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AVIATION SAFETY AND THE INCREASE IN INTER-AIRLINE OPERATING AGREEMENTS

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Abstract

Air transport is becoming increasingly internationalized. This is not only in terms of rapid growth in international traffic flows but is also pronounced on the supply-side as airlines are beginning to lose their national identity as cross-equity holdings expand and as airline alliances grow. Alliances are also becoming a significant feature of many domestic markets. These structural developments interact with the commercial and the regulatory environment in which air transport is provided and also have potential implications for air transport safety. Although safety is generally treated as part of public policy, the commercial interests of the airlines themselves also influence it. The new market structure has brought forth considerable public debate on the economic implications of globalization and strategic alliances but less assessment has been made of the safety dimension. Even more lacking is a full consideration of the implications of the new situation for the way airlines view safety matters. This paper focuses on the changes in the private incentives that the growth in airline alliances in there various forms may have on safety.

INTRODUCTION

Public interest in air transport safety tends to wax and wane at different times. The number of major aircraft accidents in 1996 began a trend of heighten concern. This was reinforced by views expressed by the aircraft manufacturer Boeing, that, while in statistical terms civil aviation may be slowly getting safer or, at worst, no more dangerous, the sheer growth of aircraft movements in future years will result in a rise in the absolute number of accidents. This concern, or at least perceived concern, has brought forth a response from the air transport sector (*The Economist*, 1997). In the US there has been the White House Commission on Aviation Safety and Security.

This has also happened at a time when the air transport market is experiencing considerable change. Air transport service suppliers are responding to commercial pressures for increased cooperation and internationalization to reap benefits on both the cost and demand sides. The growth of international airline alliances is the manifestation of this although there has been an even more rapid growth in point specific alliances. In the US the linking of Delta with United; American with US Airways and Northwest with Continental represent domestic alliances of a similar kind. Carriers see alliances as a means of exploiting economies of scale, density and scope and as a means to exploit economies of market presence in terms of patronage.

The growth in number and the nature of modern alliances have raised a series of policy issues concerned mainly with anti-trust issues. The concern of this paper is to look at another aspect of the globalization of the airline industry and of the growth of various forms of airline alliances and that is the potential effect of these developments on airline safety. In particular, it looks at the way market forces change and can influence the commercial incentive for airline operators to offer safe services. Public policy regarding safety has been reacting to changing conditions in aviation markets but such reaction should be in the context of the new commercial environment in which airlines provide their services.

The paper initially outlines some of the broad trends in globalization that are influencing developments in air transport. It then looks at what is taking place regarding airline alliances, and particularly those of a strategic nature. An important point is that conceptually the details of any airline alliance may have specific safety implications. A model of how airline safety is incorporated in both corporate and public policy is then developed and subsequently the implications of strategic alliances are set within this context. The discussion is entirely concerned with aviation markets in what might be termed the industrial world. Strategic airline alliances do exist in many parts of the world but here we content ourselves with considering those involving partnerships between carriers based in the major, economically developed countries. The arguments may be somewhat different for other parts of the world.

GLOBALIZATION AND AVIATION

Globalization and internationalization are two of the major industrial trends of the late twentieth century. Part of these trends are reflected in the significant growth of trade that has taken place in the 1990s with real export growth in the industrialized countries that make up the Organisation for Economic Cooperation and Development running at over 7% per annum. Put another way, from 1964 to 1992, first world production was up by 9%, but exports were up by 12%, and cross-border lending was up 23%. Equally, there has been a significant rise in foreign ownership of assets that are now estimated to total about $1.7 trillion.

This has been taking place at a time when the institutional structure in which air transport services are provided has seen significant developments. The US deregulation of its domestic markets for air freight from 1977 and for passengers from 1978, combined with its subsequent

commitment to an 'Open Skies' approach to international aviation the following year, have been instrumental in changing the way not only US policy is conducted but also, through both demonstration effects and direct knock-on effects, the ways in which many other air transport markets are now regulated (Button, 1990).

The European Union since 1988 has, through a succession of 'packages', moved to a position that by the middle of 1997 left air transport within the EU largely free of economic regulation. These measures initially opened up regulated fare and capacity bands, but then went on to limit fare and entry controls only to instances where governments at both ends of a route agreed to them. The creation of a Single European Market from 1993 meant that international air transport within Europe has essentially been deregulated with full cabotage within member states being allowed from 1997 (Button *et al*, 1998). Intra-EU liberalization has also been accompanied by liberalization of many bilateral agreements involving EU states and the US. The first such agreement involved the Netherlands and the US in 1992 but since that time a significant number of smaller European countries have made similar liberal agreements with the US.

Outside of Europe and the US, the majority of national markets in South America have been liberalized with extensive privatization. The markets in Australia and New Zealand have also been deregulated. Additionally, the establishment of the World Trade Organization has brought into play, albeit in a small role, a new and geographically wider policy making institution to supplement the roles already played by bodies such as the International Civil Aviation Organization and the International Air Transport Association. Aviation issues are also on the agenda of new regional groupings such as the Asian-Pacific Economic Council.

This combination of market trends and institutional reforms, combined with rising incomes and increased leisure time, have contributed to the steady growth in demand for air transport that has taken place. Additionally, technology advances have meant that aircraft efficiency has risen and air traffic control systems, despite their continued inadequacies, can handle greater volumes of traffic. This has exerted positive effects on the cost side of the air transport equation. As a result of these trends, since 1960 air passenger traffic has grown world wide at an average rate of 9% a year and freight and mail traffic by some 11.0% and 7.0% respectively. This means that in 1995, for example, some 1.3 billion passengers were carried by the world's airlines. Civil aviation is, therefore, a major service industry contributing to both domestic and international transport systems. It facilitates wider business communications and has been a key component in the growth of tourism that is now one of the world's major employment sectors. In addition to passenger transport, aviation is also an important form of freight transport and some estimates suggest that it carries up to 60% of world trade by value.

All the indications are that as a sector it will continue to expand into the foreseeable future. While forecasting of aviation markets, as with many other activities remains an art rather than a science, it seems likely that passenger traffic will grow at a rate of between 5.0% and 7.0% into the foreseeable future with much of this growth in the Asian-Pacific region (up to 9.0% a year). The forecasts are also for slower growth in the more mature US–European markets where North Atlantic traffic grew at an annual rate of 8% between 1982 and 1992 and by 5.0% for mid Atlantic routes over the same period. Nevertheless, the absolute size of the trans-Atlantic traffic flows, some 38.0 million passengers (about 13.9% of the world aviation market) in 1992, makes it quantitatively a very important aviation market. Further, taken together, the intra-European, US domestic and trans-Atlantic markets currently account for some 60% of world air traffic.

STRATEGIC AIRLINE ALLIANCES

Historically, international alliances in aviation can be traced back as far as 1945 when the IATA was established primarily to coordinate international airfares. The bilateral structure of agreements that emerged following the inability of the 1994 Chicago Convention to initiate free

international aviation markets regulated fares, routings, schedules, designated carriers and often-embraced revenue pooling. The primary aim of the immediate post-war structure was to protect non-US carriers at a time when, as a result of the Second World War, the US had built up a dominant fleet of aircraft that could be transferred to commercial uses.

The late 1980s and early 1990s saw the growth of new forms of international alliances that have embraced somewhat different characteristics and that serve different purposes. They have been less institutionalized in that they have generally been formed by privately owned commercial airlines outside of any governmental or inter-governmental agency initiative. The main growth has also been in international alliances. The first of these, between American Airlines and Qantas, was signed in 1985. Table 1 gives an indication of the main international groupings as of August 1997. Alliances are also in a continual state of flux. According to the *Airline Business* survey, for instance, the Spanish carrier Iberia reduced its alliances from 27 in 1995 to 13 by May 1996. Over the same period Austrian Airlines canceled six agreements and added four new ones, Swissair added six agreements and dropped three while United Airlines canceled six but added two. These changes generally are part of tidying-up processes as carriers formulate more coherent network strategies.

Table 1. The main strategic alliances, August 1997

Star Alliance	Continental	Delta	Northwest/KLM	American/BA
United	Air France	Delta	Northwest	American
Lufthansa	Continental	Swissair	KLM	BA
SAS	Alitalia		Quantas	
Air Canada	American West		Iberia/Aviaco	
Thai Airways	Canadian			
Varig				

The exact number of airline alliances that now exists is unclear, not only because of the dynamic nature of the arrangements that make it almost impossible to keep abreast of changes but, also because the term 'alliance' is a generic one with no precise definition. It can, in a strict legal sense, mean some degree of equity ownership of one carrier by another but it is more often interpreted in looser terms to embrace such things as code-sharing agreements, interchangeable frequent flier programs and coordinated scheduling of services. Equally, airlines are often involved in a large number of different alliances, sometimes embracing a single partner but may involve several others carriers. A more recent feature is that increasingly several major carriers are linking their activities in so-called 'galaxies'.

An annual survey by *Airline Business* attempted to track alliances involving the major carriers and to report changes in the main features of the alliances (Table 2). The growth in strategic airline alliances is immediately obvious, as is both the relatively small quantitative importance of alliances involving an equity stake and the slow growth in their numbers. The data presented is not, however, definitive and one finds, for instance, *The Economist* in 1995 producing slightly different figures and claiming that there were then 401 alliances, double the number it estimated four years earlier. The overwhelming, conclusion, though, is that the number of alliances is large and increasing.

The North Atlantic market embraces a number of major strategic alliances. This type of strategic alliance dates back to the formation of the Global Excellence alliance formed by Swissair, Singapore International Airlines and Delta in 1989. Other alliances, such as that between Continental and Alitalia and United and British Midland, are regional in their orientation involving code sharing between specific regions. The vast majority of alliances, 'point-specific' alliances, are, however, relatively minor, targeted affairs that usually generate few controversies. Blocked-space agreements are often a feature of point-specific alliances with airlines purchasing

and reselling blocks of seats on each other's flights. While point specific alliances, in their various guises, may in some cases lead to fears of monopoly domination of an individual route, the multifaceted, strategic alliances are now seen as potentially posing challenges of a somewhat greater magnitude (US General Accounting Office, 1994).

Table 2. Airline alliances 1994-1997

	1997	1996	1995	1994
Number of alliances	502	389	324	280
With equity stakes	56	62	58	58
New alliances	121	71	50	-
Number of airlines	196	171	153	136

Note: New alliances are those entered into around may of the previous year and not then listed as planned. Alliances restricted to frequent flyer co-operation were included in 1994 but excluded in 1995-7. The actual number of alliances in 1994, the first year *Airline Business* compiled information, was marginally higher than stated as some of the alliances were unreported. However, some domestic regional operators owned by majors were included in 1994, but excluded subsequently.

In detail, alliance arrangements may take a number of different forms (Button *et al.* 1998). Full mergers of domestic airlines were a feature of the US domestic market following deregulation under the 1978 Airline Deregulation Act as the initial period of instability moved into one of consolidation and rationalization. For example, of the 34 new jet scheduled carriers to enter the US market between 1978 and 1992 only 2 remain operating with the vast majority of the others being merged with incumbents. Mergers of this type are the most extreme form of alliance and have been a traditional way in which carriers can coordinate their operations and other activities. They are claimed to enjoy the advantage that complete control of a carrier is in the hands of a single board and that resources can, therefore, be allocated more effectively.

The strongest form of airline alliance short of direct mergers or take-overs involves either unidirectional (as with the USAir/British Airways and Northwest/ KLM alliances) or cross-equity holdings. While mergers still take place, more recently there has been a tendency for the level of equity holdings to fall short of a full merger. This is particularly so when airlines from two countries are involved and national laws limit the extent of foreign ownership. What the table does not show, however, is the degree of control that equity holdings can afford an airline and, in particular, voting rights are often less than the relative amount of capital involvement. The relative importance of airline alliances involving equity stakes tends to be declining with *Airline Business* recording less than 16% of agreements in May 1996 involving equity investments compared with 18% in 1995 and 21% in 1994. This, nevertheless, does not mean that there has not been a large increase in their absolute numbers and other surveys indicate that from 1992 ownership stakes of above 20% have predominated.

Potential travelers have traditionally suffered from a dearth of information regarding air travel options. The problem was compounded from the late 1970s as fare deregulation and the widespread adoption of yield management techniques by airlines introduced a massive array of continually changing fare options. The use of computer reservation systems (CRSs) provides the interface between the carriers and the potential travelers. Airlines combine to make use of the information channels provided by CRS systems to stimulate their joint traffic flows. This involves code-sharing. Code-sharing is now often seen as the main feature of any airline alliance and the number of code-shares has grown considerably in recent years.

Technically, a code-share is a marketing arrangement between two carriers that allows them to sell seats on each other's flights under their own designator code. In the case of connecting flights of two or more code-sharing carriers the whole flight is displayed as a single carrier service. From the customers' perspective it gives the impression of an on-line service or, at the least, offer some features of an on-line service such as single check-in, common frequent flier

program and coordinated flight schedule. Code-shares can be across a wide range of services, as with the major strategic alliances but more often just involve a single service or a small network of services. A stronger form of code sharing involves blocked space arrangements when one carrier buys space on another airline's aircraft that it then sells in its own right.

THE AVIATION SAFETY EQUATION

Air travel is essentially a very safe activity. All transport, as does other activities, has risks associated with it but compared to many other forms of transport, air travel is relatively safe While there are some minor problems with the data (Button, 1999) the objective evidence is that flying is much safer than say driving or being a passenger in an automobile (Table 3). Part of the reason is clearly to do with the industry having a long tradition of safety regulation but market forces have not been absent.

Table 3. Fatalities per billion passenger miles in the USA

Automobiles (1990-95)	8.29
Railroads (1986-95)	0.81
Bus (1986-95)	0.23
Commercial aviation (1986-95)	0.21

Source: US National safety Council (1996) **Accident Facts**, NSC, Chicago.

The incentive for any airline to provide safe services is the potential for lost business that it would suffer if its accident rate or, more strictly, its perceived accident rate, exceeded the net benefits that passengers enjoy from making use of its services. Safety is a very general term for which is difficult to define. This is because accidents can take a variety of forms and can be of differing intensity. Also the actuarial probability of an accident may differ from an individual's perception of the chance of being in an accident (Moses and Savage, 1990). No attempt at a strict definition of safety is, therefore, offered here but rather the subject is treated in general terms. Safety, however, is one of the attributes of an airlines' characteristics that potential customers, and subsequently investors, look at in making decisions. Regulations and codes of conduct imposed on the industry by government boost this inherent market pressure. Government involvement is usually justified because of imperfections in the market that make it impossible for potential passengers to understand fully the risks confronting them or, even if information is adequate, have insufficient market power to ensure levels of safety are optimized.

One simple way of looking at air transport safety from an analytical point of view is to think in terms of the incentives that influence the actions of those providing air transport services. Essentially, the incentive function takes the general form:

$$S = f(E, G, I) + \varepsilon \qquad (1)$$

where: S reflects the safety standard level adopted by an airline: E reflects the private economic incentive to be safe (e.g. reputation, insurance premiums, lost business, share price and the interest of flight personnel); G represent the government safety codes and policies (e.g. regarding aircraft safety features, maintenance standards and crews working hours and conditions); I represents infrastructure considerations (e.g. airport design and air traffic control). There is an additional random element in the function, ε, indicating the risk of someone else, such as a missile or bomb, causing the accident. The issues of terrorism and the growth of strategic airline alliances, however, are outside of the domain of this paper.

With respect to safety levels pursued by a carrier, there is no reason to assume that it is socially desirable for an airline to be 100% safe. There are opportunity costs associated with devoting

resources to safety and it is clear from individuals' decisions on such things as the speed they drive at or the choices they make regarding car travel over air travel that factors such as time savings or cost saving often over-ride safety considerations. Indeed, many argue that aviation is excessively safe and with better information about relative safety records society would put less resources into aviation safety (Kahn, 1988).

Regarding the items on the right hand side of the equation, while these may be expressed as independent factors they will, in practice almost certainly exhibit some degree of correlation. The nature of infrastructure provision, for instance, is inevitably linked to the safety regulatory regime adopted by the authorities. Equally, the internal economic incentives influencing an airline's pursuit of safety cannot be completely separated from the institutional regime within which the carrier operates. Nevertheless, the three-way division is helpful in tying together the implications of globalization and strategic alliances with aviation safety considerations.

STRATEGIC AIRLINE ALLIANCES AND THE SAFETY EQUATION

Considering 1, there are a number of ways in which changes in the institutional structure of the airline industry, including the creation of strategic alliances, can have a bearing. These are in terms of the internal structure of the airlines' operations and in the ways in which the authorities may respond to them. What does not exist is a large body of rigorous empirical evidence linking strategic airline alliances to safety questions. Alliances are too new for detailed statistical analysis of the type required; short term fluctuations in airline accidents rates involving a very small number of incidents does not make for easy econometric work. What one, therefore, must generally rely on in looking at the safety implications of alliances are parallel experiences of aviation developments that have also influenced the structure of the sector and on anecdotal evidence gleaned from the experiences of alliances to-date.

Aggregate air travel demand

The creation of strategic alliances is claimed in a number of studies to generate, when controlled within an appropriate economic regulatory regime, significant consumer benefits (e.g. US General Accounting Office, 1995). In particular, the various economies enjoyed by carriers combined with service enhancements and lower fares for users have lead to more travel by air; the latter being a reflection of enhanced consumer surplus. This, however, only occurs provided carriers do not excessively exploit any monopoly powers associated with the market strength that alliances could potentially generate.

More air travel beyond the increase that would occur without the growth of alliances would of itself lead to more aviation accidents according to the arguments present by Boeing in 1996. The added economic efficiency that alliances bring about and the accompanying additional traffic will inevitably increase the potential aggregate number of aviation incidents. Public policy (G in equation 1) is inevitably going to respond to this. In the US, for example, the Federal Aviation Authority (FAA) has already began releasing more information on safety in an effort to keep the public better informed, although the complexity of aviation safety issues suggests that such information will in practice not really offer any great insights. Moses and Savage (1990) make the argument that after any institutional change, the safety authorities may adjust their preferred level of safety - essentially recognizing that the economic benefits associated with the new regime are worth trading for possibly lower safety criteria. This does not, however, mean that no safety reforms are needed to meet this new safety standard: put simply all the parameters have shifted and adjustments may be needed to safety regulations etc. to allow for this even at a new safety level.

Equally, in terms of I in equation 1, the provision of and use made of aviation infrastructure may be changed. At present many airports and air traffic systems are working at or above their design

capacity and are also, in many cases, using out-dated technologies. There will be enhanced pressures both from a purely air transport perspective and from a safety stand pint to ensure that existing infrastructure is used better and new infrastructure provided where justified.

There is, though, another way of looking at this aspect of the safety issue. What is missing from many calculations on the implications of increased demand for air travel is the opportunity cost element. If individuals were not traveling by air they would be engaged in some other activity that of itself has a safety aspect attached to it. In this sense, it is not altogether clear that more air travel will result in more deaths and injuries in aggregate.

Little empirical work has been conducted into this aspect of airline safety. What evidence there is mainly relates to experiences with domestic airline liberalization in the US after the enactment of the 1978 Airline Deregulation Act (Rose, 1989; Morrison and Winston, 1988; Oster, and Zorn, 1989). The limited amount of analysis undertaken here indicates that on many routes where US airlines could compete with automobile travel then the diversion effect from car to plane as the result of improved services offered by airlines reduced the number of road deaths. The calculations are made difficult, however, because of the inherent problems in defining counterfactuals, but Bylow and Savage (1991) estimate some 275 highway fatalities were avoided by the modal switches to air travel.

Not only are the US estimates very tentative for technical reasons, but extrapolation to take account of the effect of strategic airline alliances poses particular difficulties. While the alliances do involve situations where new structures of fares, services and routes can induce modal transfers, many of the really important alliances focus on long distance travel, often over oceans, where commercial aviation is the only via transport option. There still remains the broader issue of what induced travelers would have done with their time even they would not have been traveling by an alternative mode of transport. All human activities have risks of accidents associated with them and many of those exceed those risks to do with flying.

What the alliances do seem to do within the narrow confines of transport is to induce travelers away from carriers outside of alliances. This, for instances, is seen very clearly in the analysis that has been completed on the strategic alliances affecting the North Atlantic market where the KLM/Northwest and British Airways/USAir alliances demonstrably took traffic from competitors (Gellman Research Associates, 1994; US General Accounting Office, 1995). From the safety perspective, the issue then becomes one predominantly of discovering whether the alliance carriers are safer than their non-alliance counterparts. This issue is addressed separately later.

Consumer information

Airline alliances affect the type of information that travelers enjoy regarding the actual carrier they fly with. As can be seen from Figure 1, that provides a simple schema of the links involved for Swissair in the Global Quality alliance in 1994, alliance structures can become very complex. It is not difficult to see, in this case, why, for instance, someone booking a multi-segment flight with Swissair could be puzzled at being carried on a Delta aircraft. Blocked space agreements are potentially even more confusing.

In terms of safety, consumer information raises two important questions; these concerns the identity of the carrier actually taking the passenger and the type of aircraft used for the flight. There is also the supplementary issue of who is responsible for an accident involving passengers from several airlines on an alliance flight and how is compensation to be extracted. This is not dealt with here.

Although variations are very small, airlines do have differing historic safety records. This is not only in terms of the number of accidents they have experienced but also relates to the degree to

which they have been held negligent for accidents. Airlines also offer different, frequencies, qualities of service and fares. In a perfect world, potential passengers should be able to make their choices and trade-off the various attributes of carriers when selecting the airline they wish to fly. In the case of alliances, it is often difficult to know exactly what are the various portfolios that are available because the actual carrier providing the flight is not immediately transparent.

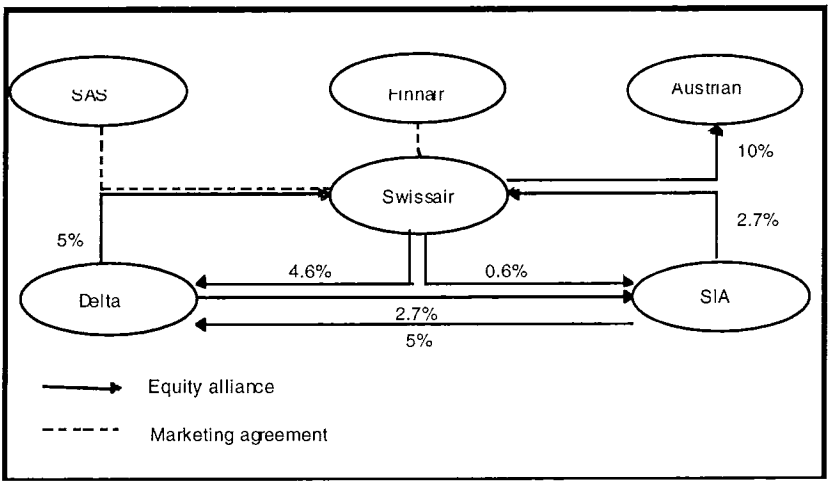

Figure 1. Swissair and the Global Quality alliance 1994.

There have been public policy efforts to ensure that alliance code-sharing arrangements are not used to misinform or disadvantage passengers. This involves not just direct issues revolving around individuals having information on the exact airline they will travel on but extends to such things as responsibility for missed connections, direction to connecting flights and ensuring appropriate information systems are available at airports. To prevent screen padding on CRS systems the European Union now limits code-shared flights to being displayed twice. The United States has no such limit on displays in this way. What the US rules do require is that passengers are informed by US airlines of the actual carrier with which they travel. The European Civil Aviation Conference (ECAC) has a similar code for disclosure but is not legally binding on member states.

It is not just airlines that have differing safety records, aircraft also do. In general, jet aircraft have a better safety record than turboprop aircraft but there are also differences within these two broad categories. For example, Boeing 747 (100, 200, 330 series) aircraft have about 1.6 crashes per million departures; Airbus A300-600 aircraft have about 1.4 per million departures while Boeing 737 (300, 400, 500 series) aircraft have about 0.5 per million departures. There are arguments that potential travelers' perception of the safety of different aircraft types can affect their decisions and that information on plane types should be transparent. Airline alliances could hide or make it more difficult for passenger to have information regarding aircraft type.

The most documented case of the commercial impact of an aircraft crash on its producer relates to the McDonnell Douglas DC-10 after two major crashes (one in 1979 and the other in 1989). Here there was evidence of significant falls in the producer's share prices immediately after the 1979 incident that could only be accounted for in terms of lower anticipated sales (Chalk, 1986). Karels (1989) extended this analysis to look at the share prices of airlines such as American that flew DC-10s and found that their share prices were also adversely affected after the accident. Focusing on patronage rather than financial performance, however, Barnett and LoFaso (1983) found that the crash had no impact on the market shares of routes where DC-10s were flown. In contrast to this the 1989 DC-10 crash seemed to have no long-term adverse effects on

the McDonnell Douglas' share prices. There is also no evidence that the share prices of Boeing or Lockheed have fallen significantly affect an accident suggesting the impact of the 1979 DC-10 crash was atypical (Chalk, 1986).

Alliances versus non-alliance carriers

One very vocal concern expressed at the time of the liberalization of the US domestic air transport market in 1978 was that free markets would force some carriers to cut corners with regard to safe operations to keep their fares competitive. The argument was resurrected after a series of accidents in the mid-1980s and the fining of a number of carriers for violating maintenance and safety regulations (Nance, 1986). In fact the evidence seem to be that in this case market changes seem to have had little effect on the overall level and trend of accidents in the US market (Morrison and Winston, 1988).

What the experience has shown is that there are variations in the inputs airline put into safety. The US National Transportation Safety Board expressed concern about budget constraints restricting maintenance although this may have reflected the actual safety regulations in place for such operations (US Congress, Committee on Government Operations, 1977). Following deregulation in the US market several studies found reduced expenditure on potentially safety related activities, such as maintenance and training, in some segments of the market (Lederer and Enders, 1989). Even if this did not produce more incidents immediately, there is an argument that in the longer term a legacy effect would result in higher accidents rates. Assessing the validity of this argument is not easy. Technical advances have reduced maintenance needs and isolating this shift in the maintenance cost function from the impact of institutional changes is not easy. There is also another set of findings of importance, namely linkages between the financial position of an airline and an airline's accident record. Rose (1990) finds in analyses of US domestic carriers, that there was a one year lagged positive effect on accidents rates of higher operating profits although the effect is negligible amongst the largest carriers.

Where does this lead with regard to the growth in strategic alliances? From the evidence obtained on North Atlantic routes, alliances tend to attract passengers from non-alliance carriers. One consideration relates to the financial pressures on alliance carriers – are the market pressures to cut corners on such things as maintenance and to employ cheaper, less experienced crew greater for alliance carriers? In general, the evidence is that alliance carriers, especially when there are mergers or equity holdings involved, have a larger resource base and are less prone to liquidity difficulties. Indeed, in the case of many alliances (e.g. British Airways/USAir and KLM/Northwest) significant financial injections were made by one partner into the other to bolster a flagging financial position. This suggests, *a priori*, that many alliance airlines are in stronger financial positions than they would be operating in isolation. This in itself may not mean overall improved safety even if it were true that a strong financial performance correlates with fewer accidents. This is because the non-alliance carriers on these routes would be the subjects of greater financial pressures.

Comparisons between alliance carriers and non-alliance carriers also bring two other different elements into consideration. First, blocked space alliance arrangements, whereby a carrier buys capacity on another plane, and coordinated scheduling by code-sharing partners can lead to the use of larger aircraft on the routes involved. The evidence that is available is that larger aircraft tend to be safer than smaller ones (Oster and Zorn, 1989).

Second, where alliances do rationalize the use of the partners' capacity this can free up the market to allow new entry. This may come about for purely commercial reasons or it may be driven by institutional factors. (In several mergers involving European carriers, slots were relinquished by the partners to meet anti-trust requirements.) This raises questions as to whether the new entrants are safer than incumbents. One of the problems with the work that has been completed in this area is that many new entrants into scheduled aviation are not new to

airline operations *per se*. In many cases they are charter carriers or regional carriers that have extended their operations (Levine, 1989). This may not have been a problem in the past, after all where the newcomers originate from is not relevant to the safety equation which is merely concerned with the implications of a change in supply on accidents. In many markets now, however, there are more genuinely new airlines. The evidence, which again is mainly from US experiences, is that there is little difference in the safety record of established carriers and incumbents measured in terms of accidents (Rose; 1989).

The airline switch effects of strategic alliance on safety are, therefore, far from clear. It does not seem that there are strong forces likely to lead to reduced safety as a result of the way traffic may switch between airlines once an alliance is formed in a particular market. Indeed, there could be made a case that if anything the changes would, on balance, have a positive effect on safety.

Managerial incentives

There are also a number of other ways in which the E component in equation 1 may change as a result of alliances. Does the establishment of an airline alliance, for example, influence the management incentive of the partner carriers to change their approach to safety? The available evidence is not altogether conclusive. Much depends on the circumstances involved and on how the airline manages the crisis. One argument is that accidents will discourage people from using the carrier concerned even after the immediate impact has passed (Borenstein and Zimmerman, 1988). While this may or may not be true, measurement of this effect is made difficult by the natural response of any carrier who is adversely affected in this way to lower fares so as to keep its market share (Rose, 1990; 1992).

An alternative way of looking at the topic is to consider the impact of accidents on the financial status of an airline. Button (1997) tracking share prices of ValuJet and TWA found significant declines in their respective share prices (both actual and against a moving average) following crashes involving their aircraft in May 1996 and July 1996. A contrast appears, however when these results are compared to an American Airlines crash. American Airlines experienced a major crash with the loss of a Boeing 757 in Columbia during 1995, but this does not seem to have adversely affected its smoothed share value index. The difference would seem to lie in the location of the crash, the American incident being outside of the US, and in the perception of who was at fault. The ValuJet case is complicated by the temporary closure of the airline by the FAA for violation of safety and maintenance codes just after its DC9s crashed in Florisda

This rather uneven pattern of stock market implications is in conformity with more rigorous studies that have been completed looking at the financial implications for an airline of crashes. In this context there has been work on a number of themes, much of it concerned with US experiences. Outside of the US, the *Edwards Report* in the UK concluded in 1969 that independent operators were less safe than regularly licensed carriers for the period 1955 to 1966 and that smaller carriers and charter operators were more susceptible to accidents.

An accident seldom costs an airline in terms of immediate payments because all carriers tend to be extensively, and frequently excessively, insured. What it may do, however, is to affect an airline's image and to impact on future insurance premiums it must pay. Mitchell and Maloney (1989), for instance, looked at insurance rate adjustments after crashes and 'brand name effects' and found that share price falls can be attributed both to the projected future costs of higher insurance and to a brand name effect associated at-fault attribution. In contrast to this, Chance and Ferris (1987) find an immediate dip in share price of an airline involved in an incident, although it is extremely short lived, but no impact on the industry in general. Golbe (1986) in his study of the early years of US domestic deregulation concluded, "There does not seem to be a statistically significant relationship between safety and profits". Borenstein and Zimmerman (1988) in contrast found that airlines suffered an equity loss of about 1.0% as a result of an accident. The picture is not, therefore, very clear on this topic.

Where does the establishment of alliances fit into this picture? Much depends upon the nature of an alliance. If the structure were extremely loose, or at least perceived to be by potential customers, then there would seem to be little reason or pressure for the management of any carrier to changes its behavior patterns with regard to safety. Where there is, however, a closer relationship, especially involving equity holdings, there may be grounds for expecting airlines to closely monitor each other's safety performance, especially if each fears that any diminution in reputation of one airline would adversely affect the other. Empirical evidence on this is simply not currently available at; the strategic airline alliances are simply too new and there structures too variable to allow any sort of detailed testing.

Alliances may serve a second positive role in this sense. Entry to airline markets on a small scale can be difficult because the various scale effects that exist in the industry. One mechanism by which new carriers can enter and take advantage of demand-side economies especially is through joining and alliance. Since there is evidence from the 1980s and 1990s in the US (Savage, 1999) that many accidents involving smaller, and often low cost carriers, are the result of inexperience rather than avarice this almost forced linking with majors may enhance safety. The new carriers general have to conform with the standards and practices of the larger airlines.

Lobbying power

Airlines often exercise considerable political power. In general large suppliers exercise more political power than do smaller ones and so one would expect alliances to have more political sway than individual airlines. Looked at in another way, airline alliances effectively change supply conditions, and therefore, this could potentially have implications for the G component of equation 1. One possible way of looking at this more systematically is to treat those involved in supporting any aviation policy as a coalition (Keeler, 1984). Following this approach strategic alliances serve the interest of a number of different parties. In terms of an airline alliance acting to alter government policy on aviation safety one must look at influence in the context of coalitions and at the factors motivating those in the 'ruling coalition'.

There would seem to be little reason for the users of air transport to try to reduce safety standards unless they were initially felt to be excessive. It is only normally economists who attempt to assess the costs and benefits of safety measures and few accept their calculations! From a competitive perspective, there would seem to be little reason for member airlines of an alliance to compromise on standards since, generally, they are the larger carriers that have solid safety records giving them a comparative advantage over non-alliance rivals. The exception to this is when an alliance has a monopoly position and it is to the combined advantage of the partners' to reduce overall safety standards and to save on their costs. There are few incentives for the bureaucracy responsible for safety to compromise on existing standards since this would reduce their power and influence. Equally, airline producers would seem to be little affected in their attitude to safety and in their lobbying positions by the formation of a strategic alliance.

What one can concluded from these few observations is that there is unlikely to be any significant changes in the attitudes of those concerned with alliances to manipulate public policy in a way that would be detrimental to current safety conditions. Indeed, since alliances are often seen as hiding information about the actual carrier upon which one is travelling, the private interest may well be to lobby for more safety regulation .

CONCLUSIONS

Recently many debates have taken place concerned with the economic and competitive implications of strategic airline alliances on the efficient internal workings of air transport markets. Much less attention has been paid to the implications of strategic alliances for airline

safety. In fact, the objective evidence clearly shows that air transport is extremely safe and any institutional change is unlikely to have more than a marginal effect on it. Nevertheless, in part because of the intensity of single incidents and in part because the media find it cost effective to cover the limited number of air crashes rather than the much more numerous but dispersed motor accidents, the public still remains concerned about air transport safety matters. It is, therefore, inevitable that safety standards will continue to remain at levels that many economists feel to be excessively high. There would seem little reason, though for them to pushed even higher because of the structural changes to the industry that strategic alliances are bringing about.

The strategic global airline alliances that represent the cornerstone of the internationalization of the aviation sector are in many ways still in an embryonic state. The new mega-alliances within the US are even more junior. Large numbers of alliances in the past have failed. They also take many different forms. Contemplating the implications of the existing alliances for safety is, consequently, far from easy and the newer ones offer even greater intellectual challenges. There does not, however, seem to be any justifiable reason to suppose that airline alliances will have any major adverse effect on airline safety and, in some ways, they are likely to reinforce the strength of the safety record of the sector.

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