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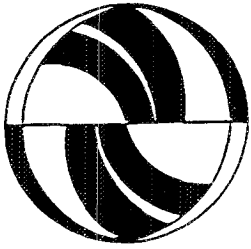
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**The Consequences of Strategic Alliances  
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The University of California  
Transportation Center  
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**The Consequences of Strategic Alliances Between  
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## **The Consequences of Strategic Alliances Between International Airlines: The Case of Swissair and SAS**

-Abstract-

The impact of the SAS-Swissair strategic alliance on service quality, market concentration, and fares is assessed. Comparison of services before and after the alliance show increases in flights between the SAS and Swissair hubs, in the number of markets in which the alliance airlines offer connecting service, and in the average service frequency offered in these markets. Further, there has been an overall reduction in the layover time associated with SAS-Swissair connecting services. Impacts of market concentration include effective monopolization of non-stop services between the alliance partners' hubs and a slight reduction in concentration in markets in which the partners offer connecting service. Fares in non-stop markets served by the alliance were found to have increased relative to those in non-alliance non-stop markets, probably due to the increased concentration. Variation in service and fare impacts among alliance airports was found to correlate so that those with the strongest service increases also had the lowest fare increases. Taken as a whole, the results point to the redistribute nature of alliance impacts.

# **The Consequences of Strategic Alliances Between International Airlines: The Case of Swissair and SAS**

## **I. Introduction**

Strategic alliances between airlines can have a wide range of impacts on industry performance. On the one hand, they can lead to benefits associated with structural economies in the form of economies of network density, vertical integration, and scale. On the other hand, such alliances may also lead to disbenefits associated with reduced competition, such as higher fares and lower levels of service. As these alliances gain popularity, particularly in Europe as industry regulation is liberalized, it is important to gain a better understanding of their consequences.

This paper presents a case study of a recent international alliance between Scandinavian Airlines System (SAS) and Swissair in order to assess its effects on service characteristics, market concentration, and fare levels. While each alliance is different, the SAS-Swissair one is broadly representative of alliances between smaller international airlines seeking--ostensibly at least--to remain competitive against larger rivals. Furthermore, it has existed for a sufficient period to allow its impacts to be observed.

We begin with brief discussions of strategic alliances and the methodological issues associated with evaluating their impacts, followed by a description of the Swissair-SAS alliance. Next, we will examine the impact of alliance on service characteristics, focusing on how the quantity and quality of connections through the Swissair hubs of Geneva and Zurich have changed since the alliance, and analyzing the sources of these changes. Next, we will assess market concentration changes in markets that have been directly affected by the alliance as well as changes in the ability of alliance airlines to influence market concentration. Finally, we will explore the effects of strategic alliances on pricing by comparing fare level changes in intra-alliance and non-alliance markets.

## **II. Strategic Alliances**

Two theories have been advanced by Youssef (1992) in order to explain the motivations behind airline strategic alliances. The first theory relates to technical efficiency and is based on evidence that larger airlines--those with larger networks or more traffic--have lower production

costs and/or better service characteristics than smaller airlines. Smaller carriers may therefore find alliances as a means of attaining similar advantages. There are several possible mechanisms for this. First, the alliance participants may be able to consolidate certain facilities, such as airline stations and maintenance bases. Second each airline can extend its "effective network" to the regions and points served by the other. The network extension effect has two aspects. First, the quality and quantity of connecting services may increase, either because of improved schedule coordination or because passengers perceive (correctly or not) an inter-alliance connection to entail less risk of lost baggage or a missed flight. Second, if the alliance included merging frequent flier programs, customers will be able to use frequent flier benefits to travel to more places. If these advantages allow the airlines to attract more traffic without extending their individual route systems, lower unit production costs may result through economies of network density. There may be a marketing advantage as well, since travelers with incomplete information will tend to contact carriers with large networks first when making travel arrangements, since these airlines are more likely to offer the desired service. Finally, consolidation of services on individual segments may yield benefits through economies of horizontal integration (Keeler and Abrahams, 1979). One advantage of such consolidation is that schedules could be coordinated so that the alliance airlines don't have flights leaving at virtually the same time.

The alternative explanation for alliances focuses on market power and views strategic alliances as a means to limit competition with other airlines. Extensive government regulation in domestic and international aviation markets have resulted in considerable restrictions on route and market entry, capacity and fare levels, and airline operations. Such regulatory practices have created sources of economic rents, and measures taken towards liberalizing international aviation by the United States (Kasper, 1988) and the European Community threaten these rents. This may cause some carriers to reduce or limit competition through strategic alliances. Specifically, alliances may create virtual monopolies in markets between the hubs of the alliance partners. Since entry into such markets by a third country airline is discouraged by both economic and regulatory factors, there are opportunities to exploit the hub-to-hub markets while offering lower fares in more competitive ones. In addition to explicitly reducing competition through the monopolization effect, alliances may foreclose competition which would have otherwise occurred from airlines seeking to expand their networks through internal expansion.

Youssef (1992) documents many of the stated motivations for equity alliances. Most alliances are justified by the partners' stated wish to increase traffic on their own routes by

improving their linkages with each other, reasoning consistent with the technical efficiency theory. Some airlines have sought an alliance with a foreign carrier with a strong domestic network in order to secure traffic feed from the foreign country. Similarly, airlines seeking improved feeder access to a geographic region where it has had a historically limited presence may seek form alliance with an airline whose network has complementary strengths and weaknesses. Improved interconnectivity, as well as reduced threats of entry into one another's markets, also encourage alliances between international and domestic airlines of a given country.

It is not surprising that airlines stress network extension effects in explaining the formation of alliances. This does not invalidate the theory that airlines form alliances to increase market power, but simply points to the "political incorrectness" of articulating this motive. Intended or not, each of the alliance types described above involves some reduction in competition, whether by eliminating rivalry in markets served by both alliance partners, or foreclosing entry by one partner into markets served by the other.

Finally, it should be noted that some alliances have resulted from considerations unrelated to the theories proposed above. Certain governments--typically of less developed countries--have sought them in privatizing their flag carriers, especially when management expertise is deficient, since a flag carrier allied with an efficient carrier may have a better chance of improving its performance and economic returns. An alliance strategy may also be defensive, since many airlines may be encouraged to enter into alliances in order not to be left out of this growing phenomenon.

### **III. Methodological Issues**

There has been little research on the impacts of alliances, perhaps because of the methodological problems associated with isolating these impacts. While it is comparatively easy to undertake before-after analyses of relevant variables, it is difficult to impute causality from such comparisons. Our research relies on the before-after approach when this is unavoidable, but whenever possible we isolate impacts of the alliance by either controlling for factors (other than the existence of the alliance) that are expected in affect the outcome variables or by comparing changes in markets directly influenced by the alliance with those in markets not directly influenced. There remains the problem that alliances contain different elements--consolidation of facilities, schedule coordination, fare coordination, etc. Here, we do not address the issue of the separability of these different elements. Implicitly, we assume that the alliance is a single event in



which the "bad" (reduced competition) must be accepted with the "good" (efficiency gains).

An additional issue that complicates the assessment of international alliance impacts is the role of international airline regulation in shaping and constraining airline conduct. Until recently, fare and capacity regulation has been so stringent that any changes in these areas would have required concurrence of the governments of both countries. However, the 1980s have witnessed considerable liberalization. In the early part of the decade, the U.S. successfully pressured for greater fare and capacity flexibility on the North Atlantic routes. This was followed in the latter part of the decade by a series of rulings that substantially eased regulation on intra-European routes. During 1989-91, the years considered in this study, European airlines were able, and indeed encouraged, to--within limits--behave competitively (Sochor, 1991). Indeed, since the nationalist system structure of the system had encouraged route networks focusing on "fortress hubs" located in the premier cities of each country, the competitive environments in the European and the U.S. domestic industries were fairly similar. Although it cannot be assumed from this that market-structure-conduct-performance relationships observed in the U.S. will also be found in Europe, there is certainly reason to look for them.

#### **IV. The SAS-Swissair Alliance**

Our case study focuses on the alliance between SAS and Swissair. These carriers each have a small "natural" customer base that is limited by small home country populations. This has translated into small airline networks relative to other large European carriers and reliance on sixth freedom service in order to sustain growth. Both airlines also operate from a high cost base (Table 1) and have chosen to target a high yield (business) passenger niche.

Two major factors have threatened SAS and Swissair during the 1980s. First, the European Common Market would allow European airlines unrestricted access to European markets, starting in 1993; this means head-on competition with giant European carriers such as British Airways, Lufthansa, and Air France. Second, there was increasing competition from aggressive U.S. carriers with very large networks and production costs lower than European carriers (Table 1). Faced with a saturated U.S. domestic market which only grew by 3 percent between 1986 and 1990 in comparison to a growth of 15.1 percent for U.S. international markets (Boeing, 1991), U.S. carriers continued to strengthen their European hub operations and directly compete with both SAS and Swissair for Europe-originating traffic.

Faced with increasing competition, SAS and Swissair initiated strategic alliance strategies independently. SAS has acquired 18.7 percent of Continental Airlines, 24.9 percent of Airlines of Britain (British Midland), and 35 percent of LAN Chile. Swissair owns 10 percent of Austrian Airlines, 5.9 percent of Delta Air Lines, and 5 percent of Singapore International Airlines. SAS, Swissair, and Austrian Airlines formed the European Quality Alliance (EQA) in 1988 (Finnair subsequently joined EQA a year later). While the commitment of EQA members to the alliance is evident in their extensive network integration and service coordination, an intended equity exchange of between 5 and 7.5 percent of equity between SAS and Swissair has been postponed by legal issues arising from the complex holding requirements of Swissair until 1992 (Andrey, 1991). However, the SAS-Swissair alliance has become particularly close, in effect creating an "alliance within an alliance."

There are a number of reasons why SAS and Swissair fit well together (Figure 1). They can be aptly summarized under the themes of convergence, competitiveness, and complementarity.

*Convergence.* Both carriers are recognized for their high service quality, safety, image and technical competence. Neither carrier was concerned that association with the other would detract from its reputation in these areas.

*Competitiveness.* Both carriers had vigorously competed against one another for intra-European sixth freedom traffic, which was described as their "bread and butter" (Andrey, 1991), prior to their strategic alliance. The alliance between both airlines offered the prospects of reduced market competition within each airline's primary market.

*Complementarity.* As shown in Figure 1, Swissair maintains a strong network in Africa, the Middle East and the Indian subcontinent, whereas SAS only serves one destination in those regions. The geographic location of SAS's main hubs at Copenhagen (CPH), Stockholm (STO) and Oslo (OSL) are disadvantageous and have probably already saturated all possible sixth freedom markets. In contrast, Swissair's hubs at Zurich (ZRH) and Geneva (GVA) are in the center of Europe, between Scandinavia and many markets not served by SAS. SAS-Swissair interline services in these markets therefore entail little circuitry. On the other hand, SAS, as a European Community (EC) carrier, would improve the market presence of Swissair, which is not an EC carrier, in the post-1992 European market by feeding traffic from EC markets into

Swissair's network.

The immediate impacts of the alliance were pronounced. During the first four months of their alliance, traffic between SAS and Swissair hubs rose by 54 percent, while transfer traffic rose by 86 percent (Aviation Week and Space Technology, 11/26/90). In the year ending March 1991, hub to hub traffic rose by 25 percent, despite the Gulf War, whereas transfer traffic increased by 35 percent (Air Transport World; 11/1991).

## V. Service Impacts

A major motivation for the SAS-Swissair alliance was to improve connecting services involving these airlines. This section analyzes how connecting services were affected by the alliance. We focus on services from SAS hubs (*origins*) to cities exclusively served by Swissair (*destinations*) via Swissair hubs (*hubs*), while recognizing that changes in these services will also affect services from other Scandinavian points which feed into the SAS hubs.

In analyzing the service impacts of the alliance, it is useful to draw an analogy with economic production theory. The inputs to production are airline flights, while the output is the set of services available. In this research, we are particularly interested in the output of connecting services, and how this is influenced by the formation of the alliance. Following the production theory analogy, a change in output may be traced either to a change in input, or to a change in technology that makes the production process more (or less) efficient. We hypothesize that the alliance has increased the efficiency of the process by which SAS and Swissair flights are assembled into SAS-Swissair connecting services. In testing this hypothesis we consider the two main dimensions of connecting service output: the number of connecting services available, and the amount of layover time they require.

The impact of the alliance on the production of connecting services will be assessed based on a comparison between the first week of June 1989 (pre-alliance) and the first week of June 1991 (post-alliance). During the first week of June 1990 (a date we pick because it is midway between the two periods compared in our analysis), Swissair served 60 destinations not served by SAS, not including U.S. cities, while SAS served 9 destinations not served by Swissair (Table 2). Using schedules published by SAS and Swissair, we have constructed interline services by matching origin to hub flights with hub to destination flights while following minimum connection

time guidelines (listed in the Official Airline Guide). Since frequencies are almost always less on the hub to destination flights, the construction process begins with these. For each combination of hub to destination flight and origin, we select the origin to hub flight (if any is available) yielding the shortest connecting time over the minimum connecting time specified in the Official Airline Guide (45 minutes). Only non-stop flights are considered, and no overnight layovers are considered. In a very small number of cases, an "inferior" connection may be included since a given origin to hub flight may be the best connection for more than one hub to destination flight, in which case the earlier of the hub to destination flights would almost always be preferred. Since hub to destination frequencies rarely exceed one per day, this has minimal impact on the overall results, however.

We have excluded three destinations (Baghdad, Kuwait, and Monrovia) which experienced political turmoil during the study period from our database, leaving 57 destinations. This provided us with a total of 3 origins and 57 destinations, or 171 possible origin-destination markets with 342 possible routings.

Tables 3 and 4 summarize how service output from the GVA and ZRH hubs changed between the pre- and post-alliance periods. In Table 3 the quantity of service is considered. Quantity is measured in three ways. First, the total number of origin-destination markets for which some service is available during a week is tabulated. In 1989 83 out of the 171 possible origin-destination markets had such service; in 1991 this number increased to 93, or 12 per cent. Second, we tabulate services on a daily basis: a market with service available seven days per week would contribute seven to this tabulation, while being counted only once in the prior one. The proportional increase in service days from 1989 to 1991 is slightly larger--17 per cent. Finally, we tabulate each individual connection offered, so that an origin-destination market with two connecting services on a given day would count twice, as opposed to once in the prior tabulation. The results are little changed from the prior, reflecting the large proportion of hub to destination segments for which only one daily flight is available. The Incas in total connections is 15 per cent between 1989 and 1991.

Table 3 also shows that service has been redistributed away from OSL and in favor of CPH and STO. The latter shows the sharpest gain: 35 per cent in markets served, 44 per cent in daily services, and 47 per cent in total connecting services. OSL saw a 14 per cent dip in markets served, and 19 per cent decline in total connecting services.

Table 4 summarizes changes in layover time between the pre- and post-alliance periods.

These changes are presented in manner consistent with Table 3. Thus, the first part of the table assesses changes in the minimum connecting times available in markets over an entire week. A 24 per cent reduction in the minimum connecting time, averaged over all markets, is observed. Next, minimum daily connecting times are considered. We find a 29 per cent reduction in the minimum daily layover for the average market. Lastly, when all connections considered, the average reduction is 31 per cent.

Unlike service quantities, layover times improved for all three origins, and by roughly the same amount. Considering all services, average layovers for markets involving CPH decreased 32.3 per cent. The reductions for OSL and STO were 26.9 and 25.6 per cent respectively. The disparity in the relative gains for OSL and STO as measured by the number of services (STO gaining, and OSL losing) and the average layover times (both gaining, OSL by slightly more) points to the importance of distinguishing between these two dimensions of service output.

While Tables 3 and 4 show that the output of connecting services through GVA and ZRH increased after the SAS-Swissair alliance, they do not indicate whether this increase was due to increasing input or increased productivity. Input--as measured by the number of flights--increased from 1989 to 1991, origin to hub flights by 42 per cent, hub to destination flights by 2 per cent, and total flights by 14 per cent. Since total connecting services increased 15 per cent, while average layover times declined 31 per cent, it appears that the SAS-Swissair alliance has not affected productivity in terms of the number of connecting services, but has increased productivity from a layover standpoint (assuming that layover is inversely proportional to the number of flights). This is rather simplistic, however: more refined estimates can be obtained by actually estimating "production functions" relating service output to flight input.

We estimated two production functions of the general form:

$$\log(Y_{ij}^{ht}) = \beta_1 + \beta_2 \cdot \log(\max(Q_{ih}^t, Q_{hj}^t)) + \beta_3 \cdot \log(\min(Q_{ih}^t, Q_{hj}^t)) + \beta_4 \cdot A(t)$$

where:

$Y_{ij}^{ht}$  is the some measure of service output for the market with origin i and destination j, through hub h, at time t;

$Q_{ih}^t$  is the frequency of SAS-Swissair flights from origin i to hub h during time t;

$Q'_{hj}$  is the frequency of Swissair flights from hub  $h$  to destination  $j$  during time  $t$ ;  
 $A(t)$  is a indicator variable for the existence of the SAS-Swissair alliance at time  $t$ .

In the first model, the output variable is the number of connecting services available during a given day. In the second model, the output measure is the minimum layover time for service in particular market during a particular day. (Obviously, this output is a "bad" rather than a "good".) Thus, in both models the unit of observation is defined by a routing (i.e. an origin, a hub, and a destination), a day of the week, and a year (1989 or 1991).

The minimum and maximum of the two service frequencies are used in both models. A priori, we expect the number of services to depend more strongly on the minimum service frequency, and the maximum service frequency to be the key determinant of layover time (since this increases the set of feeder flights from which the one with the shortest layover time is chosen).

Estimation results for both models results are summarized in Table 5. The maximum and minimum frequency coefficients are largely as expected, except that minimum frequency seems to have some positive (albeit statistically insignificant) correlation with layover time. One possible explanation is that the markets with high minimum service frequencies are intra-European ones in many of which connecting services are inherently uncompetitive because of the availability of non-stop flights. The coefficients of determination of the two models are vastly different, with the first model explaining 94 per cent of the variation in services offered, and the second only 7 per cent of the variation in minimum layover time. Both models have statistically significant  $f$  statistics, however, indicating in both cases we can reject the hypothesis that all coefficients are actually zero.

Turning now to the effect of the alliance, we find a negative but statistically insignificant impact on the number of daily services, and a negative, highly significant effect on layover time. From the former result, we conclude that the service increases observed in Table 3 are the consequence of increases in flights, not improved ability of the alliance partners to assemble flights into connecting services. On the other hand, the reduced layover times found in Table 4 derive from both a productivity gain and an increase in flight inputs. The findings are in accord with those from the "simplistic" analysis with which we began this discussion.

## VI. Market Concentration Impacts

We now examine the effects of the SAS-Swissair alliance on market concentration. Studies of the U.S. domestic industry have shown that a positive relationship exists between fares and market concentration in the U.S. (Keeler and Abrahams, 1979; Bailey et al., 1985; Call and Keeler, 1984); evidence of this relationship in Europe will be presented below. A priori, we expect the impact of the alliance on concentration to be two-fold. The alliance carriers (which we treat as a single carrier for purposes of this discussion) will increase concentration in markets where the partners formally competed. On the other hand, by offering improved connecting services, the alliance may be able to establish a presence in markets where neither partner (or interline services in which both participated) had been competitive. Concentration in such markets may be reduced as the result of the alliance.

We compared market concentration prior and following the SAS-Swissair alliance, corresponding to the first week of June 1989 and 1991. Calculations of market concentration are based on the Herfindahl-Hirschman Index (HHI), which is defined as the sum of the squared market shares of all competing services in a market. For example, a market which is equally divided between two airlines will have an HHI of 0.5; or,  $(0.5)^2 + (0.5)^2$ . The HHI index has a value between zero and one, with an increasing value corresponding to a higher market concentration.

Our calculation of market share is based on services listed in the Official Airline Guide (OAG). Market share is computed based on total service frequency. On-line and interline services are treated similarly: Swissair-Air France, Air France, and SAS-Swissair could all be competing in a given market. However, SAS, Swissair, and SAS-Swissair are treated as the same airline. A pooled service (where the same flight is listed under two different airlines) is also treated as a single competitor.

Basing market share on service frequency is admittedly less satisfactory than using passenger traffic. Moreover, the OAG lists connecting services selectively: of the 94 city-pair markets for which we could construct SAS-Swissair connecting services via GVA or ZRH in 1991, only 17 have such services listed in the OAG. Unfortunately, we saw no alternative to the OAG for this analysis. Origin-destination passenger traffic data are unavailable, and we lacked resources to construct our own connections for the large number of hubs through which there are services competing with those offered by the alliance. In choosing an analysis based on OAG

service listings as opposed to none at all, we were swayed by two factors: first, the OAG listings for the markets we considered were fairly homogeneous. Listings in a given market were either all direct or all connecting, and offered comparable travel times. In the case of connecting listings, it is also reasonable to assume that the services listed are the more attractive ones (of course this may be a self-fulfilling prophecy in some cases). We thus concluded that an analysis based on the OAG would give a meaningful indication of actual changes in market concentration.

Six hub-to-hub markets were served by SAS and Swissair in 1989, although service was terminated in the Oslo-Geneva market by 1991 following the alliance. Prior to the alliance, one market (Copenhagen-Zurich) had fifth freedom service (service from a carrier of a third country) by both Thai and Alitalia, but this was discontinued by 1991. Of the six markets served in 1989, half were served by SAS-Swissair pooled service and half were served by competing SAS and Swissair service. In 1989, the HHI values in the SAS-Swissair competing markets were as follows: Copenhagen-Zurich (0.33), Copenhagen-Geneva (0.50) and Stockholm-Geneva (0.55). By 1991, all five remaining markets were jointly served by SAS and Swissair, and thus had HHIs of 1.0.

According to the OAG, eleven origin-destination markets were served by the alliance carriers in both 1989 and 1991 (Table 6). The average number of carriers (or interlining partners) serving these markets decreased from 5.6 to 5.3 between 1989 and 1991, indicating that passengers' choice of carrier has been slightly reduced. Frequency-weighted--that is, weighting each market based on total service frequency listed--average market concentration decreased from 0.22 to 0.19, while frequency-weighted average SAS-Swissair market share was essentially unchanged. At a disaggregate level, six markets experienced increased market concentration while five markets experienced decreased market concentration.

In 1991, SAS-Swissair interline service was listed in six markets where it was not listed in 1989, and represented between 24 and 52 percent of the services listed in these markets. Of the six city-pairs, four had a decrease in market concentration between 1989 and 1991, one had an increase, one market was not listed in 1989. Overall, frequency-weighted average concentration in the markets for which comparison is possible fell from .39 to .34. In sum, the alliance contributed toward a slightly lower overall market concentration in connecting markets, and greatly increased concentration in non-stop ones.

We also found a positive correlation between the change in market share of the alliance and the change in market concentration (Figure 2) for the eleven origin-destination markets



served in both 1989 and 1991, suggesting that the alliance is in the desirable position where increasing its presence in a market tends to increase the concentration in the market (see Mauldin, 1990). In order to quantify this, we have calculated (Table 7) the first derivative of the HHI index with respect to SAS-Swissair service frequency, or the marginal effect of alliance service frequency changes on market concentration:

$$\frac{\partial HHI}{\partial f_a} = \frac{2 \sum_j f_j (f_a - f_j)}{\left( \sum_j f_j \right)^3}$$

where  $f_i$  is service frequency of airline  $i$ , and the subscript  $a$  indicates the SAS-Swissair alliance airline.

For the eleven markets served by SAS-Swissair in 1989 and 1991, the value of  $\partial HHI / \partial f_a$  went from negative (-0.051) to slightly positive (0.014). Thus, whereas in the earlier period the alliance partners were in a position where increasing service would tend to reduce market concentration, by 1991 such an increase would tend (on the average) to have the opposite effect. The relationship is even more pronounced in the markets newly served in 1991, where  $\partial HHI / \partial f_a$  averaged 0.102.

## VII. Fare Impacts

In this section, we will explore the effects of strategic alliances on fare levels in non-stop markets. As observed in the last section, concentrations in these markets increased after the alliance. If the price-concentration relationship holds in this context, we expect fares to increase also.

Since the major impacts on concentration are found in the hub-to-hub markets of alliance participants, we required a data set requiring a reasonable number of such markets. Unfortunately, there were only 10 SAS-Swissair hub-to-hub markets. To increase this number, we broaden our focus from SAS and Swissair to the entire European Quality Alliance, consisting of SAS, Swissair, Austrian Airlines, and Finnair. This increases our sample size of alliance hub-to-hub

markets to 18. We analyzed fare changes between 1989 and 1991 in 59 intra-European city-pair markets (Table 8). All of the markets have their origin as a SAS or Swissair hub. Some of the markets, which we will term "intra-alliance", also have destinations at the hubs of EQA members, while others do not. We hypothesize that fares in intra-alliance markets have increased relative to fares in other markets.

Because so many different fares levels and restrictions exist, we have focused on changes in one way Y fares, the lowest unrestricted economy class fare. Data published by the Association of European Carriers (Youssef, 1992) indicates that intra-European market yields averaged 74 percent of Y fare in 1990 and 66 percent in 1988. The Y fares used were obtained from the OAG and have been converted into US\$ using the average second quarter exchange rates for 1989 and 1991 from The Economist (Intelligence Unit) Country Profiles. Furthermore, 1991 fares have been deflated based on the consumer price indices for the origin countries for the second quarter of 1989 and 1991. Table 9 presents summary evidence on means and standard deviations for changes in fare level and market concentration.

We used a simple linear model in order to capture the determinants of fare level changes. Its general form is:

$$\Delta\text{FARE} = \beta_1 + \beta_2\text{EQUITY} + \beta_3\text{SQDIST} + \sum_i H_i\text{HUB}_i$$

In this model,  $\Delta\text{FARE}$  is the real change in Y fare from 1989 to 1991. Its value will be positive if there has been a real fare increase.  $\text{EQUITY}$  is a dummy variable for intra-alliance markets. It is equal to 1 for markets between Copenhagen, Stockholm, Oslo, Geneva, Zurich, Vienna and Helsinki. We expect that alliance city pair markets will experience higher fare increases or lower fare decreases than non-alliance non-stop markets because the alliance will eliminate any form of competition between participant carriers in those markets, and that the coefficient of  $\text{EQUITY}$  will consequently be positive.  $\text{SQDIST}$  is the square root distance of the city pair market (in miles), since it is generally accepted that airline service costs vary concavely with distance; we expect the coefficient sign of  $\text{SQDIST}$  to be positive. The  $\text{HUB}_i$  are dummy variables for market origin, which may be either Copenhagen (CPH), Stockholm (STO), Geneva (GVA), and Zurich (ZRH); dummies are used to account for other conditions at hubs (for example, congestion or competition intensity) and have been used in other studies (Bailey et al., 1985; Mauldin, 1990). Fare level changes will be computed with respect to Oslo-originating

markets, so we have not included a variable for Oslo in the model.

We first applied the model to SAS origin hubs only (Table 10), so that it has the following form:

$$\Delta\text{FARE} = \beta_1 + \beta_2\text{EQUITY} + \beta_3\text{SQDIST} + H_c\text{CPH} + H_s\text{STO}$$

The regression model for SAS hub fare increases has good explanatory power (adjusted  $R^2=.84$ ). Also, in this and the fare change regression models, the test for heteroscedasticity developed by White (1980) reveals that the null hypothesis of identically distributed error terms cannot be rejected, implying that the standard error estimates of the coefficients are consistent. The coefficient for EQUITY is positive and statistically significant, indicating that fare increases in intra-alliance markets were about \$10 greater than in otherwise similar non-alliance markets. The change in fare level for passengers originating from Copenhagen and Stockholm was on average \$16.32 and \$52.89 lower than for passengers originating from Oslo; this is consistent with the earlier service characteristics results which found improvements in CPH and STO markets and a deterioration in OSL markets.

We next applied the model to 26 city pair markets which originate at Swissair hub cities (Model Two). Fare level changes are computed with respect to Zurich-originating markets, and so the ZRH variable does not appear (Table 10). Our model thus has the following form:

$$\Delta\text{FARE} = \beta_1 + \beta_2\text{EQUITY} + \beta_3\text{SQDIST} + H_G\text{GVA}$$

The explanatory power of the Swissair model (adjusted  $R^2=.44$ ) is considerably less than that of the SAS model. While the coefficient for EQUITY is positive, the value of the t-statistic is low (1.06). This implies that EQUITY is "borderline" significant, and we thus cannot reject the hypothesis that intra-alliance markets have experienced fare level changes that are similar to those experienced by non-alliance markets. We also find that fare changes in Geneva originating markets are not different from changes in Zurich markets, since the coefficient of GVA is not statistically significant.

In the final model (Model Three) we combined services from SAS and Swissair origin hubs, which increased our sample of city pair markets to 59 (Table 10). The coefficient of

EQUITY is once again positive and statistically significant, indicating that intra-alliance city pair markets have experienced a greater increase in fares between 1989 and 1991. The dummy variables ZRH and GVA are negative and statistically significant, indicating that fare level increases were approximately \$28 less in both markets than for Oslo markets. In comparison, Copenhagen and Stockholm experienced fare increases that were \$16.73 and \$51.09 less than Oslo.

Next, we introduced a market concentration variable (the HHI index described above) into each model to see if market concentration effects could be distinguished from alliance effects. Not surprisingly, our results point to multicollinearity between concentration and the variable EQUITY, since the coefficients of EQUITY became "borderline" significant upon introducing the concentration variable. When we removed the variable EQUITY, we found that the coefficient for concentration was statistically significant. Further, the collinearity diagnostics proposed by Belsey et al. (1980) reveal that a principal component with a high condition index accounts for most of the variance of the EQUITY and HHI coefficient estimates in the SAS and SAS-Swissair models, in both of which EQUITY had been found to be significant when HHI was not included. From these results, we conclude that equity alliances increase fares through increasing the effective concentration of markets in which the partners previously competed.

To compare between the fare level changes in the different markets, we calculated a set of fares which control for stage length variation (we used the mean stage length of Oslo markets) based on the third model. Our results are presented in Table 11. Real fare level changes varied significantly between the non-alliance markets of the three SAS hubs; while Copenhagen and Oslo experienced an increase of about 23 percent between 1989 and 1991, Stockholm only experienced a 14 percent increase. This allowed the average Stockholm fare to become more aligned with the fares of other SAS hubs. In comparison, non-alliance markets originating at both Swissair hubs experienced a 20 percent increase in fares during the study period. Finally, intra-alliance markets consistently experienced an additional fare increase of roughly 1.5 percent over that occurring in non-alliance markets.

Having considered changes in service and fare levels, it is natural to consider the relationship between these changes in the different markets served by the SAS-Swissair alliance. We did this by plotting fare changes against service changes (as measured by changes in the number of SAS and Swissair flights) for the five SAS and Swissair hubs, disaggregating both changes by alliance versus non-alliance destination. The results (Figure 3) suggest a negative

correlation--the greater the service increase the lower the fare increase. Various mechanisms could account for this result: lower fares result in higher demand, which in turn calls for higher capacity, while increased capacity encourages lower fares in order to keep the planes full. In any case, it appears that the alliance produced clear-cut winners--such as Stockholm and Zurich--and at least one loser--Oslo.

### **VIII. Conclusions**

As noted in the introduction, the impact of a single airline alliance is difficult to determine empirically, since the variables upon which impact is expected are subject to many other influences. Nonetheless, we have found evidence that the SAS-Swissair alliance has impacts on both technical efficiency and market performance that are consistent with a priori expectation.

First, we found the SAS-Swissair alliance is associated with increases in both the quantity and quality of SAS-Swissair connecting services through Swissair hubs. The change in quantity of services derives from increases the number of flights between SAS and Swissair hubs, but the improved quality (as measured by layover times) reflects both flight increases and better schedule coordination under the alliance. These results provide some objective support for the claim that alliances improve technical efficiency by improving vertical integration--a claim which in the past has rested largely on the subjective perceptions of passengers and their apparent preference for on-line service.

If the improved service attracts additional passengers, alliance partners generate increased traffic without expanding their networks. Other researchers (Caves et al., 1984) have found that cost savings associated with economies of network and link density can be captured in such situations. Because alliance carriers engage in external growth, traffic volume increases are not offset by network growth and thus directly lead to higher traffic densities.

Equity alliances were also found to enhance the market power of participant carriers. Because of the dominant position of alliance carriers at their hubs, competition in hub-to-hub markets was effectively eliminated by the alliance. Furthermore, the alliance partners can simultaneously increase market concentration and their own market share in connecting markets, whereas prior to the alliance these objectives conflicted.

Our results show that fares in non-stop markets between alliance partner hubs have increased more than in other non-stop markets in the same region, and that the increase was a

concentration-mediated effect. We do not have a comprehensive understanding, however, of how strategic alliances affect fare levels--data limitations did not allow us to study fare level changes in connecting markets. Nonetheless we expect that cost savings will contribute towards fare level reductions to the extent that market competition exists, while greater market power will increase fares. The balance of changes in cost and market power fare levels in connecting markets is not easy to predict without further research.

Thus the assessment of alliances involves tradeoffs: between airline profit and consumer welfare, between non-stop and connecting markets, between service quality and fares, and between different airports. Alliance carriers appear to have captured additional economic rents stemming from higher fares (and perhaps lower costs if density economies have been realized). Thus benefits mainly flow to the alliance airlines at the expense of the air passengers. Among the latter, those in connecting markets had improved services and, in light of the reductions in market concentration, perhaps reduced fares. These intra-alliance connecting passengers have thus benefited at the expense of those in intra-alliance non-stop markets. Even non-stop passengers, however, have benefited from improved services, so that quality-sensitive passengers in these markets have benefited more (or been harmed less) than fare-sensitive passengers. Lastly, the alliance has been clearly redistributive in its impact on the alliance hubs, with Stockholm and Zurich clearly benefiting and Oslo losing.

The dominant position of strategic alliance carriers at their hubs allows them to increase their market power in hub-to-hub markets. Regulation and greater competition in hub-to-hub markets may reduce the market power of alliance carriers. First, regulating fares in hub-to-hub markets might discourage alliance carriers from abusing their monopolistic position in those markets. Second, permitting liberal fifth-freedom service in hub-to-hub markets could weaken the market power of alliance carriers. Finally, encouraging new entrant carriers, while facilitating their access to attractive slots and terminal gates, might increase competition in non-stop routes and may lead to innovating pricing and new products.

Unfortunately, experience with fare regulation has lead to poor results in the past since governments tend to protect the welfare of their carriers at the expense of its traveling population. Furthermore, while competition between carriers may reduce fare levels in hub-to-hub markets, market power conferred to alliance carriers because of hub-and-spoke networks suggests that market concentration will still remain high, and experience with U.S. deregulation has shown that non dominant carriers also earn supernormal profits in concentrated markets (Mauldin, 1990).

Thus while theoretically attractive, the above mentioned regulatory actions would probably be ineffective.

Evidence of service improvement economies in this study and other research work reveal that basic structural economies encourage airline strategic alliances. From a pragmatic viewpoint, strategic alliances may be the best strategy available to most small airlines. In the case of some carriers, in fact, it may be the only means for survival. Yet we do not have good solutions to the disbenefits associated with strategic alliances, since regulation does not seem to be an effective means of protecting consumers against the enhanced market power of airlines. So while airline consolidation may be desirable from a technical viewpoint, "suboptimal" market performance may be its inevitable concomitant.

## **Bibliography**

Andrey, A. (1991). Project Leader for Industry Cooperation, Swissair. Conversations on April 29, 1991 in Los Angeles, California, USA, September 10-13, 1991 in San Francisco, California, USA, and on November 21, 1991 in Zurich, Switzerland.

Bailey, E., D. Graham, and D. Kaplan (1985). Deregulating the Airlines: An Economic Analysis. (Cambridge, Mass.: MIT Press)

Belsley, D.A., E. Kuh, and R.E. Welsch (1980), Regression Diagnostics. (New York: John Wiley and Sons)

Boeing: Boeing Commercial Airplane Group (1991). Current Market Outlook, February.

Call, G., and T. Keeler (1984). "Airline Deregulation, Fares, and Market Behavior: Some Empirical Evidence." University of California at Berkeley, Institute of Transportation Studies, UCB-ITS-RR-84-4.

Caves, D., L. Christensen, and M. Tretheway (1984). "Economies of Density versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ." Rand Journal of Economics, Vol. 15, No. 4, Winter, 471-489.

Douglas, G., and J. Miller (1974). Economic Regulation of Domestic Air Transport (Washington, D.C.: Brookings Institution)

Kapser, D. (1988). Deregulation and Globalization: Liberalizing International Trade in Air Services. (Cambridge, Mass.: Ballinger Publishing Company).

Keeler, T., and M. Abrahams (1979). "Market Structure, Pricing, and Service Quality in the Airline Industry Under Deregulation." University of California at Berkeley, Department of Economics, Working Paper No. SL-7902.

Mauldin, M. (1990). "Hub Dominance and Pricing in the Airline Industry." University of California at Berkeley, Institute of Transportation Studies, Ph.D. Dissertation Series UCB-ITS-DS-90-3.

OAG: The Official Airline Guide (Monthly). Worldwide Edition. (Oak Brook, Illinois: Official Airline Guides, Inc.).



OECD: Organisation for Economic Co-operation and Development (1988). *Deregulation and Airline Competition*. (Paris, France: OECD Publications).

Porter, M. (1980). *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. (New York: The Free Press)

SAS: Scandinavian Airlines System (1990). *Annual Report*.

Sochor, Eugene (1991). *The Politics of International Aviation*. (Ames Iowa, University of Iowa Press).

Staszheim, M. (1969). *The International Airline Industry*. (Washington, D.C.: The Brookings Institution)

Swissair (1990). *Annual Report*.

White, H. (1980), "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrics*, 48, 817-838.

White, L. (1979). "Economies of Scale and the Question of "Natural Monopoly" in the Airline Industry." *Journal of Air Law and Commerce*, Vol. 44, No. 3, 545-573.

Youssef, W. (1992). *Causes and Effects of International Airline Equity Alliances*, Ph.D. Dissertation, Institute of Transportation Studies, University of California at Berkeley, UCB-ITS-DS-92-1.

Figure 1  
Exclusive Destinations served by Swissair and SAS, 1990

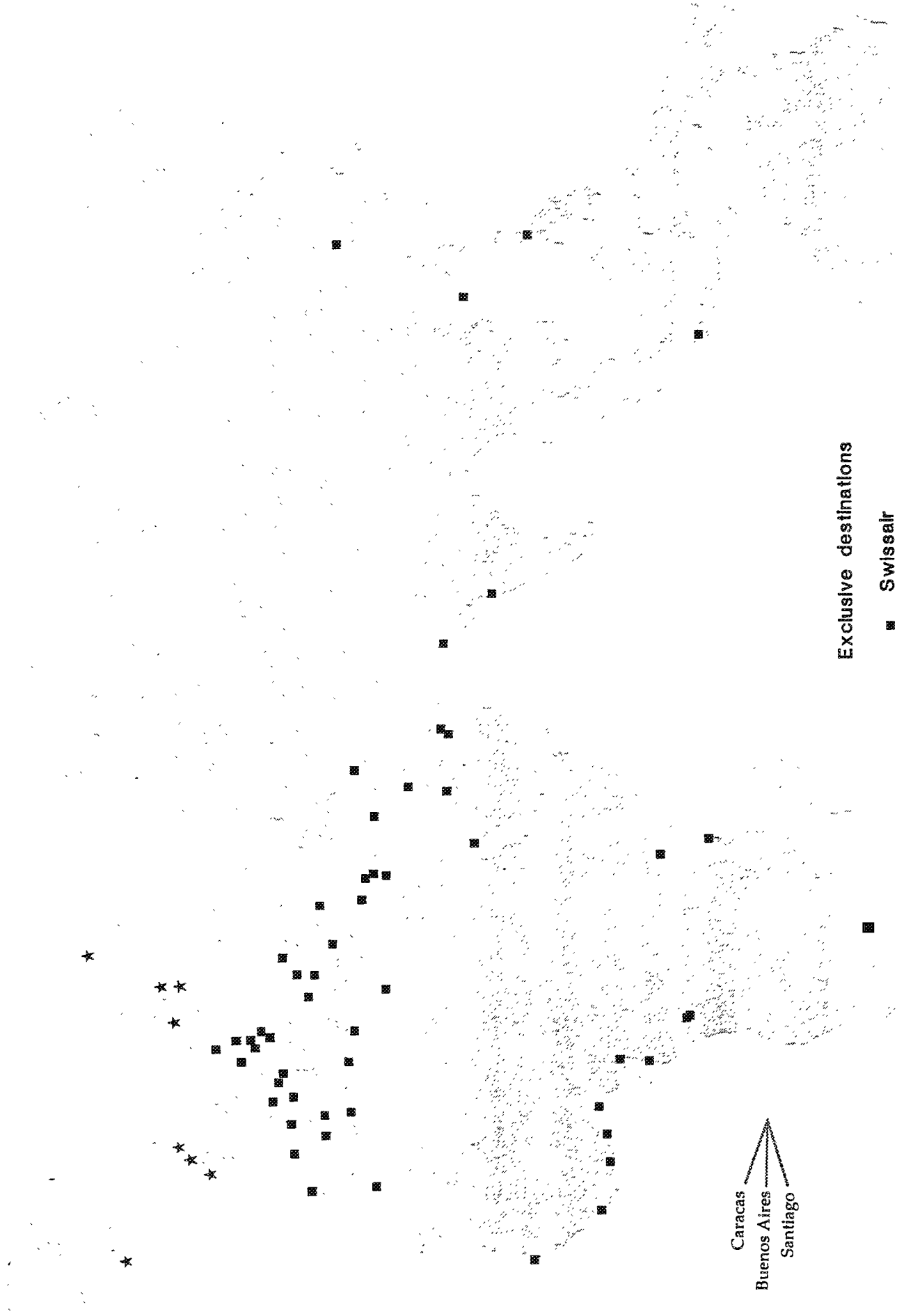


Figure 2: Change from 1989 to 1991

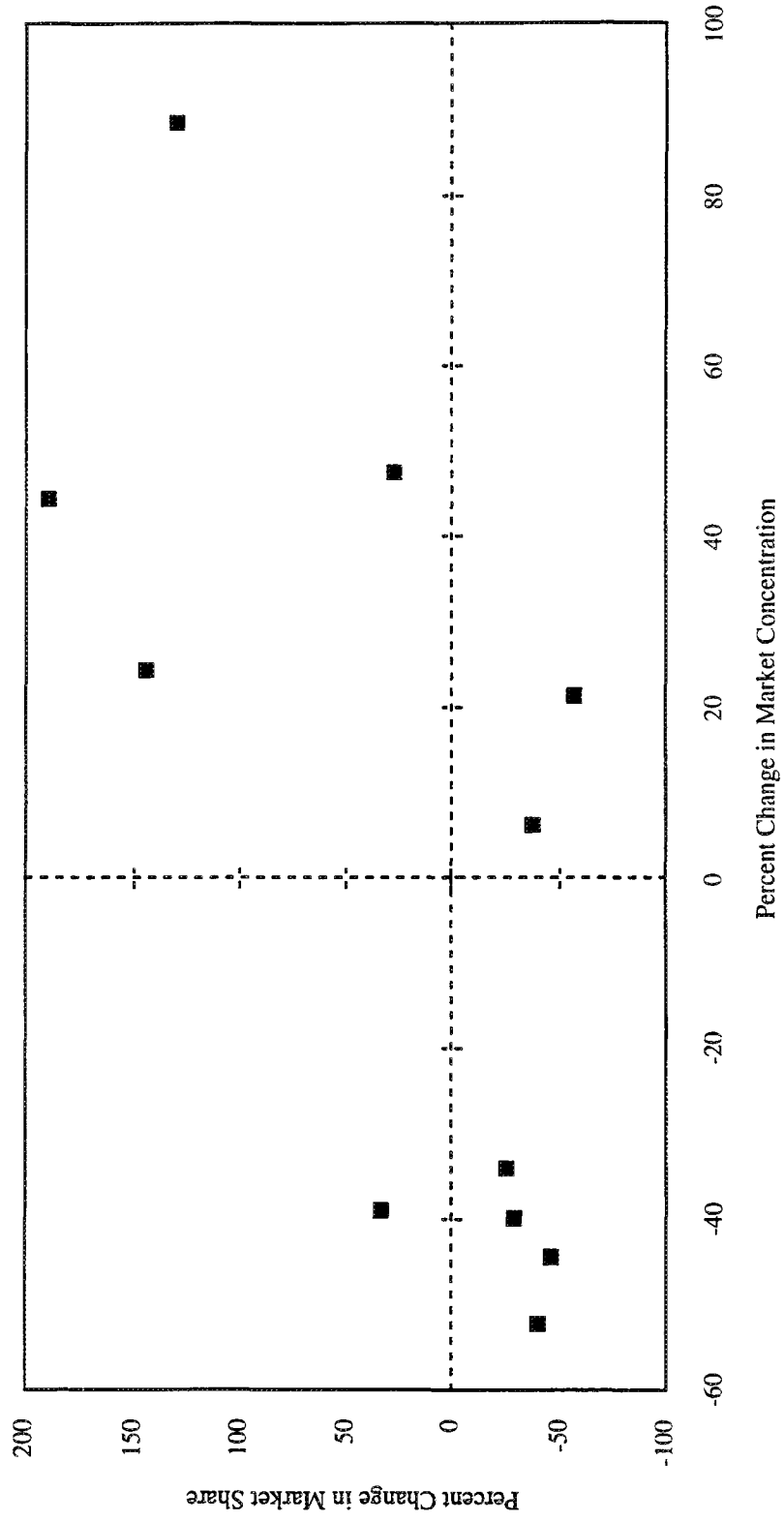


Figure 3: Change in Fare and Frequency Between 1989 and 1991

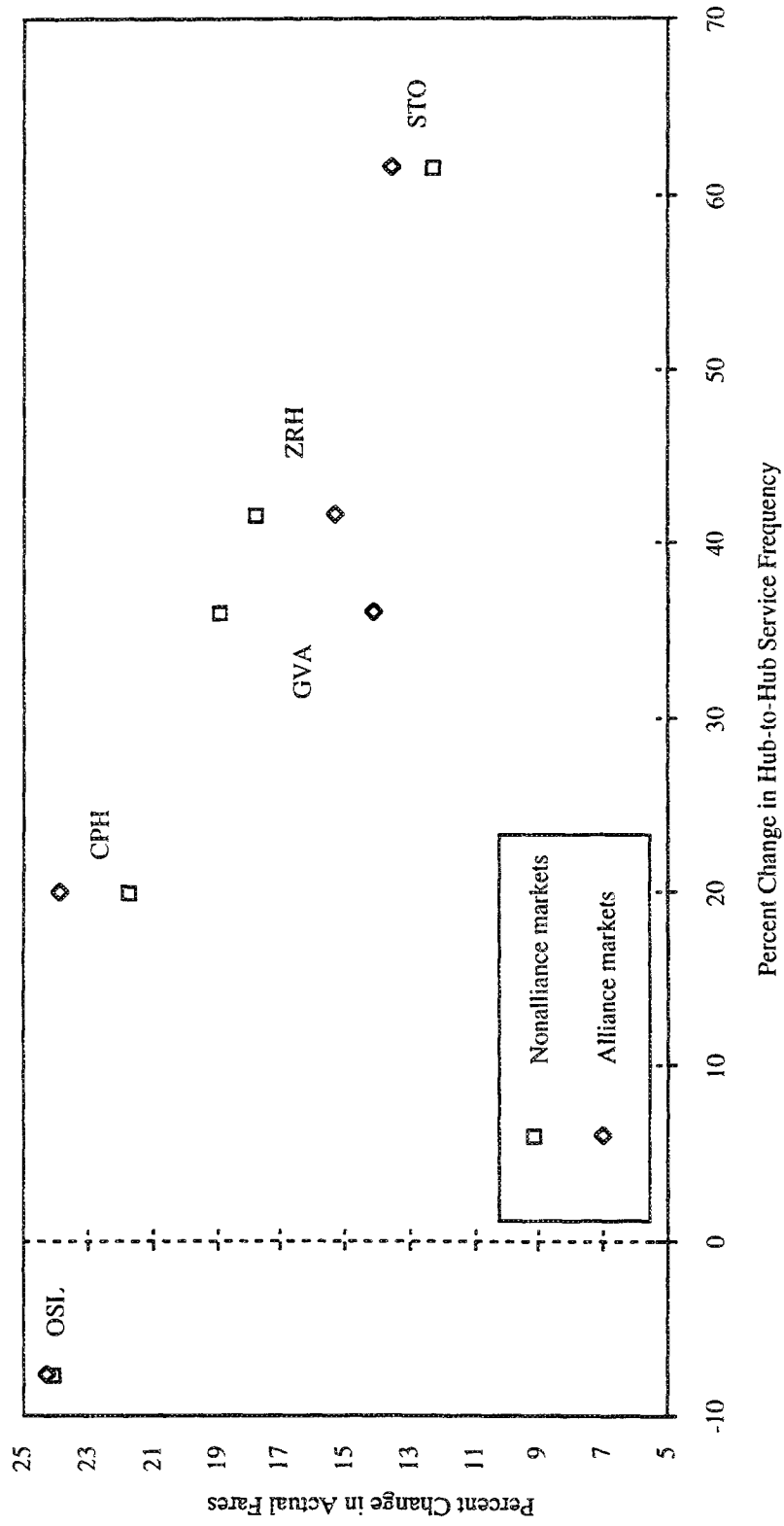


Table 1  
Comparison of U.S. and European Carrier Performance, 1989

	Revenue Passenger Kilometers (RPK) (billions)	Operating Revenues (million US dollars)	Unit Operating Costs (US cents per RPK)
<b>U.S. Carriers</b>			
American	118.3	9,961	7.81
United	112.0	9,642	7.85
Delta	95.5	8,648	8.35
Northwest	73.5	6,554	8.52
Continental	62.4	4,944	7.67
<b>European Carriers</b>			
British	60.8	7,168	10.73
Air France	36.7	5,471	14.55
Lufthansa	36.1	6,650	18.21
KLM	24.9	3,338	12.72
Iberia	21.0	2,985	13.81
Alitalia	20.8	3,505	17.38
Swissair	15.4	2,808	17.92
SAS	15.3	3,294	20.56

Source: International Civil Aviation Organisation.

Table 3  
Changes in Number of SAS-Swissair Connections

Measure	Year	Total	<i>from</i>		
			CPH	OSL	STO
Markets served	1989	83	29	28	26
during week	1991	95	35	24	35
Market- Days	1989	298	105	103	90
during week	1991	350	131	89	130
Connecting services	1989	331	117	119	95
during week	1991	382	146	96	140
Flights to Swissair	1989	72	40	14	18
hubs during week	1991	102	48	13	41

Source: constructed from SAS and Swissair timetables, June 1989 and June 1991.

Table 5  
Regression Results, Service Models

Coefficient	Associated Variable	Model One	Model Two
$\beta_1$	intercept	0.061	-2.23
$\beta_2$	Max ( $Q_{ih}^t, Q_{hj}^t$ )	0.095 (0.027)	-0.208 (0.052)
$\beta_3$	Min ( $Q_{ih}^t, Q_{hj}^t$ )	0.747 (0.029)	0.108 (0.085)
$\beta_4$	A(t)	-0.036 (0.026)	-0.186 (0.049)
Adjusted R <sup>2</sup>		0.94	0.068
F		1040	17.8

Table 7  
 Changes in Market Influence, 1989-1991  
 ( $\partial \text{HHI} / \partial f_i$ )

	All SAS hubs	Copenhagen	Stockholm	Oslo
<i>Existing markets</i>				
1989	-0.051	-0.002	-0.018	-0.031
1991	0.014	-0.025	0.024	0.015
1991 minus 1989	0.065	-0.023	0.042	0.046
<i>New markets</i>				
1991	0.102	-0.02	0.131	-0.01



Table 9  
 Statistical Evidence on Variable Means and Standard Errors

	Copenhagen	Stockholm	Oslo	Geneva	Zurich
Δ FARE	83.27 (18.68)	61.08 (23.70)	102.33 (20.08)	60.25 (30.02)	61.70 (21.07)
SQDIST	26.05 (4.64)	24.77 (7.32)	26.88 (3.27)	22.11 (6.41)	22.31 (6.60)

Standard errors in parantheses

Table 11  
 Fare Level Changes in Alliance and Nonalliance Markets, 1989-1991

	CPH	STO	OSL	GVA	ZRH
Mean Fare 1989 (\$)	373.24	485.40	424.07	362.69	371.67
$\Delta$ FARE	83.27	61.08	102.33	60.25	61.70
SQDIST adjustment	+2.32	+5.89	0.00	+13.35	+12.80
Adjusted $\Delta$ FARE	85.59	66.96	102.33	73.60	74.50
<i>Nonalliance markets</i>					
Mean Fare 1991 (\$)	458.83	552.36	526.40	436.29	446.17
Percent change	22.93%	13.79%	24.13%	20.29%	20.04%
<i>Alliance markets</i>					
EQUITY adjustment	+5.94	+5.94	+5.94	+5.94	+5.94
Mean Fare 1991 (\$)	464.77	558.30	532.34	442.23	452.11
Percent change	24.52%	15.02%	25.53%	21.93%	21.64%