-Beijing | 331135 | 2.29 |
| Guangzhou-Wuhan | 281408 | 1.37 | Guangzhou-Xiamen | 321365 | 3.05 |
| Beijing-Hangzhou | 269155 | 2.69 | Guangzhou-Kunming | 318955 | 2.21 |
| Beijing-Dalian | 257594 | 1.89 | Shanghai-Xiamen | 310201 | 2.70 |
| Guangzhou-Nanjing | 252592 | 2.44 | Beijing-Shenyang | 270628 | 1.85 |
| Shanghai-Fuzhou | 224252 | 1.61 | Guangzhou-Nanjing | 258030 | 2.48 |
| Chengdu-Lhasa | 210159 | 1.00 | Shanghai-Wuhan | 257096 | 2.84 |
| Shanghai-Chengdu | 204400 | 2.07 | Shanghai-Fuzhou | 255289 | 2.15 |
| Shanghai-Xian | 303165 | 2.41 | Beijing-Harbin | 254769 | 3.93 |
| Beijing-Urumqi | 191415 | 1.59 | Beijing-Wuhan | 240347 | 2.85 |
| Beijing-Shenyang | 179719 | 1.00 | Chengdu-Shanghai | 238830 | 2.19 |
| Chengdu-Kunming | 177325 | 2.98 | Chengdu-Lasa | 223151 | 1.00 |
| Shanghai-Guilin | 176606 | 1.86 | Shanghai-Xian | 211704 | 1.30 |
| Shanghai-Wuhan | 175220 | 2.50 | Haikou-Shenzhen | 209160 | 2.78 |
| Average | 353129 | 2.06 | Average | 382831 | 2.40 |

Notes: The equivalent number of firms is the inverted Herfindahl index, calculated using each carrier's market share on that route.

Sources: Transport (1994, 95), Timetable (1993, 95), OAG (1994)

## 5.3 Airlines' Competition

**Pricing and price competition**

The 'base price'of airline tickets in China was set by CAAC, but changes in this base price required the approval of China's State Council. Airlines were allowed the vary the average ticket price 20% above or below this base price. to take account of 'local conditions'.

As competition to sell tickets had become more intense, however, airlines had gradually introduced more and more complex discount structures for individual tickets. Off peak fares, for example. might be sold at little more than half the standard fare as carriers sought to fill up under-used capacity on certain flights. Fares also varied in response to seasonal variations in demand. Deepdiscounts were also available for 'students','teachers' various 'group bookings' and so on. It was not clear that all airlines applied the rules for deciding which passengers qualifies for discounts in a consistent and systematic way leading to what some observers described as 'non-standard' pricing. In fact, with the releasing operating power to air carrers, the execution of the CAAC's pricing regulation seems to be loose in recent years. Therefore, the excess capacity of most airlines is driving the price competition into a cruel state. It is estimated that the average ticket rate on domestic flights is 75.9% in 1995, 72.4% in 1996 and 68.9% in 1997. Table 5 shows the price competition in a domestic hot route in the first half of 1998.

Table 5. Price Competition on the Route Linking Shanghai and Beijing in Jan-June of 1998:

| Air Carriers | Scheduled Flights | Average Ticket Rate (%) |
|---|---|---|
| Air China | 506 | 60 |
| Eastern | 477 | 66 |
| Shanghai Airlines | 420 | 75 |
| Northern | 162 | 41 |
| Northwestern | 92 | 32 |
| Total | 1639 | |
| Frequency (Flights per day) | 9.1 | |

Data sources: Bulliton of Shanghai Airlines (1998)

The price competition was so intense that a lot of airlines couldn't balance their budget. CAAC had to re-announce the its price regulation and forbided the discounts of ticket price for all routes bigger than 20% off.

**Non-price competition**

Besides price competition, domestic air carriers also fight in the domain of non-price aspects. An important competitive device is a carrier's networking or route structure. In particular, a network which can offer more destinations and convenient connections has a competitive advantage. Although CAAC's approval is required for route entry, most of the airlines' requests seemed to get approved without much trouble.

The network pattern of air transportation has fundamentally changed from a single airline, linear network to a local, "hub-and-spoke" system. The country has been decomposed into six air regions which correspond to the operational bases of the six trunk airlines. By the end of 1996, there are 98 international routes and 757 domestic ones in operation for the CAAC air carriers, in which 80 routes and more than 150 routes linking those six local hubs respectively. Besides, the frequency in flight linking those hubs are so high that in top ten domestic routes in frequency in 1996, six of them are linking hubs (see Table 6).

Table 6 Top Ten Domestic Routes in Air Transportation in 1996

| Routes | Passengers (thousand) | Cargo (thousand ton) | Flights (per day) | Load Factor (%) |
|---|---|---|---|---|
| Beijin - Guangzhou* | 1123 | 51 | 14.3 | 74.6 |
| Beijin - Shanghai* | 918 | 16 | 13.1 | 77.0 |
| Shanghai -Guangzhou* | 844 | 41 | 13.3 | 66.8 |
| Beijin - Xi'an* | 616 | 9 | 10.3 | 73.8 |
| Guangzhou - Haikou | 597 | 7 | 11.4 | 81.1 |
| Kunming - Xishuangbanna | 575 | 3 | 12.2 | 89.3 |
| Guangzhou - Chongqing | 562 | 14 | 13.4 | 68.0 |
| Beijin -Chengdu* | 513 | 10 | 11.4 | 73.5 |

| | | | | |
|---|---|---|---|---|
| Guangzhou - Chengdu* | 509 | 23 | 12.8 | 72.1 |
| Guangzhou - Hangzhou | 502 | 15 | 8.5 | 72.2 |

Data sources: Transport (1997)

Note: The routes with star link local hubs.

By centering in its hub city, each trunk airline is a dominant carrier in its own region while competing with each other on routes linking major cities of different regions. For instance, China Eastern, a trunk carrier, competes with China Southern, another trunk carrier, on routes Shanghai-Guangzhou (respective hub cities) and Nanjing-Xiamen (inter-regional, non-hub cities). However, China Eastern is a dominant carrier on its intra-regional Shanghai-Ninbo route, competing only with Shanghai Airlines, a local carrier. The inter-regional routes which see competition between hub carriers usually are busy routes; they cover more than half volume of total domestic air traffic. Another competitive device which carriers can use is flight frequency. A high flight frequency on a route can reduce passengers' schedule delay costs (load factor will fall, however) and thus improve service quality. Other competitive devices include: flight scheduling, safety, aircraft type, airlines' travel agents and reservation, marketing promotions, service quality (e.g., inflight services and meals), and flight punctuality.

Competition has played a positive role in the airlines' drive to maximize economic profits and/or minimize costs, reflected in the improvements in their financial performance and productivity. Competition is good for business; apart from forcing the players to be more competitive, competition can create demand. Many Chinese, for example, have yet to fly an aircraft, so flying is a noval experience for them. The entry of new local carriers in the late 1980s and early 1990s helped to fill that need especially for people living in remote areas.

Competition also plays an important role in airlines' adopting new technology and/or ensuring the efficient use of technology. This is achieved through a longer-term view of investment in technology and the principle of fitness survival. A necessary condition here is that the firm can retain profit and make its capital purchase decision. In the Chinese airline industry, observations suggest that now each carrier has greater incentives to acquire new and more efficient aircraft and to develop efficient compute reservation systems and hub-and-spoke delivering systems. CEA, for example, is considering to develop or license an 'expert system' for yield control.

### 5.4 Market Performance

Table 7 shows some new characteristics of market performance in air transportation industry of China in the third stage of its reform. First, the investment on infrastructure grows rapidly. By the end of 1996, there are 144 airports in operation in the mainland of China, in which 35 are new ones built in four years and most others are also upgraded or expanded in that period (Transport, 1993-97). This has expanded the capacity of air transportation and raised service quality.

Second, the load factor decreases to about 70%, which seems at normal level compared with that of the most countries. Reaching normal load factor is helpful to form an efficient environment for competition, eliminating inefficient firms and pushing the upgrade of technology.

Third, the labor productivity grows constantly at an annual rate of 8.7%. However, as seen Table 8, the index is almost one forth of IATA average. The labor productivity of China Eastern Airlines and China Southern Airlines are three times and twice of the domestic average and reach the lower middle of IATA average. This reveals one of the disadvantages when domestic airlines compete in the international market.

Forth, the rate of flight on time decreases to 77.6%, which implies about 10 million passengers suffered the delay and the service quality should be improved. This is another disadvantages in competing in the international market.

Table 7 Market Performance of Air Transportation Industry in the Third Stage of Reform

| Items | Unit | 1992 | 1993 | 1994 | 1995 | 1996 | ann. growth (%) |
|---|---|---|---|---|---|---|---|
| Fixed Asset | bi. yuan | 34.4 | 42.0 | 58.1 | 77.0 | 93.5 | 28.4 |
| Net Fixed Asset | bi. yuan | 29.8 | 34.3 | 46.5 | 57.5 | 66.9 | 22.4 |
| Investment on Infrastructure | bi. yuan | 1.1 | 2.2 | 3.4 | 4.6 | 6.0 | 52.8 |
| Operating Income | bi. yuan | 16.8 | 22.5 | 32.8 | 41.6 | 48.2 | 30.1 |
| Profit | bi. yuan | 3.0 | 1.7 | 1.1 | 6.3 | 8.3 | 29.0 |
| Total Volume | bi. ton-kms | 4.28 | 4.75 | 5.24 | 6.28 | 6.94 | 12.8 |
| Passenger Volume | bi. px-kms | 40.6 | 43.4 | 48.3 | 58.2 | 62.6 | 11.4 |
| Employee | thousand | 110 | 125 | 132 | 138 | 149 | 7.9 |
| Total Available Seats | thousands | 35 | 48 | 57 | NA | NA | NA |
| Load Factor | % | 78.4 | 71.8 | 69.0 | 71.5 | 69.3 | -3.0 |
| Domestic Load Factor | % | 86.9 | 76.6 | 73.5 | NA | 72.4 | -4.5 |
| Rate on Time | % | 87.4 | 85.1 | NA | 71.7 | 77.6 | -2.9 |
| Utilization Rate | hour/day | 5.4 | 4.9 | 4.8 | 5.6 | 6.8 | 5.9 |
| Total Volume Per Capita | thou. ton-kms/px | 38.59 | 40.92 | 44.32 | 51.92 | 53.94 | 8.7 |

Data sources: Transport (1993-97)

Table 8 Comparison of Labor Productivity of China's Airlines to Foreign Airlines (1997)

| Airlines | Pilots and co-Pilots | Cabin Attendants | Total Employees | Ton-Kms Flown (million) | Pilot Ratio (%) | CA Ratio (%) | Productivity (thousand ton-kms/px) |
|---|---|---|---|---|---|---|---|
| United Airlines | 8289 | 21335 | 91721 | 21754 | 9.0 | 23.3 | 237 |
| American Airlines | 8326 | 17690 | 80842 | 18583 | 10.3 | 21.9 | 230 |
| British Airways | 3249 | 14348 | 54200 | 13593 | 6.0 | 26.5 | 251 |
| Japan Airlines | 2004 | 5366 | 18112 | 11403 | 11.1 | 29.6 | 630 |
| Singapore Airlines | 1264 | 5772 | 13549 | 10096 | 9.3 | 42.6 | 745 |
| Korean Air Lines | 1290 | 3529 | 17050 | 9305 | 7.6 | 20.7 | 546 |
| Cathay Pacific | 1444 | 5470 | 15747 | 7330 | 9.2 | 34.7 | 465 |
| Thai Airways | 633 | 3917 | 24186 | 4467 | 2.6 | 16.2 | 185 |
| Malaysia Airline System | 1191 | 4839 | 23524 | 3783 | 5.1 | 20.6 | 161 |
| Philippine Airlines | 630 | 2137 | 13582 | 2144 | 4.6 | 15.7 | 158 |
| China Southern | 947 | 2117 | 16622 | 1741 | 5.7 | 12.7 | 105 |
| China Eastern | 607 | 1155 | 8539 | 1270 | 7.1 | 13.5 | 149 |
| IATA Total | 126000 | 278000 | 1611000 | 320079 | 7.8 | 17.3 | 199 |

| | | | |
|---|---|---|---|
| CAAC | 149249 | 8050 | 54 |

Data sources: IATA (1998)

## VI. Concluding Remarks

China's air transportation industry has made a great development through nearly twenty years of regulatory and enterprise reform. However, there are still some problems make CAAC worries about. International market is beneficial for airline industry because of its long distance and low average cost. For the statistical data from major airports in mainland of China, the ratio of international traffic volume is increasing rapidly. In the Hongqiao International Airport in Shanghai, for example, the ratio of both regional (major from and to Hong Kong) and international air traffic volume was one tenth in 1978, one fifth in 1980, one forth in 1987 and one third in 1995. However, survey shows that on most international routes, China's airlines get only one third of market share with lower price and higher cost compared with the foreign airlines.

Faced with the intense competition in the international market and the tendency of deregulation and globlization of the industry in the world, CAAC worries about the disadvantages of domestic airlines. It appears that its policy implication begin to transfer from pro-competition to somewhat consolidation. Besides forbidding new entry, CAAC is encouraging acquisition and merger in the industry. Air China has acquired the Dragon Airlines in Hong Kong, China Northwestern has controlled Nanjing Airline and China Southwestern has merged with Guizhou Airline, some bigger mergers are under consideration.

It is sure that a wave of merger and acquisition in the industry is coming, which will make a deep impact on the market structure and firm's behavior in the industry.

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II. Change of Government's Regulation

1992Äê£°ÊÕÈ¡»ú³¡¹ÜÀí½¨Éè·Ñ£»Öð²½Ìá¸ßÆ±¼Û£»½¨Á¢Ãñº½»ù´¡ÉèÊ©½¨Éè»ù½ð£»¶ÔÃñº½Æóµ
µËùµÃË°ÊµÐÐÓÅ»ÝË°ÂÊ²¢Ãâ½»¡°Á½½ð¡±£»Í¶×ÊÌåÖÆ¸Ä¸ï
(ÖÐÑëµØ·½¸÷·Öµ£Ò»²¿·Ö)£»Íê³É1987Äê¿ªÊ¼µÄÃñº½ÏµÍ³¹ÜÀíÌåÖÆ¸Ä¸ï·½°¸¡£

Distribution of Investment on Infrastructure of Air Transport (million yuan)

| | 1992 | % | 1993 | % | 1994 | % | 1996 | % |
|---|---|---|---|---|---|---|---|---|
| Gov. Capital | 32 | *3.09* | 132 | *5.66* | 32 | *0.92* | 269 | *4.16* |
| Loan from Fund. | 266 | *25.71* | 272 | *11.66* | 261 | *7.50* | 329 | *5.08* |
| Loan from Bank | 389 | *37.60* | 910 | *39.03* | 1334 | *38.40* | 2067 | *31.90* |
| Firms' Capital | 220 | *21.29* | 355 | *15.23* | 691 | *19.90* | 1565 | *24.14* |
| Fund of Construction | | | 470 | *20.16* | 782 | *22.51* | 1330 | *20.52* |
| Charge on Airports | 25 | *2.38* | 73 | *3.11* | 174 | *5.01* | 720 | *11.11* |
| Bond | 103 | *9.93* | | | | | | |
| Foreign Loan | | | 50 | *2.14* | 200 | *5.76* | 200 | *3.09* |
| Others | | | 70 | *3.00* | | | | |
| Total | 1035 | *100.00* | 2331 | *100.00* | 3474 | *100.00* | 6480 | *100.00* |

The investment mechanism has been changed since the beginning of 90s. The fundation of construction in air transport industry is gathered from domestic airlines (It is declared in 1993 that all domestic airlines should present some ratio of operating income (10% of that from domestic routes and 4-6% of that from international routes) to the foundation of construction in air transport industry which use as the investment on infrastructure.)

It is considered that organized all behavior and performance of China's air transportation industry with the theory of industrial organization

**--Structure-Conduct-Performance Paradigm**

STRUCTURE:
number of sellers and buyers;
product differentiation;
barriers to entry;
vertical integration;
diversification.
CONDUCT:
pricing strategies;

Market between Beijing and Shanghai in Jan-June, 1998

| Company | SAL | Air China | East | N-W | North | Total | Flight per day |
|---|---|---|---|---|---|---|---|
| Formal Flights | 420 | 506 | 477 | 92 | 162 | 1237 | 6.8 |
| Tickets rate | 75% | 60% | 66% | 32% | 41% | | |
| Relay Flights | 0 | 995 | 549 | 0 | 0 | 1544 | |
| Total Flights | 420 | 1501 | 1026 | 92 | 162 | 2781 | 15.4 |

product design strategies;
research and innovation;
promotional strategies;
plant investment strategies;
legal tactics.
PERFORMANCE:
allocative and 'X' efficiency;
equity;
progressiveness;
macroeconomic stability.

ENVIRONMENT
(1) MARKET:
supply side:
technology;
labor skills and organization;
legal framework;
raw material sources;
transportation cost.
demand side:
purchase method;
substitutability;
price elasticity;
rate of growth;
cyclicality and seasonality.
(2)GOVERNMENT(public policy):
taxes and subsidies;
regulation;
price controls;
antitrust;
international trade rules;
basic research;
information and education;
public ownership.

The airline reform may be divided into two stages. The first stage occurred between 1980 and 1986 and the aim was to bring back business aspects to air transportation. The administrative structure was reformed first in 1980 and then again in 1982 which effectively separated civil aviation from the air force. Beginning 1981 the central government adopted the policy of "self-responsible for losses and extra-profit retention" towards the airline sector. The policy was further simplified to a one-nine division of airline revenue between the state and CAAC. Within CAAC, six regional civil aviation bureaus became basic units for recording profits and losses in 1979. The practice was further extended to twenty-three provincial civil aviation bureaus a year later. Furthermore, CAAC in 1982 extended the profit-retention system to six regional civil aviation bureaus and gave them more autonomy in making operational decisions. During this period, however, CAAC continued to be the operater of all flights, all airports and the National Air Traffic Service.

## IV. AIR TRANSPORT DEVELOPMENT AND COMPETITION

This section examines the impact of the reform on the growth and development of China's airline industry. In particular, the following aspects of the industry will be discussed: air traffic growth and route development, market structure, and airline operation and competition.

### 4.1. Air traffic growth and route development

As indicated earlier, the Chinese airline industry was stagnant in its growth prior to the airline reform but has grown tremendously since the reform. Tables 2 and 3 further report data on, respectively, air traffic volume and number of routes over the 1950-94 period. Both the total tonne-kilometers and revenue passenger-kilometers performed in 1994 were about 20 times of those in 1978. The total number of routes in 1994 was more than four times the number in 1980 (4.0, 4.3 and 4.7 times for domestic, regional and international routes, respectively).

*** TABLE 2 ABOUT HERE ***

*** TABLE 3 ABOUT HERE ***

Table 4 shows this recent growth in the context of world aviation. In 1994 China ranked 8th (11th) in the world in terms of revenue passenger-kilometers (total tonne-kilometers) performed, compared with its 33th (35th) place in 1980. In 1994 China's domestic passenger-kilometers ranked 4th, behind the U.S., Russia, and Japan. Its annual growth rate during the 1980-94 period averaged around 21% for both domestic and international traffic. This rate was 4.3 times the world average.

*** TABLE 4 ABOUT HERE ***

### 4.2. Market structure and route concentration

*** TABLE 8 ABOUT HERE ***

### 4.3. Airline operation and competition

## VI. CONCLUDING REMARKS

The (former) centrally planned economies share at least one common feature with the market economies: the transport sector is one of the largest sectors of respective economy. It is no small challenge to understand the functioning of this vital economic sector in the transition process. In this paper I have described the dramatic airline expansion in China. This expansion is made possible, not only by China's general economic growth creating new levels of affluence and business traval, but also by its enterprise and regulatory reform focusing on economic incentives, corporate governence and market competition. In more recent years, however, traffic growth is probably more than matched by capacity, and rationalization of the industry has the potential to further improve efficiency while at the same time maintaining competition.

Based on the Chinese experience in airline reform, two lessons may be drawn for general enterprise and industry reforms. First, major carriers' attitude towards entry and competition is essential for the success of reform. This point is related to the role of economic/output expansion in the initial stage of industrial reforms. From the above discussions, we have seen that allowing (almost) free entry in air transport has had little adverse effect on state-owned companies. This is because there is enough business for everyone. Political pressure to restrict entry has consequently been limited and has been outweighted by the objective of creating competitive markets. This would then build the momentum for furthering the shift to unlimited competition and making it irreversible. As capacity becomes more adequate, however, coordinated efforts may be needed to limit the entry of inefficient carriers or to allow them to be merged with other carriers. Second, to deepen the SOE reform we need to examine the transitional industrial policies such as merger/competition policy in the presence of various imperfect markets (e.g., imperfect financial market). This approach will help re-focus our attention of enterprise reform from the enterprise *per se* to the surrounding industrial and market environment.

China, with a population more than double that of the U.S. and Western European combined, will undoubtedly play a more important role in world aviation in the future. The traffic growth rate for China will depend upon its rate of economic growth and, in turn, on its political evolution. The regulatory regime will continue to change to reflect these trends. These trends, and the aviation system arising from them, will contribute to bringing China and other nations closer together.

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## China's Air Transportation Industry

❸ The change of China's air transportation from middle of 80's to the end of 90's
such as regulations, degree of control, change of number and scale of airlines(sentralization degree),

❸One paper could be organized to make a positive analysis that **if the development of China's air transportation industry matches with the theory of industrial organization**, that is, the pattern of 'structure-conduct-performance'.
--market structure change. degree of centralization change from unique one to six airlines, then to 41( including 28 carry both passengers and cargo); and rise a tendency of merging now. entry barrier: Building of new airlines has been barried since the end of 1994. The change of demand
-- firms' conduct: profit-seeking? signal? profit ratio? cost?
-- market performance: service quality
In the study, we check that what is the characteristics fit with the theory and what is not. pay close attention to effect of govenment's policy and economic reform.
This is a **positive research**.

❸ One paper could be organized to make a **comparative study**.Through compared to that of foreign contries, we can find the disadvantages of China's airlines as well as the operating mechanism of the industry. We can slao find optimal policy and scale, etc.

## The Reform and Performance of Air Transportation Industry of China

framework of the paper
I. Introduction (1949-80)
background of China's economy, history of China's air transportation(1949-80)
II. Change of Government's Regulation (1980-87)
1. In 1987-92, the reform of seperating operating units, such as airlines, airports and fuel oil suppliers from administration bereau (CAAC) begin.
2.
III. Market Structure and Performance (1987-92)
three stages: first is to separate CAAC into six airlines, depart airlines,airports and fuel oil suppliers from administrators. market concentration decreases and a competition mechanism begin to be built. The number of airlines increases rapidly, the scale of economy is far from reaching.
second is to raise the barrier of entry, competition of existing airlines; expansion of airlines, aircraft, routes, service quality(phone call booking with free charge), etc.
third is to face the situation of supply over demand. load factor decreases, price as well as profit of airlines decreases; government make a restriction for price reduction and encourage the merger of airlines.
substitution of other transportation
IV. Airlines' Behaviors (1992-97)
V. Change of Environment

# An Analysis of the Development and Targets of China Civil Aviation Industry

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## 1. INTRODUCTION

This paper discusses the development of China's civil aviation industry and its targets in the future. As we have known, although hit by both the Asian financial crisis and the severe summer floods, Chinese economy still obtained a growth rate of 7.8% in 1998, and the tax collected accordingly achieved an increase of RMB 100 billion yuan, which laid a good foundation for improving the economic operation environment in 1999.However, when both the railway and the post & telecommunication industry speeded up their construction, and the development of China's civil aviation industry appeared weak. Even though in 1998 the transportation volumes of the whole industry were completed fairly, the state owned airlines fell into great loss with negative growth in the passenger volume, which broke the record of keeping profit for 23 years, and furthermore, with the benefit index of passenger seat rate, loading factor, and revenue rate per kilometre passenger decreased continuously while the operative cost increased greatly, the situation would be rather more serious. What had happened to China's civil aviation in recent years? In order to answer the question clearly, this paper firstly gives a look backward of the history of the reform for the industry since 1978 in brief. In no doubt, the reform and open policy over the last twenties years has equipped the civil airlines industry of China with the wings to soar high.Then, this paper outlines the main achievements gotten in recent years by the industry. The dramatic growth of the civil aviation industry of China can be attributed to China's general economic growth now.In the next section of the paper, our second objective in this paper is to analyze the major problems in the development of the industry which are most of reasons for the great losses in the airlines industry.Section 4 addresses the 5 targets for the industry in the next 5 years (that is, the 10th Five-Year Plan of China). In other ward, these are the ways to draw the civil aviation industry of China out of the disadvantage situation at present.
Final section contains several concluding remarks.

## 2. THE DEVELOPMENT OF CCAI

### 2.1. The History of CCAI Reform

Prior to 1978, China Civil Aviation Industry (hereafter, abbr. as "CCAI") was a semi-military organization with the Civil Aviation Administration of China (CAAC) as a department of air force for most of the years. During the period CCAI had suffered unsatisfactorily persistent financial losses, whose survival depended mainly on the central government's subsidy to the industry. In 1979, the State Council held the Civil Aviation Reform Conference and made a decision to separate the CCAI from the Air Force. The central government made a policy that CCAI must be on the way for an enterprise in the market economy, which pushed the civil aviation reform ahead effectively. The State Council approved "Report on Civil Aviation Reform Measures and Implementation" in February 1987. The comprehensive adjustment of agencies and enterprises was held in the CCAI in the large scale. More specifically, the following policy initiatives were included:(1) To separate the regulator from also being the operator of the CCAI;(2) To separate airport operation from airlines operation;(3) To encourage the other enterprises in the market entry;(4) To deregulate the airlines industry and promote competition in both domestic and international market. From then on, a new era was opened for the CCAI.

### 2.2. The Achievements of CCAI

Over the 20 years since the reform and opening-up in 1987, the CCAI obtained brilliant achievements and advanced with surprisingly giant strides at a speed three times higher than that of the Contracting States of ICAO consecutively for years. The annual average growth rate of China's air traffic performed approximately doubled that of the national economy, tripled that of the domestic transportation and four times that of the world air transport industry, and its ranking rose from the 37th place in 1978 in the world to the present 10th place.In 1978, CCAI performed a total traffic of 299 million tonne-kilometres, while the figure of 1997 was 8.67 billion tonne-kilometres. In 1978, CCAI carried 2,309,100 passengers, while the figure of 1997 was 56.3 million passengers. In 1978, the total length of air routes operated by CCAI was 148,900 kilometres, while in 1997 the figure reached 1,858,700 kilometres. In 1978, CCAI had 162 domestic and international air routes, while 1n 1997 the figure was 967, including 109 international air routes and 7 regional air routes serving 57 international cities. In 1978, CCAI had 81 airports in use, most of which were medium-sized and small airports. While in 1997 the number of airports officially serving scheduled airplanes reached 141, including 14 airports available for B747 and 90 airports available for B737.By the end of 1998, the CCAI performed a total traffic of 90.92 billion tonne-kilometres, representing an increase with the average annual growth rate of 18.76%, and passengers-kilometres 5.7million with 17.44%, cargo & mail 1.4 million tons with 16.70% in the past 20 years. These numbers performed in 1998 were about 31, 24 and 21 times of that in 1978 respectively. The average annual growth rate of the total traffic statistics of CCAI was over 20% during the period.The whole CCAI paid to the State a total amount of 4.09 billion yuan of taxes in 1998. Among the enterprises directly subordinate to CAAC, China Yunnan Airlines and Xinjiang Airlines made profits in the year, while Beijing Capital International Airport and Guangzhou Baiyun International Airport maintained fairly good profit level; most local airlines achieved relatively good benefits. In 1998 the units directly owned to CAAC accomplished 15.44 billion yuan and local authorities accomplished 8.2 billion yuan respectively in fixed assets investment, totaling 23.64 billion yuan, representing an increase of 6.5% over the figure of the previous year.

## 3. THE PROBLEMES OF CCAI

### 3.1. To Operate Too Extensively and Neglect the Adaptation of the Industrial Structure.

Such high growth rates performed in the past depended on the extensive expansion measures, such as to put more freight capacity, to construct high standard airports and corresponding facilities. The economic profits of the airlines industry depended on the regulation of the ticket price. It's necessary that the air services was enlarged through the extensive expansion when the air transport market was a seller's one. The CCAI, however, was confronted against the substituting competition of the train and high way, and the air transport market changed from seller's one to buyer's. Under the situation the conflict of industrial structure of CCAI became serious and significant, which was the result of the extensive operation of the airlines. The problem reflected as follow:(1) That in the air services the passengers' services is emphasized more than the cargoes' one caused not to fill the loss of the passengers' one which was not satisfied. This was the main reason for the dramatic losses in the CCAI in recent years.(2) The general aviation of China has been stagnant since 1980, which has been out of the attention of CAAC policy for the near twenty years.(3) The route structure was mainly the trunk intercity. The feeder line aviation was too weak to supply the abundant passengers to the trunk route.(4) There was the tendency that the extra large and international airport had been constructed in most of provinces, this was updated too much. The reasonable supplication of large, media and small airports hadn't been established already. Though one or more large and international airports are necessary for some metropolises opening aboard, but the kind of airport was generally constructed in most of the media and small cities, this reflected that considerations were not taken into in economic way.

3.2. To Allow Too free Entry and Be Lack of the Competition Capacity with the Small Scale

At the present time, there are 53 airlines with their own legal entities in China, including 34 ones providing fixed air services and 19 ones doing general aviation. These airlines have 485 airplanes that equal to the number of America Northwest Airlines' airplanes, and are half of America Airlines' flight (990). The six airlines, that is, Air China, China Eastern, China Southern, China Southwest, China Northwest and China Northern, have more aircraft, which was convenient in adapting the team of aircraft and time and route. However, Great Wall Airlines, Mail & Cargo Airway and Shanxi Airlines have just three aircraft respectively. At the same time, Chang'an Airlines, Guizhou Airlines, Allied Airline and Shenzhen Airlines just own 5-6 aircraft respectively. This caused the no-scale economy in the past. As a result, the operative cost of most of them was very high at all time, they were too weak to compete with the foreign airlines in the international air transport market. The lack of the capacity of the international competition was reflected from the fact that the revenue of the international routes had been falling down from 1994.

3.3. The All-Round Interference with the Airline's Operation Hindered the Reasonable Competition in the Air Transport Market.

CAAC has operated the civil aviation as the one enterprise for many years. It was very important for the foundation of the competition market and the improvement of the economic performance that the CAAC policy departed the government from the airlines' operation and authorized the formation of the local airlines owned to the local government after 1987. The major decision rights of the trunk airlines owned to CAAC in investment (especially in flight purchasing and labor management) were controlled by CAAC. The trunk airlines couldn't take part in the market competition as an independent legal entity. Because of the consolidation of pricing and the restriction of route entry the airlines were limited to compete in providing flight, improving service and perfecting market. The role of price competition was neglected which was the important weapon for market competition.Being lack of competition, most of airlines had the lower level of management. They yet didn't in general set up the measures of cost and yield management, and the category and technique of marketing in the condition of marketing economy, which were more and more important for their competition. Although CAAC deregulated the price of air service through the policy of "one price, various discount" since the end of 1997, the airlines' competition evolved into the "throat cut" one in price because there was no variance between the air services, and the seller's agent was out of control. In effect, this sustained to the dramatic decline of economic performance of the whole civil aviation. In order to convert and stop the decline tendency, CAAC decided to recover the price decision right to the government upward from May 1998, and enhanced the pricing management of air transport market.

3.4. The Relationship between CAAC and Air Force was not Sorted out in the Area of the Air Traffic Control.

At the present time, China air traffic control system is regulated in unity, while operated respectively by CAAC and Air Force. Thus, under the unified leadership of the air traffic control committee of the State Council and the Military Commission of the Central Committee of the Chinese Communist Party, the national flight is regulated by the air force in the whole. Under the condition, the military aviation is regulated by the air force, however, the civil one by CAAC. The whole controlled airspace is divided into two parts that belong to them respectively. With the rapid development of CCAI, the problems of the above air traffic control system become evident as follow:(1) The airspace is not utilized at its best yet because its designation was not consolidated and reasonable;(2) The same airspace is regulated by one or more parties so that in the event of emergence which needs to change the state of flight, the request sometimes couldn't be replied by them in time. This situation causes easily to accidents;(3) The air infrastructure construction was not unified and very outdated, the skills for managing the air traffic control was very backward. This situation had more or less affected the convenience and efficiency of the air traffic control. Although the route of Beijing-Guangzhou-Shenzhen was transferred to regulate completely by CAAC from the air force, this was just a start-point for Chinese civil aviation. The air traffic control system had erected a serious barrier when airlines wanted to found its route network, especially "hub-and-spoke" one. These disadvantages had already limited the development of the airlines industry of China and the maximum of utilization of the national airspace sources. Something must be done to change the disadvantage situation as soon as possible.

3.5. The Monopoly of Supply of Fuel and Equipment Was Harmful to Minimize Airlines' Cost.

The cost of fuel is the biggest item for international airlines at the present time, which is half of operative cost, and one third of the total cost. For China, the cost of fuel shares two third operative costs, one fifth to one forth of the total operative cost. China Aviation Oil Supply Corporation monopolies to supply airlines the fuel exclusively. Its fuel price is higher half to one time that of foreign market. This is one of the most important reasons why our airlines have been having a high cost and losing competitive advantages. For example, in Singapore market, the fuel price has been sustaining $185 or so per ton, whilst in China market RMB 2,800 Yuan (about $ 337) per ton. The fuel price in China is near twice (1.82 times) that of the former.China Air Flight Equipment General Company has owned to the CAAC, who purchases aircraft abroad on behalf of all of the airlines of China with authority. It in effect plays a role of intermediate agency with exclusion. Because airlines cannot purchase directly aircraft from the manufacture factory without intermediary services, they therefore lose dramatic benefits.

The above discussions show that the supply system of fuel and equipment should be reformed as soon as possible. One of the more important reform measures of China civil aviation managing system is to destroy the monopolies of the above two companies in the market, and drive competitiveness into the fuel and equipment market.

### 3.6. The Economic Efficiency of CCAI Is Relatively Low.

The stagnation of economic efficiency of CCAI is mainly reflected by the serious decline in profits. The trunk airlines owned to the CAAC made the profits RMB 18.4 billion Yuan in 1996, while up to 20.5 billion Yuan in 1997. But airlines incurred dramatic losses rapidly in 1998 because of the impact of Asia financial crisis and airlines' price competition. There are at least three other reasons for the decline in profits. First, the main cause for the decline is the dramatic increase in the supply of aircraft since 1993. The sudden increase of capacity immediately lowers load factors and aircraft utilization rates in 1993 and 1994. Therefore, it is the first time for CCAI to confront against the relative surplus of capacity. On the contrary, the cost of airlines rapidly increases. Second, the supervising system of cost is too weak, and airlines in general operate extensively. Third, the debt factor of the airlines is too high, and financial cost increase quickly. In principal, the losses mainly attribute to the decline of industrial competitiveness of aviation. The China airlines are not responsive to the change of competitive situation of market in time.

## 4. THE TARGETS FOR CCAI

### 4.1. The Growth of CCAI Should Response to the National Economic Growth.

From the sixth plan for 5 years, the central government announced clearly that the strong subsidiary and support were to be paid to the transport industry by the national finance as a strategic point for the construction of national economy. As a prior department in transport industry, at the end of the 8th Five - Year plan, CCAI sustained to grow by the rate three times that of transport industry. The 9th Five - Year plan declared that importance was still laid on the industry, and that the industry was to be made a significant progress during the period of 1996-2010 to satisfy primarily with the development of national economy in 2010. This suggested that the total transport, passengers and cargo and mail should doubled before year 2000, up to 14.0 billion ton-kilometers, 0.1 billion passengers and 2 million tons by the annual average growth rate 15% or so, and that after year 2000 CCAI should sustain the rate of 10%. This rate in principal satisfied with the request for CCAI by the national economy. In fact, the practical situation was not so satisfactory as the plan' schedule in the total air transport traffic which was under the line made in 9th Five - Year plan.

Table 1: Growth Ratio of Air Transport from 1996 to 1998

| Items | | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| Investment | Total (billion yuan) | 9.92 | 18.23 | 23.64 |
| | increase (%) | 57 | 20 | 6.5 |
| Air transport traffic | Total(billion ton-kilometers) | 8.05 | 8.67 | 9.22 |
| | Total (%) | 12.7 | 7.5 | 6.3 |

| | | | | |
|---|---|---|---|---|
| Passengers carried | Total (million) | 55.51 | 56.30 | 57.15 |
| | Increase (%) | 8.5 | 1.3 | 1.5 |
| Cargo & mail carried | Total (million ton) | 1.14 | 1.247 | 1.392 |
| | Increase (%) | 13.1 | 3.4 | 11.6 |

Sources: the annual report of CAAC in 1998

From the above index, we can find that there is a decline in the development of the airlines industry. The decline, however, doesn't show that the CCAI has completely satisfied with the development request of the national economy, and that national subsidiary and support will not necessary for the industry in the future. Why did the 9th five years plan not realize successfully at all? Except for the outside background and the interior system, this is in some degree relative to the inefficient policy in practice. There are a big gap between the CCAI and the request of the national economic growth. In the future, some reforms should be made to adjust the managing system, carry out the preferential policy, and regulate the economic structure of civil aviation. The scale of the CCAI must be enlarged through developing new economic growth points to satisfy with the request of national economy. The CCAI should take an important position in the modern system of transport.

4.2. To Exert to Develop Air Cargo Transport and General Aviation

The development of air cargo transport and the express service is to be regarded as the new traffic growth point. Something should be done to accelerate the development of the air cargo transport and the express service. The development, as a new economic growth point, can overcome the problems, in some degrees, which have brought by the lower load factor of airlines and the serious waste of capacity. At the same time, this is the major content for CCAI in adjusting the structure of air transport service. With the development of economy, the air cargo transport is more and more important for the social request. It is proved clearly by the fact that in recent three years the growth rate of the air cargo transport is higher than that of the total air traffic and passengers volume. In the air cargo transport and the express business, the growth needed to kept through the expansion of the freights, routes and the airplanes, the completion of the air cargo infrastructure, perfection of the cargo agency network as well as the interline with the ground transport. General aviation, as an important part of CCAI, is now faced by bad economic benefits and flight safety situation, disorder of the market competition, deterioration of the guaranteeing environment, as well as the imperfection of the infrastructure. Since 1980, the general aviation had been stagnant, which did not fit to the high growth of national economy. Gradually, with the development of both the national economy and the society, it is becoming the hot point to promote general aviation.The main part of the general aviation operators needs to be constructed to adapt to the demand of the market economy. First of all, according to "the Law of Enterprise" and the principle of separating general aviation from air transport business, the major airlines, the investor or the owner, should set up the new airlines with independent operation and business accounting to operate general aviation conformable to the demands of the market economy, such as running limited cooperation with the local enterprises or institutes, and setting up joint ventures with the foreign enterprises.Secondly, multiple general aviation enterprises are encouraged to be sponsored, in another word, both the nation-owned and the private enterprises and the foreign business are encouraged to operate the general aviation. Lastly, the charging system of general aviation must be reformed to regularize the flight and the airport fee standard. To return the right of pricing to general aviation enterprises has the priority in the charging reform. The enterprises should determine their own price according to the situation of market demand and provision. The airport fee standard should be regularized, and the illegal charge is prohibited.

### 4.3. To Accelerate the Development of China's Feeder Air Transport and Form the "Hub-and-Spoke" System.

To develop the regional air transport is necessary for the whole industry's development. Firstly, feeder air transport is crucial for the construction of the complete nation's air transport network. For example, in the developed countries, air transport id operated in the network comprised of the main, regional and international air routes. Secondly, regional air transport is significant to the economic development. With the improvement of the national economy, air transport plays a more and more important role in both the nation's and the regional economy development for its characteristics of high speed and long distance.As a result, the local governments are active in operating air transport especially for the poor areas with the abundant tourism resource and raw materials. However, they are hampered by the airport construction which need large amount of investment, compared with which, regional air transport is more flexible with low demand on the airport degree to assist the local economic construction. Thirdly, regional air transport is important to enlarge the market percentages to increase the economic benefits. The regional air transport is efficient for air transport to obtain the market below 1,000 square kilometers especially in the range of 500-700 square kilometers.

The policies to support regional air transport needed at present must be made in time. Measures need to be taken in the air routes management, ticket price and boarding program, which had restrained China's regional air transport.

Firstly, in the air routes management, airlines should be encouraged to operate the regional air transport on one hand, blind competition must be prevented on the other hand. For a certain airlines operating regional air transport, a fixed range is necessary and the principal of entering these air routes is to guarantee the interest of the airlines based in this area especially for high efficient air routes, and complicated consideration is needed in the market demand situation, the cost reception and the airlines benefits, etc.

Secondly, in ticket price, as the competitors of the regional airlines are not from the air transport industry, but the other transport measure such as railway and highway, a price standard with high competitiveness is necessary. The airlines must strengthen the interior management and cur cost, and the government should offer some support in the other hand, for example, decrease the tariff of import, airport fee, air route fee, etc.

Thirdly, in boarding program, it is necessary for the airlines to carry ort strict security examination and check-in progress. For example, setting up a path exclusive for the regional passenger from the main passenger to simplify the boarding program, or using small aircraft to increase the airplanes to make the regional air transport become the authentic "bus in the air" so that to attract more passengers.

4.4. To keep the full competition between airlines

Compared with foreign air transport industry, China's airlines have the general competition between them, but not full, especially lack of the way of competition on the basis of the price one. Under the protection of CAAC and/or the local government, China's air carriers often exempt `from the bankrupt. As a result, the situation would lower the efficiency in arranging the airspace source and decrease the potential social welfare. It's possible for CCAI that the airlines' competition would cause to the blinded price competition, therefore, make many airlines into bankrupt at all on one hand. However, the competition would bring the society the better carriers, the better services and the preferential price on the other hand. Furthermore, the airspace sources would be utilized at most through their competition.In particular, the price decision right was performed arbitrarily by CAAC. This situation should be changed. The airlines should get the decision right in order to determine the price according to the passenger type, the season and festival. On the basis of price competition, the carriers are encouraged to get the advantage position in competition through the measures improving the quality of their services, creating the famous mark, etc.It is irreallistic for CAAC to determine the reasonable price of thousands of air routes for every airline. It may be appropriate for the administration to transform the direct fare regulation to the market surveillance, and let airlines make their own price according to the situation of supply and demand and its market strategy.

To keep the competition is crucial to the healthy development of China's civil aviation industry. Under the market economy, airlines, big or small, local or government owned, ought to prove its right to stand in the market. The operators should be courageous and patient enough to face the result of the competition, which is hard to be attained through the executive measures.

4.5. To Operate in the large scale and enhance the capacity of competition with the foreign carriers

Because of the free entry policy in some period, China's carriers in general were too small in the scale, therefore, too weak in the international market competition. In addition, they had the higher equity-debt ratio. As a result, the operating cost couldn't often cut down successfully. This is one of the main barriers for CCAI to transfer from the extensive operation into the intensive one at present. Under these conditions, it is necessary for CCAI that the structure of the exiting assets should be improved and rearranged to the optimized compose through interline and merging between airlines. The new policy of consolidation was made to encouraging takeovers and mergers by CAAC recently. Target for CCAI at present is to realize the formation of several corporate groups and the scale effect in economy.

## 5. CONCLUDING REMARKS

As people knows that the planned economy has left deeper impression on Chinese civil aviation industry. For a long time, both the commercialization and the later reformation of China's civil aviation were not completely resulted in the unsettlement of the enterprises' market subject status, the lack of the market mind and the weak competitiveness. However, all the problems were shadowed by the rapid growth of the air traffic and the insufficient supply in air transport market. So that the whole industry turned ignorant at the buyer's market and the competition brought by other transport measures and the foreign air carriers. It must be proposed that civil aviation industry should be based on enhancing the economic benefits, targeted by benefit maximization.In short, the difficulty that CCAI encountered was not caused by the shrinkage of air transport market demands, but the lack of competitiveness. If CCAI transform its operative ideas, carefully study the market and endeavor to adapt to the market, CCAI will definitely step out of the predicament and realize the circulation of continuing, rapid and healthy development.

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**Direct Flights Across Taiwan Strait and Their Impacts on Eastern Asian Air Transportation Market**

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In the past decades, Hong Kong has been successfully playing a role as a gateway to China. It is also the most important hub between Taiwan and China since 1988. According to the statistics, over 5 million passengers were travelling on the link between Taipei and Hong Kong in 1997. Such a big volume has made this link the busiest one in the world's international air links, and contributed 1/6 of the passengers in the airport of Hong Kong, which was the most crowded one with most international passengers in Asia before 1997. But in the foreseeable future, Taiwan will possibly start some direct services to China; the air link between Hong Kong and Taipei will then compete with many links across Taiwan Strait. These changes may cause the transformation of the market and network structure in eastern Asia. Niches of specific airlines and airports will disappear. This paper examines the issues of possible changes in eastern Asian air transportation market. The current market environment, the problems for direct flights across Taiwan Strait, the future role of Hong Kong, and the market structure in the future will all be discussed.

## 1. Introduction

According to the statistics, the link between Taipei and Hong Kong has been the busiest international route in the world since 1995 (International Civil Aviation Organization [ICAO] 1996). But back a decade ago, there were only 750 thousand people in this route in 1986 (Tourism Bureau 1987). Nowadays over 5.5 million people are travelling from Taipei to Hong Kong. Namely, the passenger volume has increased 7 times during the past, including some of the worst years in the world's aviation industries ever (Air Transport World 1993). The close relationship between Taipei and Hong Kong should be one of the reasons of such a big movement, so could the rapid growth of the economics in eastern Asian areas during the years. But it is widely believed that the deregulation of travelling between Taiwan and China was the most important factor.

Soon after the civil war in China, the declaration of martial law by Taiwanese government has prohibited any forms of direct or indirect travels to China since 1949. For almost 40 years, lots of Chinese in Taiwan were not allowed to visit their relatives and friends in China; in the other hand, PRC government did not welcome Taiwanese before the 'Open Door' policy made in 1979, either. The martial law in Taiwan was finally lifted in 1987, and some indirect travel from Taiwan to China was then allowed with at least one stop over. Because of the close relationships and geographical advantages to both sides, Hong Kong is the most frequently used transit hub

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for people travelling between Taiwan and China. In 1997, the huge volume of cross-Strait passengers has contributed more than 1/6 of the 28.3 million passengers to the airport of Hong Kong, which is the largest one of international traffic in Asia, and made the link between Taipei and Hong Kong the busiest one in the world.

Not only Hong Kong, some other major hubs in eastern Asia are also providing connection flights for the passengers across Taiwan Strait. Macau is the biggest competitor of Hong Kong. With her outstanding location, lower fares, and much less crowded terminal, Macau has attracted lots of transit passengers from Taiwan. If the airport in Macau had not been built in 1995, the link between Taipei and Hong Kong would have been much busier. In addition, foreign carriers are also providing some other links for Taiwanese to get into China. Because of the less service frequencies and inconvenient schedules which are not designed for cross-Taiwan Strait travellers especially, these foreign hubs are not that important as Hong Kong or Macau.

Although the current network in Asia can satisfy the visitors across Taiwan Strait, yet the indirect flight may cause several problems to both sides. Politically, the sovereignty of Hong Kong has already returned to China after July 1st 1997. It has lost a third party status by view of either side of Taiwan and China. Physically, it is highly inconvenient to stop over Hong Kong, especially for those senior citizens from Taiwan. Economically, it creates an unnecessary cost for travellers. After some peace talks between Taiwan and China in recent years, the direct services has seemed to be an inevitable policy in the coming 21st century. That is to say, at least 5 million passengers in eastern Asia will find their new ways to fly in a restructured network. Other travellers from America and Europe will also find some new, probably more efficient routes to visit China. This change will certainly be the biggest variable to the air transportation market in Asia and Pacific region. Apparently, a much more competitive market of air passengers in this area is now emerging.

## 2. The Current Market Environment

Since there is no other alternatives for travelling, the actual scale of the air transportation market between Taiwan and Hong Kong can be evaluated by the passenger volume on the link. Through the statistics listed in table 1, we can find that the traffic on this link is growing with the number of Taiwanese visitors to China. Apparently, these two numbers are moving towards the same direction. The deregulation of travelling in 1988 has almost doubled the passenger on the Taiwan-Hong Kong link just in the first year. In addition, we can find that the passengers from Taiwan to Hong Kong are not only by-pass passengers. Most of the transit passengers have also visited Hong Kong on the way to China or on the way back to Taiwan. For the past 10 years, Taiwanese visitors have always been top ranked on the list of arrivals in Hong Kong, and they have also been very generous to the tour industry of Hong Kong.

Table 1: persons travelled between Taiwan and China since 1986*

| Persons (thousands) \ Year | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chinese visited Taiwan | 0 | 0 | 0.38 | 4.85 | 7.52 | 11.11 | 13.18 | 18.05 | 23.65 | 42.30 | 56.52 | 73.54 |
| Taiwanese visited China | 0 | 0 | 438 | 541 | 948 | 947 | 1318 | 1527 | 1390 | 1532 | 1734 | 2117 |
| Taiwanese visited Hong Kong | 220 | 354 | 1094 | 1133 | 1345 | 1298 | 1640 | 1777 | 1665 | 1761 | 1821 | 1782 |
| Taiwanese on Taiwan-Hong Kong links | 121 | 196 | 622 | 811 | 1246 | 1368 | 1747 | 1935 | 1745 | 1910 | 2135 | 1987 |
| Passenger Volume on Taiwan-Hong Kong links | 375 | 428 | 845 | 1019 | 1437 | 1549 | 1940 | 2146 | 1984 | 2154 | 2788 | 2777 |

* All listed data are one-way traffic only. Round-trip traffic should be doubled.

Source: Tourism Bureau (1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997)

Currently flights between Taipei and Hong Kong are operated by 9 carriers together, including China airlines (CI) of Taiwan and Cathay Pacific (CX) of Hong Kong. Some other foreign airlines listed in table 2 from specific countries with fifth freedom have also provided such services. With free endorsement and frequent services, this market is mostly shared by CI and CX. The privileges have created amazing profits for both of the two airlines. CI and CX are now carrying over 84% of the total passengers, and the revenue is estimated 600 million US dollars or more. Before 1996, links between Taiwan and Hong Kong have contributed a quarter of the total revenue to China Airlines, while the Taipei-Hong Kong link has contributed 15%~20% of the revenue for Cathay Pacific (Ionides 1996). An estimated 10%~15% of the revenue was still earned by these so-called 'golden links' for both airlines in 1997[2]. Other carriers are competing with lower fares, but much less frequencies. During 1996 to 1997, carriers in Taiwan, Hong Kong, Macau and China have signed lots of cooperative contracts to provide low-fare alliance products as competing tools in this market. Intentionally designed timetables for transit-only passengers are also popular within these competing airlines.

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[2] China Airlines has reported 58.33 billion NT dollars revenue in 1997. The estimated revenue on Hong Kong links was around 10 billion, which accounted for 17.14% of the total revenue. In the same year, Cathay Pacific has announced a 30.65 billion H.K dollars turnover, the revenue on Taipei-Hong Kong link should be as high as 3 billion that is 10% of the total revenue if calculated with her market fare and passengers carried.

Table 2: Airlines Served on the links between Taiwan and Hong Kong

| Year end 1997 | China Airlines | Eva airways | Cathy Pacific | Dragonair | Other Carriers includes Singapore Airline, Thai Airways Japan Asia Airline, British Airways Garuda Indonesia |
|---|---|---|---|---|---|
| Service Routes | TPE-HKG<br>KHH-HKG | TPE-HKG | TPE-HKG | KHH-HKG | TPE-HKG |
| Weekly Flights Each Direction | 80<br>25 | 10 | 88 | 21 | 27 |
| Market Share | 38.13% | 1.67% | 46.11% | 3.38% | 10.71% |

Source: Civil Aviation Administration [CAA] (1997)

### 3. Problems for Direct and Indirect Flights Across Taiwan Strait

It is quite clear that the success of Taipei-Hong Kong link is based on the disconnection between Taiwan and China, but the separation itself has created another dangerous but interesting fact: the hijack incidents. In the past 6 years, there were totally 14 hijack incidents between Taiwan and China. 12 of the 14 incidents occurred in the peak year during April 1993 to June 1994. Because direct flights across Taiwan Strait is still a political taboo to both sides, such kind of 'direct flight' is then a certain kind of revenge to either side of Taiwan or China. The purposes of all the hijackers in these hijack incidents have nothing to do with terrorism, but solely embarrassing their organizations and governments, even friends and lovers, and then asking political refuge from the government in other side through these dangerous activities. Since there was no other claims for the hijackers, all the cases were quickly solved within hours. The much stronger restrictions for Chinese to visit Taiwan and the much better political effects have made most of the hijack incidents initiated in China by PRC's citizens.

There are still other problems for indirect services. In the early days of deregulation of travelling, most of the travellers were senior citizens from Taiwan to visit their real old friends and relatives in China. These people were not familiar with the complex procedures of air travelling. The transfer facilities in Kai Tak airport were also not that good as they are now in Chek Lap Kok of Hong Kong. So in the beginning of 1990s, it was very easy to find lots of Taiwanese who missed their connecting flights slept in the corners around the airport of Hong Kong. Since then, direct linkage has always been expected to be a total solution for all these chaos. Unfortunately, there are also some technical problems for both sides. Although the PRC government has promote their direct-link policy towards Taiwan for over 20 years since its first announcement in 1979, a guiding principle was not yet made until 1991. Even though, this principle was still unacceptable by Taiwan because the legitimacy of all the aircraft and flight attendants' licenses issued in Taiwan can not be admitted in China for their political beliefs.

Moreover, Taiwan has also made some restrictions for direct flights into China. In Taiwanese government's point of view, direct flight is nothing more than a political trap set by China. So basically, the government in Taiwan has never taken positive attitude towards direct flights. Nowadays policy makers in Taiwan are trying to make this issue as a bargaining chip when negotiating with China. Different parties and interest groups with different claims have also added much complexity to this sensitive issue.

### 4. Progress Made in the Past Years

Although the difficulties for direct service across Taiwan Strait have not been removed, yet there are still some progress made in the past 5 years. First of all, some aircraft have already flown directly across Taiwan Strait. During the peak years of hijack incidents, Taiwan has asked all the captains of hijacked aircraft to stop over Hong Kong or Macau when flying back to China. Although not confirmed, it is believed that the nearest 2 to 3 cases of the 15 hijacked aircraft have flown directly across Taiwan Strait and back to China directly. Taiwan did not made any complaint on these cases for they think they have already asked the pilot to go back indirectly. So practically, direct flights seemed to be allowed under such circumstances.

The opening of Macau airport and Air Macau in 1995 was the milestone for direct flights. Air Macau has operated flights from Macau to both Taiwan and China, it can easily use a same aircraft to provide service from Taiwan to Macau, then to China. This convenience has created a niche for Air Macau to compete with Hong Kong. With less congestion in the airport and better-arranged schedule, Air Macau has shortened its minimum transfer time to 50 minutes. The same aircraft service is even more attractive to the transit passengers. With changing flight numbers, passengers can just take the same aircraft from Taiwan to their destinations in China. Although not a purely non-stop direct flight, this indirect service can actually be viewed as a format of one stop direct flight. Soon after Air Macau's successful policy testing, another regional airline that has both links from Hong Kong to Taiwan and China, the Dragonair, also started its same aircraft operation. This is a big step of the direct service policy.

Moreover, Air Macau is a joint venture of China and Macau. With over 51% shares owned by China, Air Macau is by all means a Chinese airline registered in Macau. This is also the first Chinese airline that can fly into Taiwan's territory, except those hijacks. Soon after Air Macau had started operation, Cathay Pacific transferred her shares of Dragonair to the same Chinese group which holds the major shares of Air Macau. Thanks to the experience of Air Macau, Dragonair is still operating her services to both Taiwan and China. It means that a Chinese airline, at least a Chinese owned airline based in an autonomic zone, is freely to travel between Taiwan and China.

The most interesting fact is that the Macau airport which was newly built in 1995 is located in Guangzhou Flight Information Region (FIR) of China. Aircraft land or take-off in Macau will fly over Guangzhou FIR of China, and guided by or receiving flight information from this FIR. It is certainly a format of first freedom. Currently there are 2 Taiwanese airlines served in the links between Taiwan and Macau; both of them are enjoying the services of Guangzhou FIR, but there is not any single agreement between Taiwan and China. This is certainly a big movement.

Researchers have also contributed themselves in exploring the pros and cons around direct services through their researches. Lots of important issues are already under discussions now. The conflicts of laws of air transport, the regulations of the quasi-international flights, the future network structure, and the roles of Taiwan, Hong Kong and China played in direct service market have all been analysed academically and practically. These researches are of much help for solving the technical problems of direct services.

Finally, the direct sailing across Taiwan Strait is also encouraging the direct flights. The so-called 'offshore trans-shipment centre' which allowed ships of foreign countries and Flag of Convenience (F.O.C), the ship belong to Taiwan or China but registered in a third country, to sail directly across Taiwan Strait, has started operation at Kaohsiung in 1996. Before its operation, all the ships were also asked for one stop over in Hong Kong or other ports in a third place. Since ships and containers can now sail directly, it should not be too difficult for aircraft and passengers to fly directly in the future.

## 5. The Future Role of Hong Kong

As a major hub in eastern Asia, the future role of Hong Kong in air transportation industry is highly concerned by different parties. Many of them are predicting a considerable loss of traffic when the direct links between Taiwan and China are connected (International Air Transport Association [IATA] 1997; Wong 1997; Mackey 1997, 1998). This is just what we can expect in the future. Through the analysis of possible connection(Shon, Chen, and Wong 1997), we can find that the first 4 prior connections have linked to the demand nodes that account for 1/3 of the total travel demand. That is to say, at least 1/3 of the cross-Strait passengers on the link between Taiwan and Hong Kong will mostly switch to direct services, unless these passengers are also intending to visit Hong Kong. Moreover, connected airports can also providing services to other demand nodes with much more frequencies and much lower fares via domestic links in China. These potential competitions would change the behaviour of travellers to other destinations, too. Even if the service frequencies of future Taiwan-Hong Kong links can stay at the same level that is not likely to happen, a simple market share indicator which uses only service frequencies in table 5 has also suggested a 33.3% loss of the current Taiwan-Hong Kong market. The much lower domestic fare will probably attract even more traffic on these links.

Table 3: Estimated Demand Shift From Hong Kong to Direct Links

| Direct service nodes | Xiamen | Shanghai | Beijing | Guanzhou | Fuzhou |
|---|---|---|---|---|---|
| Estimated Round Trip Published Fares Reduction from Direct Service: USD | 334.21 | 333.56 | 369.47 | 33.34 | 441.32 |
| Weekly transfer service frequencies to 10 major demand nodes (Hong Kong: 50 ; Macau: 14) | 97 | 196 | 317 | 248 | 112 |
| Estimated demand shift from Hong Kong* | 4.32% | 6.74% | 8.70% | 9.59% | 3.84% |

IATA's forecasting are arguing that the loss of Taiwanese travellers in Hong Kong will be 'largely offset by the emergence of the large Chinese outgoing travel market which is still in its infancy.'(IATA 1997) But other possibilities could be very negative to the outbound traffic from China. First of all, the PRC government is trying very hard to extend her global flying network, major airlines in China are also starting alliance partnership with foreign airlines. It's very possible for Chinese travellers to travel abroad from their own residing cities in a very near future. Secondly, the links between Taiwan and China can also provide services for Chinese travellers to the destinations around the world. If direct links finally get connected, a great number of cross-Pacific Chinese passengers who currently transfer in Tokyo and Hong Kong may switch to Taipei because of the attractive fares and frequencies provided there.

The success of Macau has also proved that the hub position of Hong Kong is substitutable. Thanks to the better arrangement of the same aircraft operation and considerate flight schedule, more and more Taiwanese are now using Macau as a gateway to China. The passenger volume between Taiwan and Macau has grown 5.45 times in the past 20 months. In 1997, Taiwan-Macau link has served over one million passengers. Currently there are 16 scheduled links from Macau to China, less than 21 links provided by Hong Kong. But Macau has already served most of the cities with heavy travel demands across Taiwan Strait. The cities connected and frequencies provided by both Hong Kong and Macau are listed in table 6. With lower fares and expending network, Macau has become a very strong competitor in this market. The changes of load factor and passenger volume of Taiwan-Macau link since 1996 is presented in figure 2. Although unstable, the trend of growing passenger volume is obvious.

A sudden strong growth in traffic volume of Taiwan-Macau link can be easily found after July 1998. The fast growing passengers were mostly shifted from Hong Kong because of the chaos of the new Chek Lap Kok airport starting operation. More or less, it has shown that hubs can be easily

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* This percentage was calculated by a/b, where

a = the possible passenger volume shifted from Hong Kong = travellers to the node + travellers to other major nodes transferred in the node (transfer service frequency in the node / transfer service frequency in all nodes * transfer demand)

b= total traffic volume between Taiwan and Hong Kong substituted if they are not doing well, or if they have lost their comparative advantages.

Table 4: Current Links From Hong Kong and Macau to China and Taiwan

| Transit Airport | Service Cities in Taiwan (Weekly Flights) | Service Cities in China (Weekly Flights) |
|---|---|---|
| Hong Kong | Taipei(205) Kaohsiung(46) | Beijing(45) Changsha(3) Chengdu(10) Chongqing(7) Dalian(10) Fuzhou(22) Guanzhou(36) Guiling(7) Haiko(7) Hangzhou(14) Kunming(9) Ningbo(8) Nanjing(7) Qingdao(7) Shenyang(6) Shantou(14) Shanghai(49) Tianjin(7) Wuhan(1) Xian(6) Xiamen(21) |
| Macau | Taipei(85) Kaohsiung(35) | Beijing(7) Chengsha(2) Chongqing(4) Dalian(1) Fuzhou(12) Guilin(5) Haiko(1) Nanjing(2) Ninbo(2) Qingdao(2) Shanghai(14) Sanya(1) Wengzhou(1) Xiamen(14) Xian(4) Zhenzhou(2) |

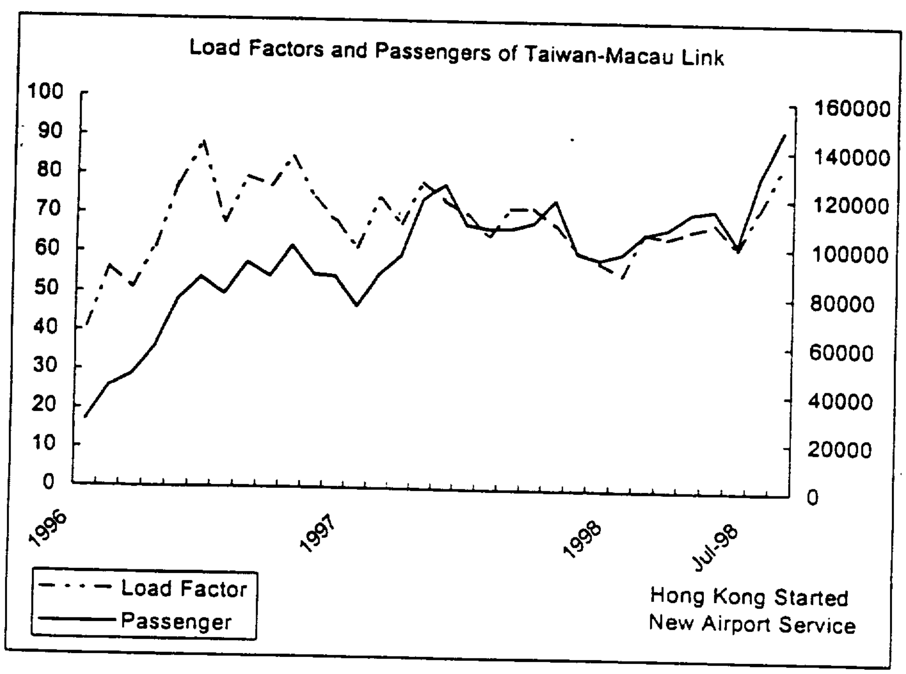


Figure 1: Load factors and passenger volume of Taiwan-Macau Links

It is quite clear that the future role of Hong Kong will be heavily affected by the direct service between Taiwan and China. Airlines based in Hong Kong will be shocked firstly and directly. Dragonair, the regional airline that has most links from Hong Kong to both China and Taiwan and served mainly for the passengers across Taiwan Strait, will be hit most seriously. In 1996 Dragonair has flown 2.2 billion kilometres on the routes between Hong Kong and China, roughly 67% of the total kilometres flew by the airline. 68.3% of total traffic revenue and 83% of the operating revenue in Dragonair can be accounted for Chinese market. Taiwanese travellers, in particular, have contributed 16.7% of the total revenue (Mackey 1998). Heavily relying on the service between Taiwan and China, Dragonair will face a big problem of recession after direct services start.

For Cathay Pacific, the major international carrier in Hong Kong, some losses will also occur after direct links get connected. Obviously, the most profitable link between Taiwan and Hong Kong will mostly be affected. In addition to this golden link, drops of load factors in some international routes can be expected, too. With a fairly good constructed international network to over 50 destinations in the world, Taiwan can be a very good competitor as a gateway to China. Travellers to China can access transfer services easily in Taiwan, especially for those travellers from rest of Asia and U.S that accounted for almost 75% of the total travellers to China in 1996 (National Tourism Administration of the People's Republic of China 1997).

### 6. The Market Share of the Biggest Pie in the Asian Air

Since the traffic on the busiest international air travel link of the world is prepared to shift, one interesting issue would then be the future market share of the direct service market. As described above, currently both China airlines and Cathay Pacific have created amazing profit on the link between Hong Kong and Taipei. But the biggest winner in the transfer passenger market is the China National Aviation Corp, which is known as CNAC in this area. CNAC is a Chinese based business group who holds major shares of both Dragonair and Air Macau. These two airlines are enjoying a high net profit margin because they can operate both links to Taiwan and China from Hong Kong and Macau. However, the niches of the two airlines will soon disappear after direct service start. Obviously, this market is going to be restructured.

The key issue to the future market share is the definition of the routes. If the links between Taiwan and China is defined as a domestic link, or area link as they are now defining in Hong Kong and Macau, then only airlines based in Taiwan and China can provide such services. That is to say, both Air Macau and Dragonair are out of this game. In the other hand, if the routes are defined as international routes, some foreign airlines may have the chance to compete. The policy of direct links on both sides and the experiences found in Hong Kong and Macau are showing that the area link will be the case. There will be very little chance for airlines in Hong Kong or Macau to share this market, nor will it be possible for foreign nations to get the fifth freedom on these links (Rao 1994). If so, some airlines in Taiwan and China will be the biggest winner in the competition of the direct service market. If the estimated 4 prior airports: Beijing, Shanghai, Guanzhou and Xieman in China are going to be connected, airlines based in these airports including Air China, China Eastern, Shanghai, China Southern, and a much smaller Xiamen airlines of the local government will be the best candidates to provide direct services. In Taiwan's side, the China Airlines group who controls China airlines, Mandarin Airlines, and Formosa Airlines, together with the Evergreen group who owns major shares of Eva Airways and Uni Airlines, and the American International Group (AIG) who holds major shares of Far Eastern Airlines and TransAsia Airlines will be the most important players in the market. However, those airlines based in China will probably dominate the cross-Strait market for they can provide domestic extension services to other destinations in China, while airlines of Taiwan can attract some outgoing passengers from China by using Taipei as a global hub.

Although foreign airlines and entrepreneurs may have very little chance to participate in this market, they are still trying to make some earnings indirectly. The most famous case is the investment of AIG group, an American life insurance company, to the airline industry in Taiwan. Currently AIG is the major stockholder of both two of Taiwan's best regional carriers. They are also considering buying the public released shares of China Airlines which is the biggest one of the two international carriers in Taiwan (South China Morning Post 1998). As a professional investor, AIG feels confident for the return of cross-Strait links, they also believe the future of these Taiwanese airlines (Paisley 1997).

Singapore Airlines is the second foreigner that moves for her interests in the cross-Strait market. Recently Singapore Airlines and China Airlines have announced a forge strategic alliance plan and signed a Memorandum of Understanding for a long term, multidimensional co-operative relationships which includes stock exchange, business operations, reinvestment, and flight safety (China Airlines' Home Page 1998). These two partners will try to exchange 5% of the equity stake to cross hold each other's shares in the first stage, and the ratio of cross-holding equity stake may increase to 25% in the long run. This is just another format for foreigners to share this market.

It is believed that competitions among the airlines can be very intense, but the market size is also big enough to accept most of the competitors. There were 2.1 million Taiwanese visited China in 1997, with natural growth rate from a simple regression model, the passenger volume can be as high as 2.5 million in 2000 in prediction[3]. This is just the case of current indirect operated flights. Apparently, some trips will be induced by the

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[3]A regression model can be reached using the statistical data listed in table 1. The model has suggested an annual growth rate of 7%, which predicted 2.16, 2.33, and 2.49 million Taiwanese passengers travelling to China in 1998, 1999 and 2000.

lower fares and convenience of direct services. Moreover, the small amount of 73 thousand Chinese citizens visited Taiwan in 1997 has also shown some potential of this market. Further deregulation of travelling and touring activities will fill the Chinese passengers on the major links across Taiwan Strait. Even if the strict regulation for Chinese to visit Taiwan can not be removed, a certain number of curios Chinese travellers going abroad will still try to find their transit in Taipei. Under such circumstances, transit would be the only chance for Chinese to visit this island which should belong to them in their beliefs. If curiosity can easily lift up the volume, the traffic on the link will still grow for many times.

## 7. Conclusions

Issues around direct flights across Taiwan Strait are always one of the hottest topics in eastern Asia transport market. Although the direct links have not been connected yet, they are still highly concerned by different disciplines of politics, laws, and management. Airlines and related business also watch closely to these issues for policy changes will easily affect their interests in Chinese market which the future of the air transportation in eastern Asia is heavily depending on. In the past decades, Hong Kong was the most important hub in this market; it will still be an important one in the future. It is proved, however, traffic on the link between Hong Kong and Taiwan can be shifted to the link between Macau and Taiwan, so can it be shifted to the links across Taiwan Strait. Moreover, outgoing passengers from China transferred in Hong Kong can also find transit services in Taiwan. These movements will possibly cause a big change in eastern Asian air transport system for there are millions of passengers travelling in this area.

The uncertainties of direct links across Taiwan Strait are still leaving some problems unsolved. Whether the direct links will be defined as international routes or domestic routes are not clear; the selection of hubs and airlines to provide direct services are not yet made; even the type of freedoms and bilateral agreements can also change the market and network quite a lot. A much bigger volume of passengers can also be found if further travelling deregulation for Chinese to travel across Taiwan Strait can be made. All these variables are making issues around direct flights worthy of continuous observant.

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