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Paper for SIG-8 (ATRS Session Stream)

Airline Alliances on the north Atlantic: An analysis of traffic, market share and concentration.¹

D.E.Pitfield
Transport Studies Group
Department of Civil and Building Engineering
Loughborough University
Loughborough
Leicestershire LE11 3TU
UK
Phone +441509223416
Fax: +441509223981
E-mail: D.E.Pitfield@lboro.ac.uk

This paper examines the impact of airline alliances on traffic of the constituent airlines using an analysis of US Bureau of Transportation Statistics (BTS) T-100 International Market Data on a monthly basis for five routes to the US from European hubs. The European hubs are Frankfurt (FRA) and Paris (CDG). The period covered is January 1990-December 2003; a sufficiently lengthy period to enable the derivation of good time series models before the 'intervention' of alliance formation and development. The alliances focussed on are Air France and Delta, part of the SkyTeam Alliance and Lufthansa and United Airlines, part of the Star Alliance. It is possible to distinguish code sharing agreements and then the subsequent immunity from US antitrust legislation.

Simple examination of traffic figures examining market share, traffic volume and frequency/capacity is not very conclusive except to suggest that the impact varies by route. Causality is also an issue if the topic is examined in this manner, but much less of one if intervention analysis and ARIMA modelling is utilised. In this case, significant interventions can be identified and their impact at their start date on the whole series identified. To achieve this ARIMA models with autoregressive and moving average terms are first calibrated on stationary seasonal data before modelling the resulting residuals using similar terms. The residuals of the combined models are white noise.

It is also possible to suggest some conclusions on the differences in alliance development in the more liberal open skies environments adopted by many European countries with the more traditional, stricter regulated bilaterals that exist in others such as the UK. Competition is examined using the Hirschman-Herfindahl Index (HHI) so as to throw light on the impact of alliances on market concentration by route.

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¹ I am grateful to my former student Tom Pagliano for raising my interest in this topic and for providing much of the material on competition analysis. An alternative version of this paper, The Impact on Traffic, Market Shares and Concentration of Airline Alliances on selected European-US routes, will appear in the Journal of Air Transport Management.

1.0 Introduction

A number of publications have examined the impact of alliances, in particular, Oum *et al* (2000), the Brattle Group (2002) and Morrish and Hamilton (2002). There are expected differences in impact depending on the type of alliance. More recently, Iatrou and Alamdari (2005) have surveyed and reported on the expectations and perceived impacts of alliances. There is an expectation of a positive impact on traffic on a route as well as on the shares of the alliance members and that these impacts will be greater if the participating airlines operate hub and spoke systems based at both the origin and the destination. In addition, these impacts are thought to reach fruition “between 1 and 2 years of the inception of the partnerships” (Iatrou and Alamdari, 2005, p.129) and will be greater from the inception of antitrust immunity.

Analysis of traffic data from the US Bureau of Transportation Statistics (BTS,2005)² does not yield unambiguous conclusions in accordance with theory or expectations. Data can be analysed year on year or month on month and the picture that emerges is complex, for amongst other things, capacity on the principal routes examined here is changed by both the incumbent airlines and airlines leaving and entering the market and this causes traffic volumes to fluctuate.

Nevertheless, both the date of code sharing agreements and of immunity from US antitrust legislation can be firmly stated³, so it should be possible using ARIMA and Intervention Analysis to identify both the size and the significance of these influences on traffic by route⁴. These impacts should be able to be identified if they are significant, despite the implausibility of the *ceteris paribus* assumption; there are many other influences on traffic volumes and market shares besides alliance formation and development.

² This data is available online from 1990. Flows from the European hubs are used as an indicator of demand and generated traffic.

³ Open skies agreements exist with the Netherlands, Belgium, Finland, Denmark, Sweden, Luxembourg, Austria, Czech Republic, Germany, Italy, Portugal, Slovak Republic, Malta, Poland, France, Norway, Switzerland and Iceland, see GAO (2004).

⁴ A previous paper (Pitfield, 1993) has discussed the relative applicability of regression analysis and ARIMA models to monthly time series data. In short, ARIMA models are generally more appropriate.

The impact of alliance formation on market concentration and competition can also be identified by the examination of market share data.

2.0 Types of Alliance and Routes Selected

Previous studies of the impact of alliances have often focussed on the north Atlantic although there has been a study on transpacific routes (Oum *et al* 1996). This has been the focus, in part, because of the importance of the market both in scale and size and the role within it of the so called global alliances. To study the north Atlantic also provides an opportunity to follow up the work of Oum *et al* (2000) where a variety of alliances that were current at the time their empirical work was conducted were examined. Two of these, consisting of KLM and Northwest (NW) and United Airlines (UA) and Lufthansa (LH), are now part of SkyTeam and Star Alliance, respectively. Oum *et al* (2000) also looked at Delta (DL), Sabena and Swissair and DL is now also in SkyTeam along with Air France (AF). In addition, Oum *et al* (2000) looked at the code sharing agreement between US Air and British Airways(BA) and although BA along with, for example, American Airlines (AA), is now part of the Oneworld alliance, there is no current alliance operation involving BA from London Heathrow (LHR) on the north Atlantic⁵.

If the transatlantic market is to be concentrated on it is clear that that the European hubs of note are LHR, CDG, Amsterdam (AMS) and FRA with minor complementary roles for London Gatwick (LGW) and Paris Orly (ORY). Alliance routes from these origins to US points of entry can be examined looking at non-stop traffic⁶. However, when choosing actual routes for a time series examination, the interest is focussed on CDG and FRA as the alliances operating from these airports have a history of non-alliance operation in the early

⁵ The US General Accounting Office (GAO 2001) considered that the gains from the alliance between AA and BA and from negotiating an open skies agreement “may not offset the harms from reduced competition”.

⁶ The point of entry may not be the final destination in the US.

1990's, followed by code sharing, followed by antitrust immunity. The impact of both these interventions can be examined.

The London area airports are excluded here as despite the code sharing agreement with US Air from 1993 that was soon dissolved, there is no intervention to examine during 1990-2003. This is almost true of routes out of AMS where code sharing was initiated before 1990 and only the impact of antitrust immunity could be examined in January 1993. However, a sufficient number of illustrative alliances can be selected from the routes from CDG and FRA.

There are a variety of types of alliance that differ in the way that airlines cooperate with each other and that can also form a basis for route selection for further study. Specialist literature on this includes Hanlon (1999), Holloway (1998) and Oum *et al* (2000). However, for this paper it is important to distinguish parallel and complementary alliances. The first is where two airlines collaborate on a route where they were previously competitors. In these cases, competition is expected to decrease. The actual impact on traffic, market share and competition can be addressed, particularly as the findings of Iatrou and Alamdari (2005) suggest positive impacts on traffic by contrast to the theory on parallel alliances and the previous empirical results. Examples of such alliances are CDG to New York (JFK) with AF and DL and FRA to Chicago (ORD) with LH and UA. This Chicago route is also a good example of a route with mixed alliance and non-alliance carriers; another possible basis for route selection.

Complementary alliances are where two carriers link up their existing networks so as to feed traffic to each other. Such alliance carriers can coordinate their flight schedules, restrict output and increase fares as well as share ground facilities and frequent flyer programmes. The best examples of these are for networks beyond a US Gateway where the US carrier operates within the US but the European partner flies the north Atlantic. Empirical work by Oum *et al* (2000) suggests the biggest boosts to alliance output are experienced here but it

may well be that overall traffic declines and an example is FRA-JFK with United operating onward routes from New York, albeit not in impressive numbers. Further similar routes with onward code share connections are from CDG to Los Angeles (LAX), ORD, Boston (BOS) and Newark (EWR) as well as FRA to BOS, EWR and LAX. Preliminary investigation of these suggested that some of these were unlikely to provide good evidence of alliance impact and only, FRA-LAX and CDG/ORY-BOS were chosen to increase the sample studied in depth. In these cases, the theory suggests that fares decrease and more choice is offered to passengers as network possibilities expand. Again, the impact on traffic, shares and competition can be empirically determined.

These findings may be compared to the Brattle Group (2002) that undertook work for the European Commission where they judged that transatlantic passengers had increased by ten percent because of the open skies agreements and that a further liberalisation of the bilaterals with Greece, Ireland, Spain and the UK would raise traffic a further 2.2 million per annum.

3.0 ARIMA Modelling

ARIMA models are calibrated so as to replicate the variations in a time series. They cover all the indigenous influences on the data. The procedure here is to calibrate models on the traffic and alliance share data before the advent of the alliance. This is done by taking a logarithmic transformation of the series to ensure a constant variance before plotting the autocorrelation function (ACF) and partial autocorrelation function (PACF) so as to investigate at annual 12 month lags the pattern of spikes and attenuations to identify the seasonal ARIMA component. Seasonal differencing will be necessary before this if the ACF does not die out rapidly at these lags. If the PACF shows a single spike and the ACF attenuates then an Autoregressive model with one parameter is suggested, AR(1), whereas if it is the PACF that attenuates and the ACF that has a

spike, then a Moving Average model with one parameter is suggested, MA(1). Greater numbers of spikes suggest a greater number of parameters.

The residuals of this model are investigated to determine the non-seasonal part of the model in a similar way where non-seasonal differencing may first be required to ensure stationarity. A successful model will have white noise residuals, which can be assessed by looking at the Box-Ljung Q statistics, reasonable goodness-of-fit and preferably be parsimonious. This model form is then applied to the whole time series and intervention terms are included.

Interventions were specified for both the alliance effects as well in some cases for the entry/exit of a major competitor and 9/11. The descriptions of the analysis of each route provide the necessary detail. Interventions can be specified as abrupt step functions, which become pulses for a differenced series, and as gradual interventions. These gradual interventions will grow over a predetermined period to reach a full impact and interventions were specified here to both exponentially grow over either one or two years as well as to grow over one year at 1/12 and over two years at 1/24 per month⁷. The abrupt interventions can also have lagged impacts. This variety of interventions was investigated as the literature has suggested lagged or gradual impacts. The intervention coefficients are correctly interpreted as showing the impact on the whole series.

More formally, ARIMA models are normally described by three parameters, (p,d,q). p refers to the order of a vector of autoregressive parameters AR(p), d refers to the degree of differencing and q to the order of a vector of moving average parameters, MA(q). So a ARIMA(1,0,0) or AR(1) model can be written as

$$Y_t = \phi_1 Y_{t-1} + a_t \quad (3.1)$$

⁷ It may be more difficult in the case of these interventions than abrupt interventions to argue that no other exogenous influences are confounding the influence of the intervention of interest on the time series over the period of the gradual impact.

and using the backshift operator, $B Y_t = Y_{t-1}$

$$(1 - \phi_1 B) Y_t = a_t \quad (3.2)$$

where Y_t is the time series data and a_t is the disturbance or random shock at time t .

If the data, Y_t , is differenced before the application of the model so as to ensure stationarity, then a (1,1,0) model results and Y_t is replaced by $z_t = Y_t - Y_{t-1}$ and the backshift operator now is in terms of z_t as $B z_t = z_{t-1}$

If the model has a seasonal component, for example, if the data is gathered over a long period of time and is recorded for short intervals within this period, then it will be necessary to specify a seasonal ARIMA model. These are also described by three parameters (P,D,Q)S where P refers to the order of a seasonal autoregressive vector, D refers to the degree of seasonal differencing and Q is the order of a vector of moving average parameters. S is equal to 12 as the data is monthly with an annual periodicity. So a SAR(1) or Seasonal ARIMA(1,0,0)12 model can be written as

$$Y_t = \Phi_{12} Y_{t-12} + a_t \quad (3.3)$$

and using the backshift operator, B^{12} , which as it is raised to a power involves repeating it,

$$(1 - \Phi_{12} B^{12}) Y_t = a_t \quad (3.4)$$

If seasonal differencing is required, then this model is applied to the seasonal differences, $w_t = Y_t - Y_{t-12}$.

Combining the two model components multiplicatively, gives an ARIMA(p,d,q)(P,D,Q)S model which can be generally represented as

$$\phi_P(B^S) \Phi_p(B)(1-B)^d(1-B^S)^D z_t = \theta_q(B) \Theta_Q(B^S) a_t \quad (3.5)$$

Variations can be derived from (3.5), for example an ARIMA (1,1,0)(1,1,0)12 is applied to the regularly and seasonally differenced data where

$$w_t = z_t - z_{t-12} = (Y_t - Y_{t-1}) - (Y_{t-12} - Y_{t-13})$$

and is given by

$$w_t = \phi_1 w_{t-1} + \Phi_{12} w_{t-12} - \phi_1 \Phi_{12} w_{t-13} + a_t \quad (3.6)$$

and using the backshift operators, B and B¹² now applied to w_t

$$(1 - \phi_1 B)(1 - \Phi_{12} B^{12}) w_t = a_t \quad (3.7)$$

Inspection of the ACF and PACF determine p,d,q and P,D,Q as indicated above, although it is the consensus that this process is as much art as science. There is a tendency to favour parsimonious models as well as to avoid some mixed models which may suffer from parameter redundancy (McDowell et al, 1980). A good text on the subject is Wei(1994).

4.0 Time Series Intervention Analysis by Route

4.1 Paris-New York (CDG-JFK)

On the route from CDG to JFK, AF and DL formed a code sharing agreement in June 1999 (SkyTeam)⁸ and received antitrust immunity in January 2002 as final approval was given to the application⁹. However, examining traffic by quarters both one year and two years after these interventions suggests that traffic was particularly stimulated in the year after code sharing and less so two years after immunity. The AF/DL share appears to have been little affected by code sharing or antitrust immunity. These data are shown in Table 4.1

⁸ Delta Airlines Annual Report (1999) at <http://investor.delta.com/edgar.cfm?DocType=Annual&Year=>

⁹ This application was filed in August 2001 (see Thomas Crosbie Media, 2001 at <http://archives.tcm.ie/breakingnews/2001/12/04/story32172.asp>), agreed in October (see Lu, 2003, Chang *et al*, 2004) and finally approved in January (Delta Airlines Annual Report, 2002 at <http://investor.delta.com/edgar.cfm?DocType=Annual&Year=>).

and Figures 4.1 and 4.11 show both traffic and share data and the timing of the interventions. Such increases in output seem contrary to the theoretical impacts of parallel alliances but not to the expectations of airlines (Iatrou and Alamdari , 2005)

Intervention variables were specified that represented an abrupt impact on the appropriate date; a lagged abrupt impact, one year after and a gradual exponential intervention effect, culminating in a full impact one year after the date of the change in alliance status. In addition, the entry of AA in October 1999 was represented by an abrupt intervention variable.

The usual ARIMA procedures were followed to yield models on the total traffic and the alliance share of the total traffic before the interventions. These models are parsimonious and have white noise residuals. These model forms are then applied to the whole data series, including the interventions.

The analysis of the traffic yielded no significant interventions as did the analysis of shares, although the intervention of American is nearly significant on the share data and has the right negative sign.

It seems the fluctuations of traffic and shares on this route were not primarily due to the influence of variables representing alliance formation and refinement but to other indigenous influences on traffic, such as those that traditionally appear in demand models along with adjustments to timetables and capacity/frequency not to mention the impacts of competitors and exogenous factors such as 9/11. As this last influence occurred before the final approval of antitrust immunity it was specifically accounted for so as not to risk an inaccurate estimate of the intervention terms of interest. It was treated as an abrupt intervention term. As would be expected, there was a significant impact on total traffic from 9/11, although not on the alliance share. Total traffic was reduced by some 42 percent with $t = -3.673$ but the alliance interventions remained insignificant

and as a result it is difficult to tell whether these impacts are in accordance with the theory or the expectations of airlines but is likely they are in accordance with neither.¹⁰

4.2 Paris-Boston (CDG/ORY-BOS)

At various times since 1990, AA, AF, TWA and NW have operated from CDG to BOS. From early 1997 to mid 1998, no service was offered from CDG whilst AA offered service from ORY. To avoid the difficulty of having zeros in the data series for traffic where the procedures may demand that logarithms are taken, the traffic from both Paris airports is examined here. This seems to show a steady growth that coincides with the introduction of code sharing but little impact from the approval of antitrust immunity. The SkyTeam Alliance shares show a different picture as this has increased both by one year after code sharing and especially two years later. However, this is likely to be a function of changes in capacity and participation on the route because for two months in the second quarter of 2003, AF was in a monopoly position as it was in early 2003 and 2004. At other times, when only AA operated the route, AF's share was zero so this introduces a time series analysis problem that cannot be solved by meaningful aggregation as in the case of traffic data. Data on traffic and shares is shown in Table 4.2 and Figures 4.2 and 4.22.

The traffic can be modelled with a (1,1,0)(2,1,0)₁₂ ARIMA model, although McDowall et al (1980) suspect that two parameter seasonal autoregressive models are rare. This yields a lower root mean square error than the alternatives and any spikes in the ACF of the residual are not at seasonal peaks and are hardly significant. Experimenting with a variety of specifications of intervention terms sometimes yields nearly significant terms for the advent of code sharing. The most significant indicate that code sharing immediately reduced total traffic by some 15 percent ($t=-1.076$). It seems the impact of the alliance was to reduce total traffic. However, the terrorist attacks of 11th September 2001 take place immediately before the antitrust immunity was

¹⁰ The detailed ARIMA results are available on request from the author. One difficulty with the French routes studied here is the short time series after antitrust immunity.

approved so it is necessary to investigate this intervention specifically. In this way we can see that as an abrupt intervention the impact of terrorism on this route was to reduce it by some 50 percent ($t = -3.065$) whereas the intervention for alliance interventions remain insignificant.

Examining alliance share presents a difficulty as for some of the months traffic was zero and this, of course, prevents a logarithmic transformation to make the variance of the data a constant.

4.3 Frankfurt-New York (FRA-JFK)

LH operates on the route from FRA to JFK. It has had a code sharing agreement (Star Alliance) from June 1994¹¹ with UA and antitrust immunity was received in May 1996¹². This is a complementary alliance. Another Star Alliance member as of 2000, Singapore Airlines (SQ), also has a presence on the route, operating from 1992. However, examining traffic by quarters both one year and two years after these alliance related interventions suggests that traffic was not particularly stimulated in the year after code sharing and after immunity, total traffic fell. This is contrary to the theoretical expectation from such an alliance but the figures may reflect the withdrawal of Trans World Airlines (TWA). The alliance share appears to have been slightly stimulated after code sharing and stimulated much more as a result of gaining immunity after Germany signed an open skies agreement making it easier to add frequencies on the route. These data are shown in Table 4.3 and Figures 4.3 and 4.31 show both traffic and share data and the timing of the interventions.

The analysis of the traffic did not yield significant interventions, which might be surprising, but the intervention for LH share shows a significant negative impact of the initial code sharing agreement. This is significant if modelled as a gradual intervention and nearly significant if an abrupt impact is used. It seems quite surprising that the apparent surge in share after immunisation is not captured but clearly the timing of

¹¹ Star Alliance Press Room (1994), http://www.staralliance.com/star_alliance/press_room/brief_history/brief_history.html

¹² See the United Airlines Annual Report (1996), p13 at <http://ir.united.com/phoenix.zhtml?c=83680&p=irol-reportsAnnual> and Chang *et al* (2004).

the interventions is all important. The quarterly fluctuations reflected in Table 4.3 reflect other influences that are not expressly modelled and the interventions do not seem to capably reflect either the theory of complementary alliances or the expectations of airlines.

4.4 Frankfurt-Chicago (FRA-ORD)

LH also flies from FRA to Chicago O'Hare (ORD) as in this case do UA and both airlines hub at both origin and destination¹³. This is a parallel alliance and Table 4.4 shows traffic figures for selected quarters. Compared to JFK, the passenger numbers are lower, but there seem to be clear increases in traffic due to the alliance especially two years after the gaining of antitrust immunity. This is also reflected in the data on shares.

The airline in competition throughout this period is AA who also hub at ORD. Their traffic share fell throughout this period to the particular benefit of UA. The Star Alliance partners increased capacity both in terms of frequencies and seats available, whilst AA did not change service offerings in any significant manner.

Figures 4.4 and 4.41 show the traffic and shares by month over the period 1990-2003 and the timing of the alliance interventions. It appears on the basis of expectations that the best case for a significant positive intervention impact can be made for this route as the alliance partners hub at both FRA and ORD.

Both the traffic data and the alliance share pre-intervention can be modelled with $(1,1,0)(1,1,0)_{12}$ ARIMA models. These models have white noise residuals. Specifying a variety of intervention variables yields interesting results. From the best result on traffic, it appears that the advent of the code sharing agreement between LH and UA led to an abrupt positive impact of 16 percent, although the t statistic is not quite

¹³ The code sharing agreement and the details of antitrust immunity are shown in section 4.4 on FRA-JFK.

significant at 1.62. Nevertheless, this magnitude of impact is consistent with the observed changes in traffic shown in Table 4.4. Examining the alliance shares of the market, interventions are best modelled with an abrupt impact mirroring the impact previously found on traffic from code sharing and an exponentially weighted gradual intervention effect resulting from immunity culminating in its full impact two years later. Again, the *t* statistics are not significant, but the intervention coefficients at 2 percent and 8 percent are totally in accordance with the tabulated figures, being of the correct absolute and relative size. It seems in this case that the claims for the impact of alliance formation on traffic and market share, when the participants hub at both ends of the route, may well be supportable. By contrast, there is no support for the notion that parallel alliances result in a decline in traffic.

4.5 Frankfurt-Los Angeles (FRA-LAX)

This final route was chosen for two reasons. First, it appears to be a good example of a complementary alliance with UA and LH hubbing at LAX and FRA respectively. In addition, there is a presence on the route of another alliance member, Air New Zealand (NZ), which is in competition before joining the alliance in March 1999 whereupon it code shared with LH on the main capacity offered on the route, along with UA and other partners, such as Scandinavian (SK). NZ also offered a weekly service that was not subject to a code share until it withdrew in April 2001, leaving LH as the monopoly carrier.

Table 4.5 shows the traffic data and the alliance share on average for the quarters at the time of the two interventions and one and two years later. The monthly traffic and shares are shown in Figures 4.5 and 4.51. It appears traffic was stimulated to a new plateau level by one year after code sharing whereas there appears to be little change as a result of antitrust immunity, with the exception of a decline after two years. The share data appears to show little impact from code sharing but a large impact from antitrust immunity. However, in June 1997 DL withdrew from the route roughly one year after the alliance gained antitrust immunity and this is probably the major impact on the changes in market share shown here in the Table.

A (1,1,0)(2,1,0)₁₂ ARIMA model successfully models the total traffic before alliance formation giving white noise residuals and investigating the variety of intervention terms provides weak evidence that there was a positive abrupt impact on traffic after code sharing although the t statistic is not significant. The impact of antitrust immunity also appears to be positive, but the significance is weaker and the coefficient smaller. These results are consistent with the inferences drawn from Table 4.5. On shares, an identical model form accounts for the pre-intervention data. The most significant results for interventions suggest that code sharing had a positive impact, albeit gradual, culminating in a full impact one year later. The coefficient is 0.220 with a $t = 1.187$. Antitrust immunity, by contrast, has an immediate negative impact. The coefficient is -0.116 with $t = -2.091$. This doesn't appear to be consistent with Table 4.5 where the alliance share grows, perhaps in part because of the withdrawal of DL from the route 11 months after the intervention. The alliance share may grow because of this, rather than the intervention. However, it must be remembered that in these Tables monthly figures are being examined after averaging whereas the ARIMA models work directly on the monthly data. It is better to look at Figure 4.51 where it can be seen that a negative immediate impact is quite consistent with the time series data before the withdrawal of DL. Antitrust immunity had the impact of lowering the market share of the alliance.

5.0 Market Concentration and Competition

Apart from the impact on traffic by route and the shares of the incumbents, the same data can be used to look at market concentration using the Hirschman-Herfindahl index. This is a standard way of examining competition and was initially used in a proposed soft drinks case merger in the US (Stiglitz, 1993). Indeed, it is a standard means of measuring the acceptability of mergers and alliances and of their impact on market share and competition.

The index is given by,

$$HHI = S_1^2 + S_2^2 + S_3^2 + S_4^2 + \dots S_n^2$$

where S_i^2 is the market share of individual firms i (airlines here) and it is used by the UK Office of Fair Trading, the US Department of Justice and the US Federal Trade Commission. Values of HHI of less than 1000 are said to represent an unconcentrated and very competitive market whereas market values greater than 1800 represent concentration and a relative absence of competition. If mergers and alliances were to raise the HHI above 1800 then the merger would be challenged however when the statistic is already above 1800, any proposed merger should not result in an increase of more than 100.

If this index is calculated on an annual basis using market share data by route for the non-stop direct services being examined, then the competitiveness of routes can be seen as can the impact of the alliances¹⁴. This data is shown in Table 5. For the CDG-JFK route it can be seen that the market is concentrated with HHI values well over 1800. Indeed, the trend seems to be an increase in concentration and that this has been accentuated by the alliance as the hypothetical figures in brackets indicate. These figures show the HHI if, *ceteris paribus*, the airlines shares were not considered to be in the alliance. It seems that the AF/DL alliance reduced competition and increased the alliance market power.

The figures for CDG/ORY-BOS show a high concentration of shares, indeed, for one year AF has a monopoly position. It is not clear that there is a discernible trend over time but whereas the advent of code sharing seems to have had little impact, the advent of open skies seems to have lessened competition.

The data in the Table for the FRA routes also suggests that competition has declined although there are some differences to be observed between JFK, ORD and LAX. JFK has the most competition before the alliance

¹⁴ This analysis only covers the north Atlantic and so ignores any possible increase in service offerings and competition *from* US gateways.

was formed whereas for ORD, it appears that the alliance has clearly inhibited competition despite the aims of the open skies agreement¹⁵. This can be seen by comparing the bracketed figures for HHI with the figures for the alliance. The LAX figures show a decline in concentration before code sharing which appears to have had little impact and then a sharp increase in concentration from the antitrust intervention until LH becomes the monopoly carrier.

The Table also includes a column for the LHR-JFK route that is not covered elsewhere in the paper. This has been included for two reasons. The first is to enable comparison between the open skies routes to JFK and that from LHR and second to roughly estimate the likely impact of any alliance on this route between AA and BA. It can be seen that generally, there is more competition at LHR despite the constraint on slots. The figures are always much lower than for CDG and are only higher than FRA in four years and none of these are after FRA-JFK gains its antitrust immunity. In addition, an alliance would increase concentration, as it does on other routes as the hypothetical bracketed figures show, but even in this case it would still be more competitive than CDG and since 2001 than FRA-JFK. These results appear to support the findings of the US GAO(2001) that competition would be reduced.

6.0 Conclusion

For the parallel alliances the intervention analysis shows that for CDG-JFK there is no significant effect whereas for FRA-ORD it appears there was an almost significant positive impact on traffic from code sharing in accordance with the expectations argument, especially as the alliance partners hub at both ends. However the result does not support the theory of parallel alliances.

¹⁵ It is hard to imagine a competitor appearing on this route. For example, AA, the largest carrier in the world that hubs at ORD, is less likely to attempt to compete with the Star Alliance than it might have been with the constituent carriers. I am grateful to Pagliano for this point.

By contrast, the complementary alliance intervention analyses for CDG/ORY-ORD and FRA-BOS provide weak evidence that traffic and shares fall which counters the predictions of both theory and expectations. The stronger evidence for FRA-JFK is for a significant negative impact on share from code sharing. The FRA-LAX route, by contrast, provides weak evidence of a positive impact on traffic after code sharing and stronger evidence of a gradual positive impact on shares achieved within a year of code sharing. This supports both theory and expectations. By contrast, the strongest intervention effect is found for this route where antitrust immunity has a negative impact on alliance market share. This again is contrary to theory and expectations.

It seems that the fluctuations in traffic and traffic shares has more to do with the *ceteris paribus* conditions than with alliance formation and development, despite the expectations of airlines and the hypotheses of theory. The observed traffic is a product of the interaction of demand and supply through changes in frequency and aircraft size. Over a long period of time, the ARIMA models are able to mimic this traffic based implicitly on these underlying variables. As no intervention representing alliance activity is significant, it can be concluded that although supply and pricing may be affected by such activity, the existing ARIMA models are able to deal with the resulting variations in traffic. Whereas it might be expected that alliance activity would lead to changes in traffic that disturbed the status quo, the insignificance of the interventions suggests that this is not so. Alliance activity does not result in changes in traffic beyond what ARIMA models based on past demand and supply can successfully model.

The analysis of market concentration is instructive as it shows that competition declined irrespective of alliance type. The impact of parallel alliances has this expected result. More suggestively, the comparison of the LHR route demonstrates both the lesser market concentration on LHR-JFK, despite the slot constraints at LHR and the debilitating impact that an alliance between BA and AA might have had on competition.

It is hard to see how these results can be viewed as compatible with the views of the Brattle Group (2002) that the spread of open skies agreements will increase transatlantic traffic. Open skies agreements do not seem to result in either a significant growth in traffic or in increased competition. Indeed, the strength of the alliances could act as a barrier to entry, contrary to the rhetoric that surrounds open skies policies¹⁶. However, the deliberate focus of this paper on the north Atlantic clearly ignores markets where open skies policies might satisfy their rhetoric when a large volume of latent demand is satisfied as especially restrictive bilaterals are replaced, for example, the possible case of Japan.

Although this paper has been able to reach some conclusions on traffic, shares and market concentration it has not touched on the other issues which determine the desirability of alliances, namely, profitability. If extra passengers are obtained this may be through yield dilution and although sharing between the partners increases across many aspects, it is not obvious that costs will decrease. These aspects need to be further researched to add to the conclusions from this paper.

¹⁶ Pagliano first suggested this conclusion.

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Table 4.1

Paris (CDG) – New York (JFK)

Traffic

	A	B	C
	Average monthly traffic in the quarter including start of intervention	Average monthly traffic in the quarter 1 year after A	Average monthly traffic in the quarter 2 years after A
Code sharing	42,573	54,529	58,128
Immunity	33,290	32,817	36,339

Alliance Share %

Code sharing	73.2	72.1	71.1
Immunity	77.9	77.4	75.8

Table 4.2

Paris (CDG/ORY) – Boston (BOS)

Traffic

	A	B	C
	Average monthly traffic in the quarter including start of intervention	Average monthly traffic in the quarter 1 year after A	Average monthly traffic in the quarter 2 years after A
Code sharing	12,858	13,481	14,767
Immunity	10,434	8,924	10,004

Alliance Share %

Code sharing	47.2	61.7	69.8
Immunity	65.2	100.0	100.0

Table 4.3

Frankfurt (FRA) – New York (JFK)

Traffic

	A	B	C
	Average monthly traffic in the quarter including start of intervention	Average monthly traffic in the quarter 1 year after A	Average monthly traffic in the quarter 2 years after A
Code sharing	42,064	42,856	43,090
Immunity	40,623	29,872	32,630

Alliance Share %

Code sharing	30.6	32.7	32.5
Immunity	33.0	46.5	51.7

Table 4.4

Frankfurt (FRA) – Chicago (ORD)

Traffic

	A	B	C
	Average monthly traffic in the quarter including start of intervention	Average monthly traffic in the quarter 1 year after A	Average monthly traffic in the quarter 2 years after A
Code sharing	17,889	21,030	22,392
Immunity	22,392	23,632	32,472

Alliance Share %

Code sharing	73.1	74.5	76.8
Immunity	76.8	79.4	83.5

Table 4.5

Frankfurt (FRA) – Los Angeles (LAX)

Traffic

	A	B	C
	Average monthly traffic in the quarter including start of intervention	Average monthly traffic in the quarter 1 year after A	Average monthly traffic in the quarter 2 years after A
Code sharing	14,511	18,264	18,622
Immunity	18,622	19,319	17,134

Alliance Share %

Code sharing	51.1	54.4	51.4
Immunity	51.4	74.4	83.7

Table 5

Hirschman- Herfindahl Concentration Index

Year	CDG-JFK	CDG/ORY-BOS	FRA-JFK	FRA-ORD	FRA-LAX	LHR-JFK
1990	3295.2	7876.5	3137.8	3845.7	6281.8	2709.9
1991	3530.6	6542.3	2637.0	3387.8	6390.0	2419.8
1992	4934.6	4074.2	2423.4	3448.8	3766.5	2935.2
1993	4947.3	4129.8	2431.7	3475.4	4002.7	2330.5
1994	4989.3	5202.3	2190.4	6055.3	3926.3	2282.0
1995	4825.2	10000.0	2319.3	6197.7 (3484.4)	3818.1	2347.8
1996	4640.9	5196.7	2256.0	6357.3 (3470.9)	3743.5	2542.5 (4480.9)
1997	4492.5	9461.9	2991.0	6860.7 (3625.0)	5430.3	2481.0 (4304.3)
1998	4109.3	5672.1	3614.7	6834.4 (3556.8)	6789.7	2442.1 (4133.5)
1999	5329.2	5005.1	3477.1	7119.6 (3674.7)	7627.1	2410.4 (4014.7)
2000	5602.1 (3874.7)	5437.8	3660.3	7507.9 (3865.7)	7606.0	2357.4 (3805.0)
2001	5657.8 (4229.8)	5789.9	4626.0	7469.8 (3856.8)	8988.2	2248.2 (3629.5)
2002	6684.9 (3960.6)	6070.4	4641.3	7433.6 (3840.8)	10000.0	2450.5 (4206.4)
2003	6799.9 (4830.3)	7469.2	4908.0	7206.7 (3783.1)	10000.0	2559.1 (4285.9)

Figure 4.1: Traffic CDG-JFK 1990-2003

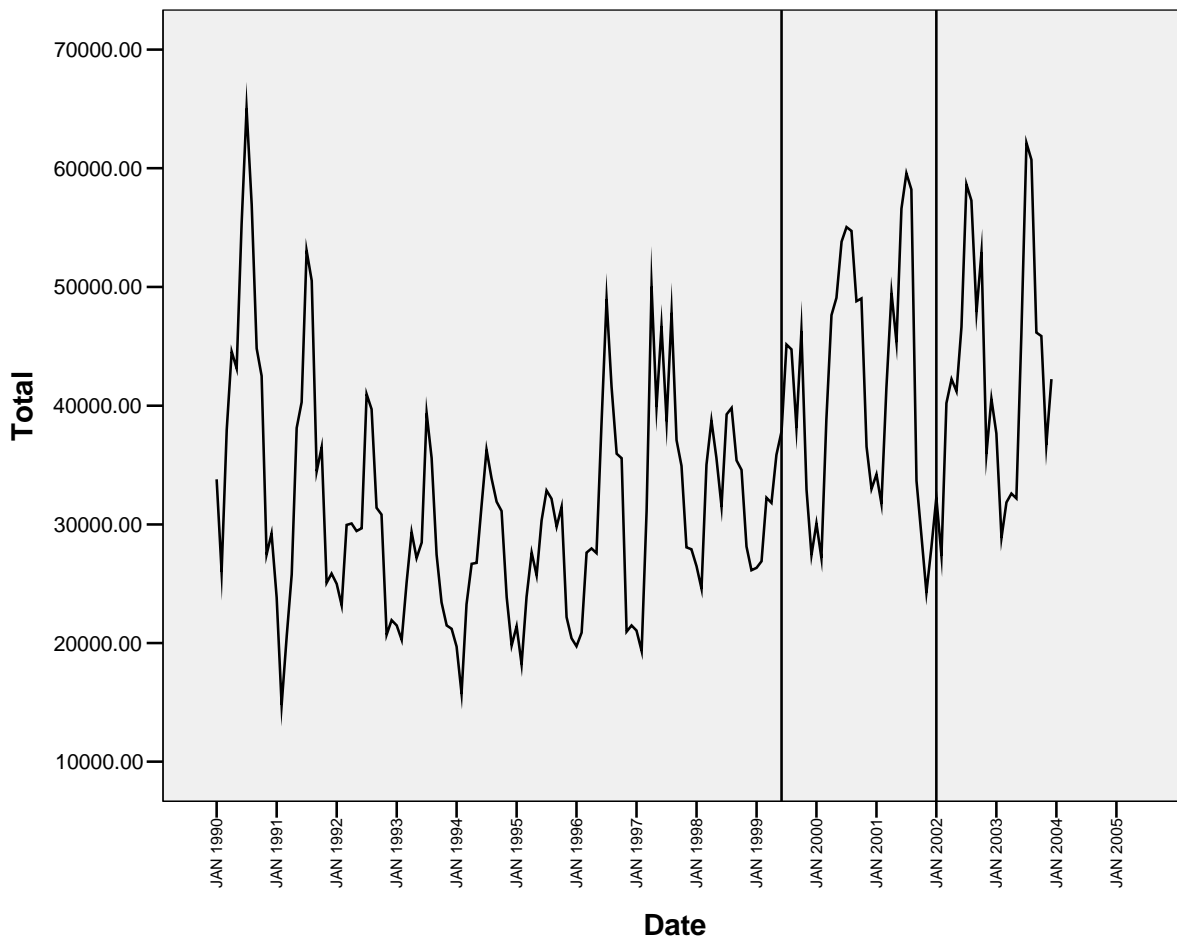


Figure 4.11: Alliance Share, CDG-JFK 1990-2003

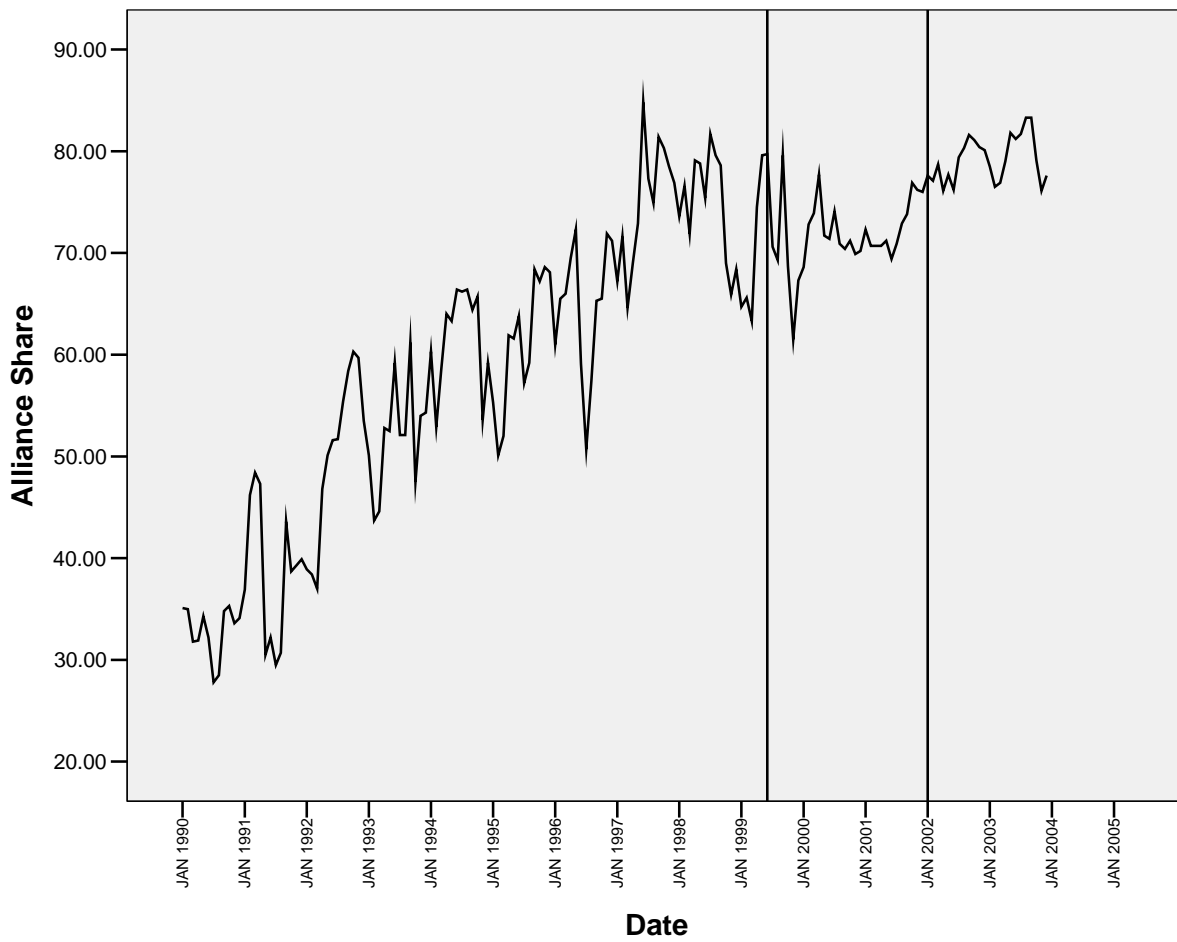


Figure 4.2: Traffic CDG/ORY-BOS 1990-2003

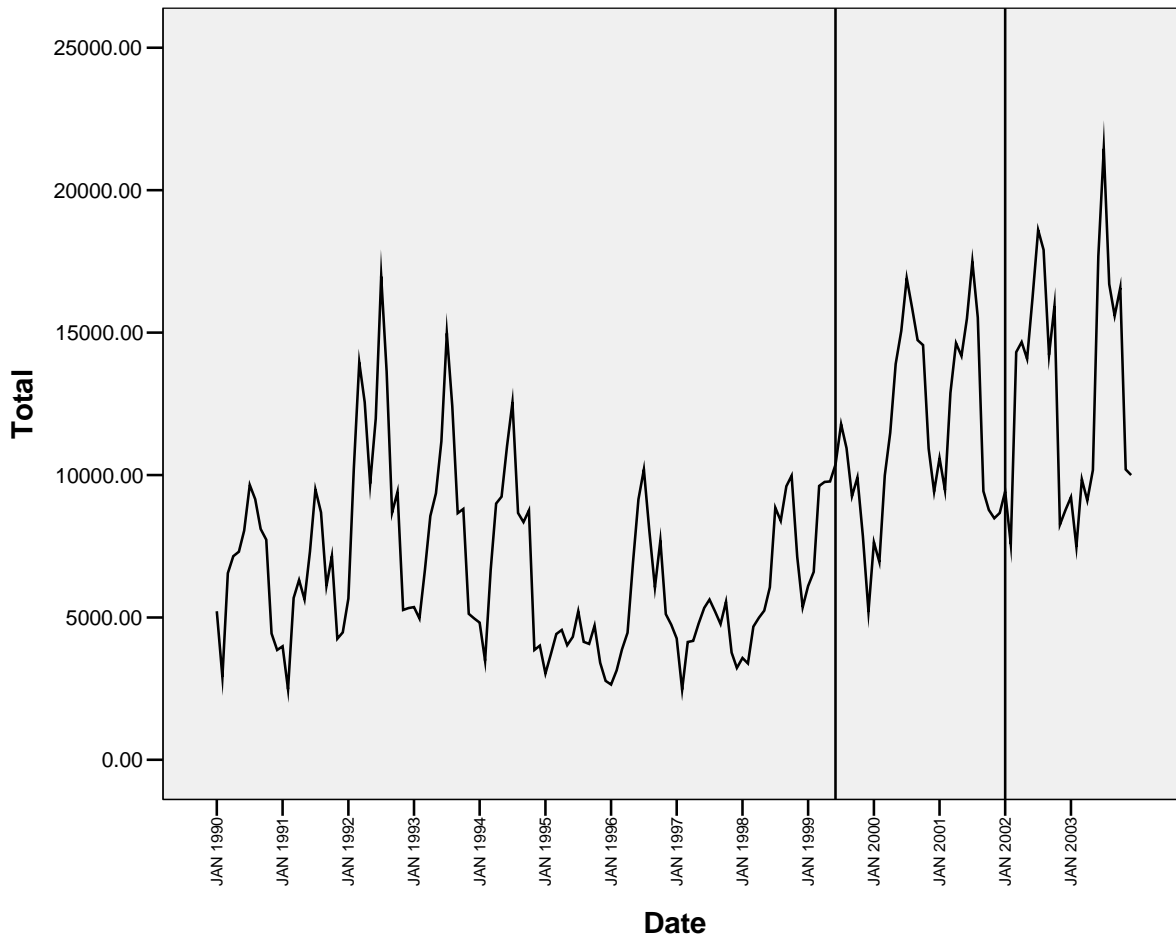


Figure 4.21: Alliance Share, CDG/ORY-BOS 1990-2003

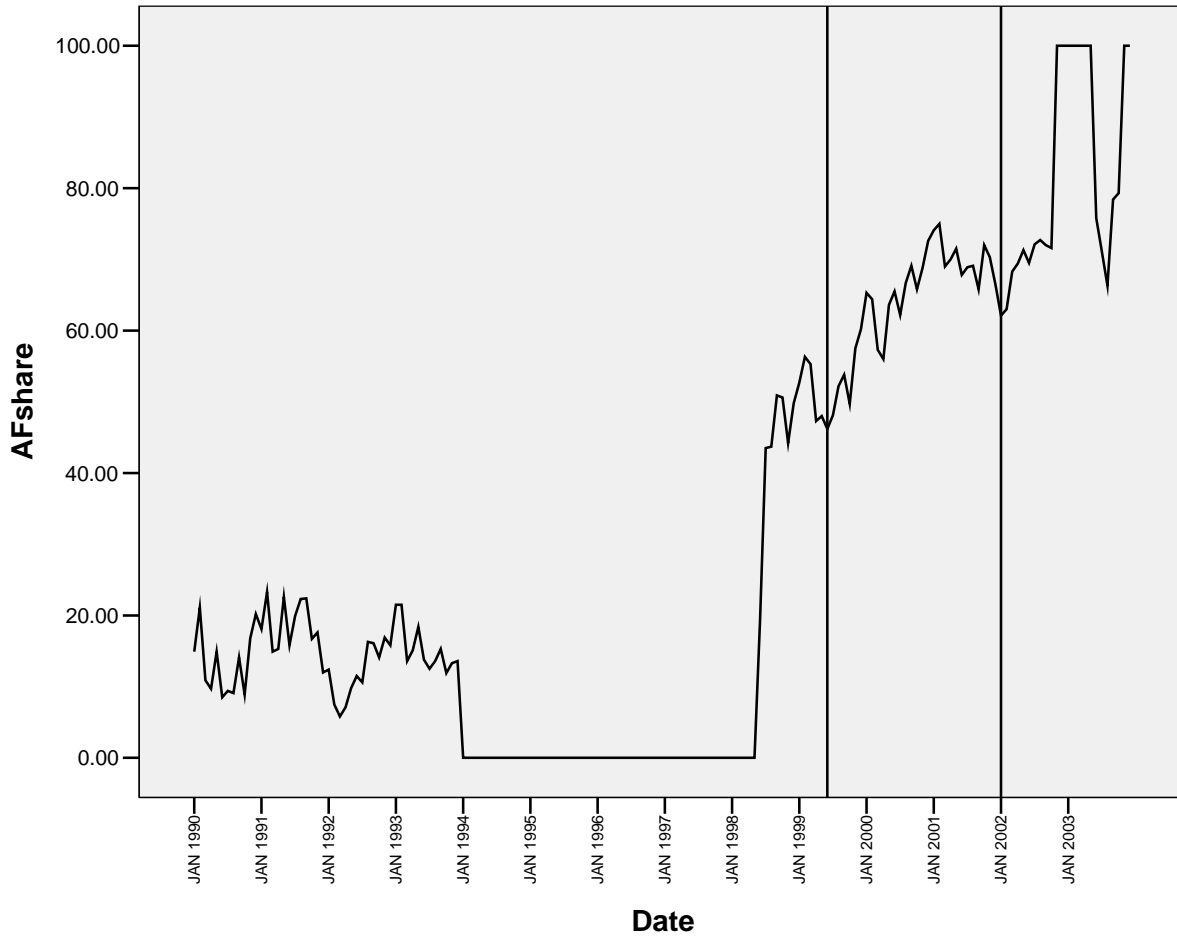


Figure 4.3: Traffic FRA-JFK 1990-2003

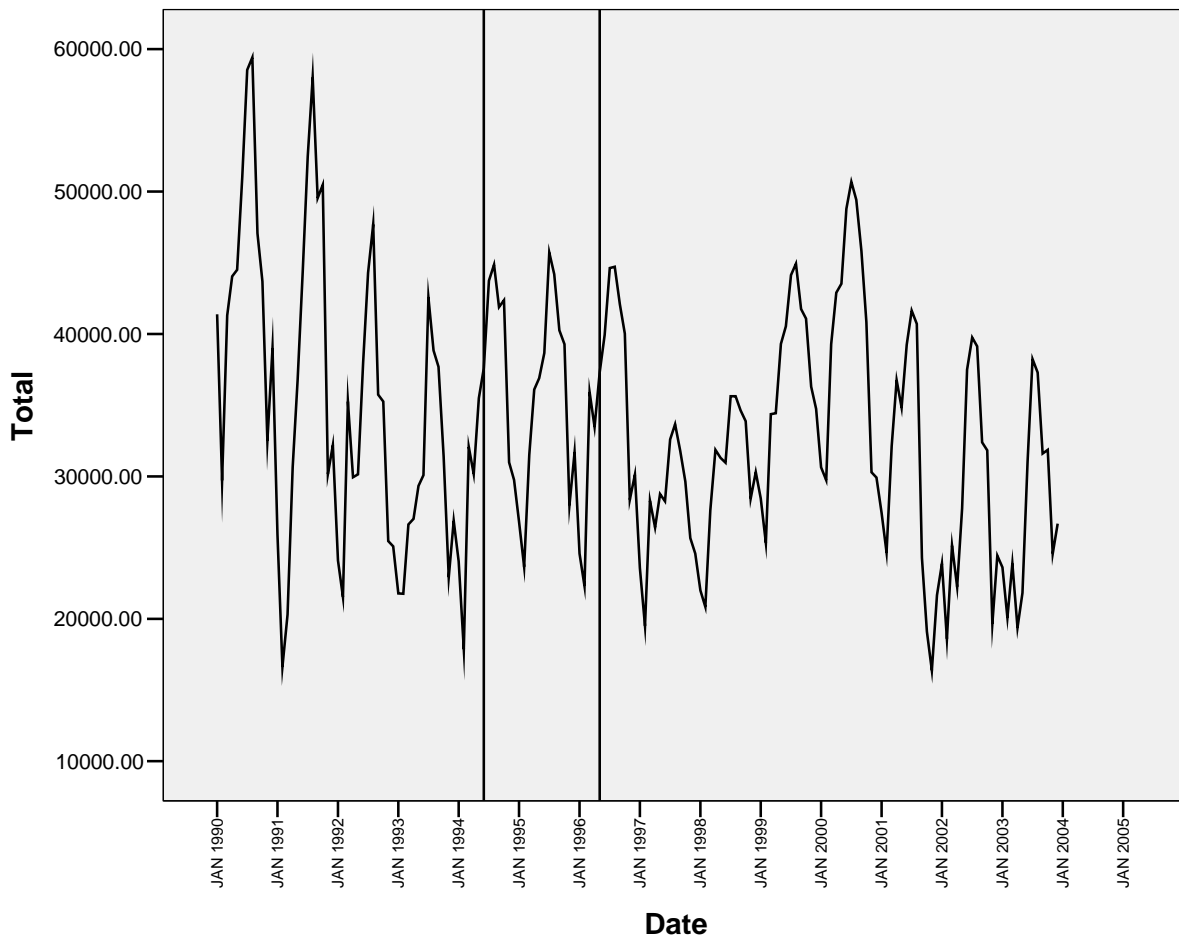


Figure 4.31: Alliance Share, FRA-JFK 1990-2003

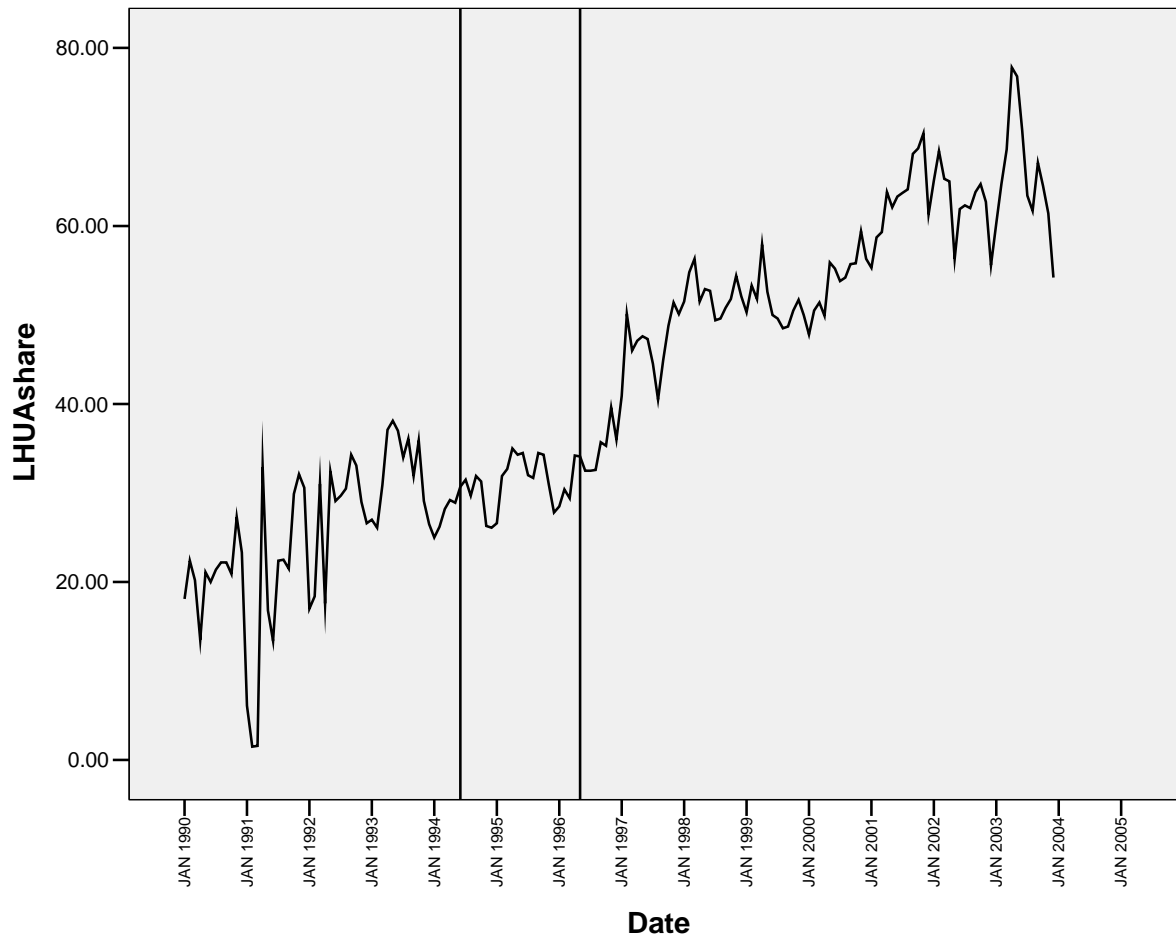


Figure 4.4: Traffic FRA-ORD 1990-2003

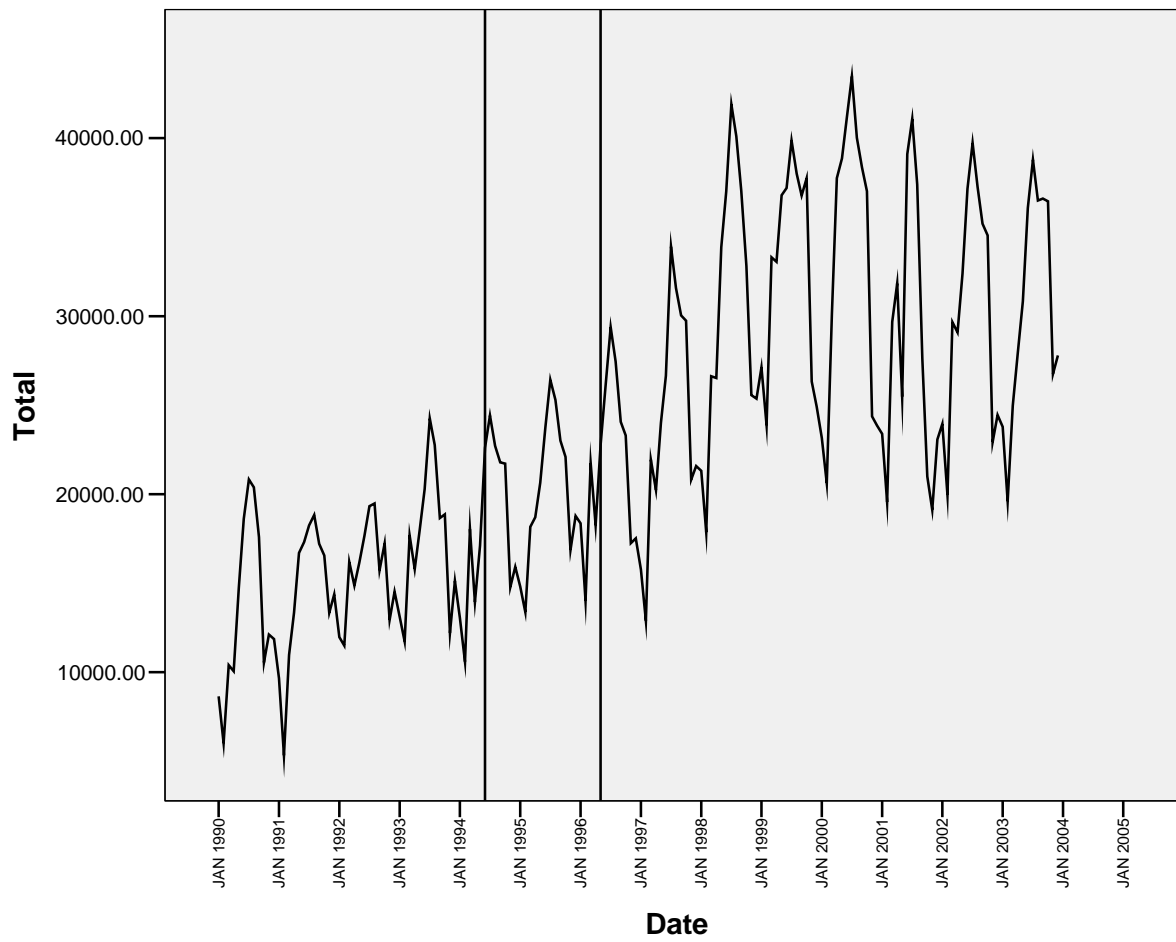


Figure 4.41: Alliance Share, FRA-ORD 1990-2003

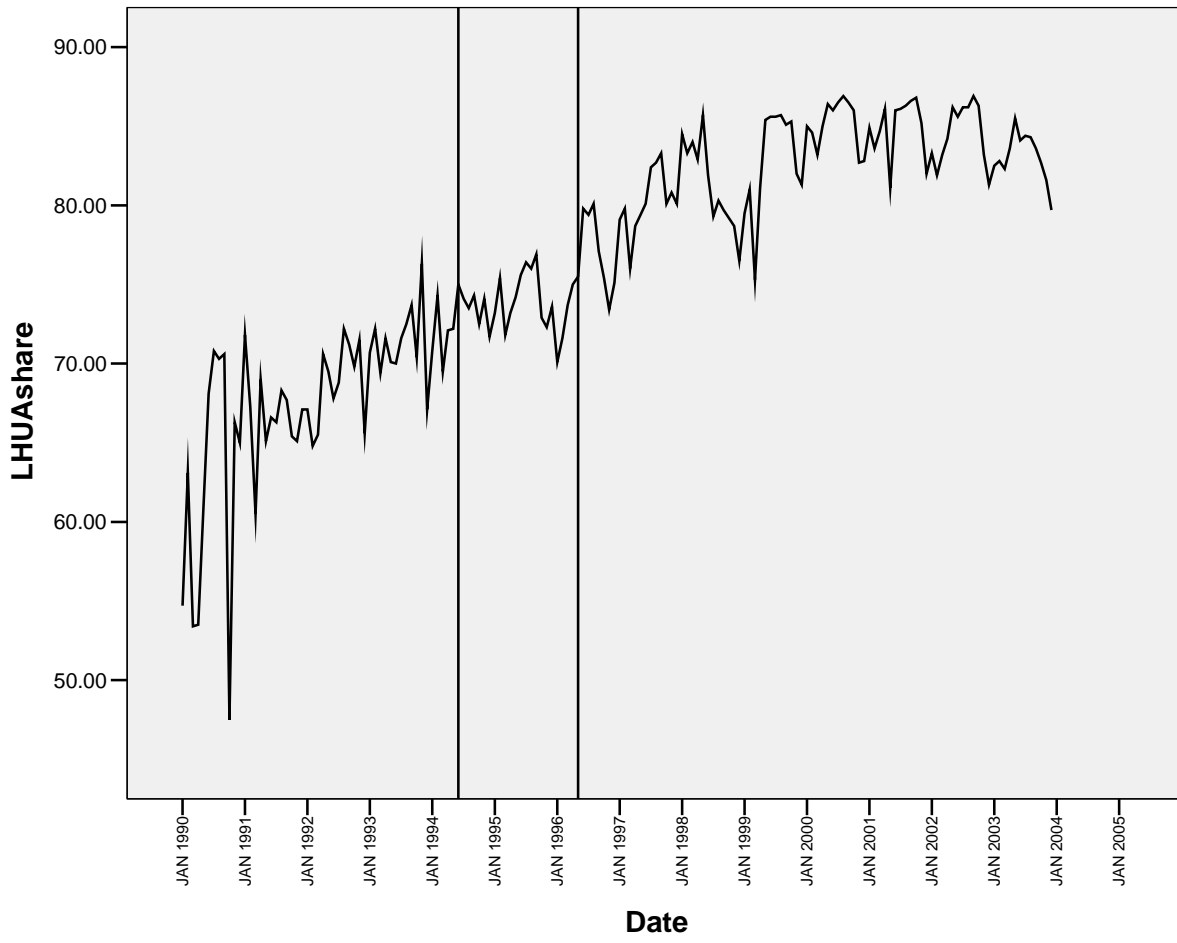


Figure 4.5: Traffic FRA-LAX 1990-2003

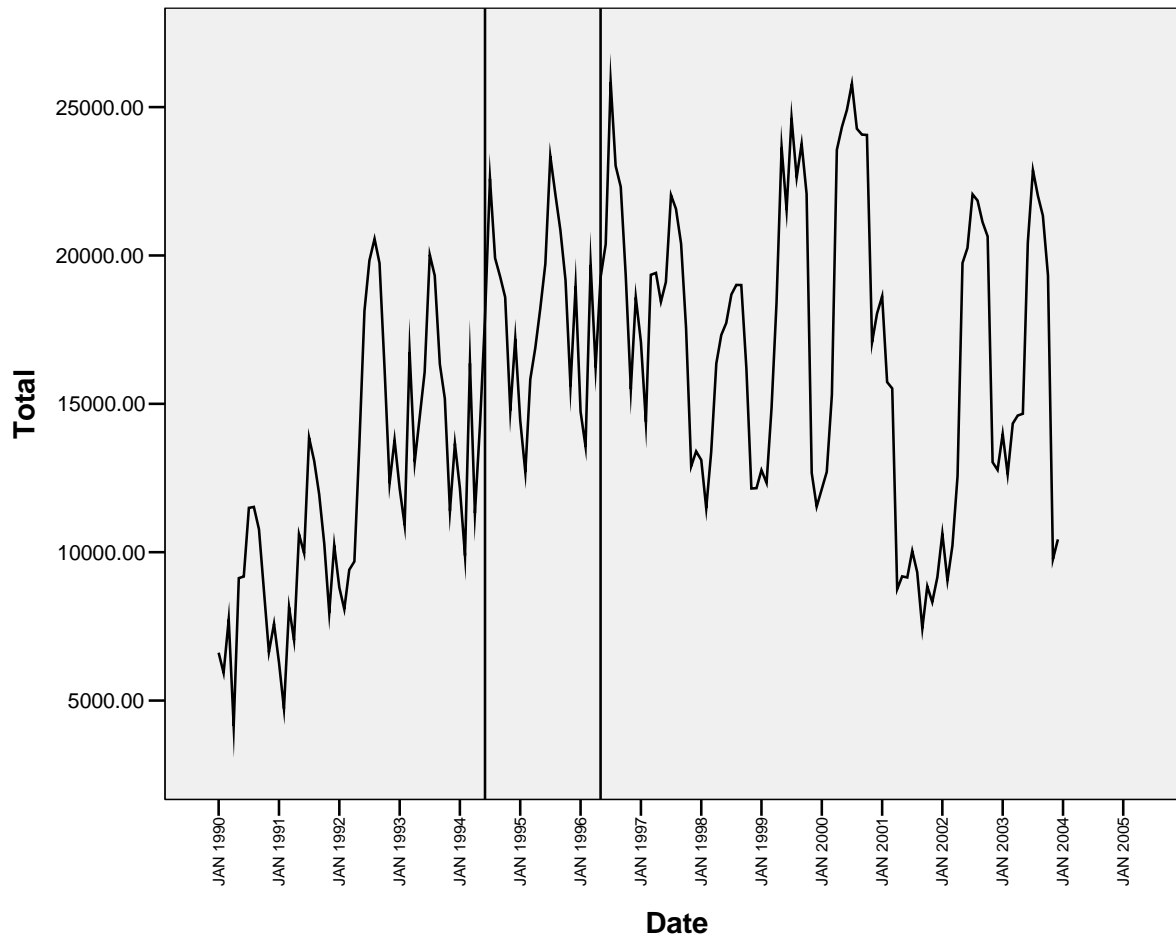


Figure 4.51: Alliance Share, FRA-LAX 1990-2003

