Topic Area: SIG-8 (Air Transport Research Society) Session Track

The Impact of the EU-US Open Skies Agreement on Passenger numbers at London Airports.

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Abstract

The advent of the EU-US Open Skies Agreement has been widely anticipated. A number of consequences have been predicted, for example, impacts on fares, on passenger volumes, choice and on consumer welfare. Airline costs are also predicted to fall as a result of increased competiveness and increased cooperation among airlines.

In the short period since the implementation of the Agreement, it is relatively easy to assess the supply-side changes that have been made, but more difficult to make wider judgements. For example, can traffic growth be attributed to Open Skies and does airline and alliance market power result in less fare flexibility with consequently less influence on passenger volumes? This paper offers some insight into the data that will be required to make these and other wider judgements and discusses some methodological difficulties. Early estimates of the impact on passenger numbers are given using times series analysis focusing on London airports in particular London Heathrow.

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1. Introduction

There has been widespread interest in the introduction of the EU-US Open Skies Agreement. Before the Agreement commenced, consultancies undertook studies on the likely consequences of an open aviation area for the EU. These major studies by Brattle (2002) and Booz Allen Hamilton (2007) are briefly summarised in Pitfield (2009a, 2009b) along with the comments of government bodies and industry spokesmen. A special issue of the Journal of Air Transport Management contained papers from the AirNeth meetings in Belgium to which experts were invited to contribute and notable examples are given by Button (2009) and Humphreys and Morrell (2009). Pitfield has also covered this introductory discussion and undertaken some empirical work on France (Pitfield, forthcoming) and the Netherlands (Pitfield, 2010).

The EU-US Open Skies Agreement came into force at the end of March 2008 and the main provisions, reported in Pitfield (2009a, 2009b) are repeated below:

- Removal of restrictions on route rights – any EU airline is allowed to fly from any EU city to any US city. Conversely, any US airline can fly into any EU airport and from there onto third destinations. In addition, EU airlines can fly between the US and non-EU countries that are members of ECAA, the European Common Aviation Area, such as Norway and Croatia. The unequal treatment of cabotage is an issue; although US airlines can fly onwards in Europe, EU airlines cannot fly domestically in the US.

- Foreign Ownership – the main change here is that US companies can now only own 49 percent of the voting rights in European Airlines, whereas European Airlines can still hold only 25 percent in US airlines, although they can own more in non-voting shares.

It is the intransigence of the US position here, as well as on cabotage, that has led first to a delay in the implementation of the Agreement and then the EU's right to suspend the Agreement if insufficient progress towards a revised Agreement is made by mid-2010.

The mechanism by which there is a resultant change in consumer welfare as a result of the Agreement has been explained in Brattle (2002) and Booz Allen Hamilton (2007). Restrictions on route rights permit the expansion of supply giving greater choice and the increased competition leads to downward pressure on airline costs and so fares. Prices are also thought to fall as a result of increased cooperation between airlines.

It is clear that the supply side changes may be directly attributed to the Agreement. However, although passenger numbers may change it is difficult to attribute this to the underlying causes given the lack of data on costs and variations in fares. Pitfield (2009a, 2009b) addresses these concerns of the usability and availability of cost and fare data. By contrast, passenger data are easily obtained from the US Bureau of Transportation Statistics so changes can be observed. The difficulty here is correctly attributing observed changes to the advent of the Agreement. What would the traffic have been if the Agreement had not been signed? If this can be determined, the counterfactual, then the observed changes on top of this may be correctly attributed to the Agreement. This paper is concerned with identifying these components of change in passenger numbers. The desiderata of improved data on costs and fares are noted in Pitfield (2009a, 2009b).

Time series models or Autoregressive Integrated Moving Average (ARIMA) models are suited to model data over long time periods with short periodicity. The passenger data are available monthly from 1990 so the approach is to model this up to the point of the first intervention on the series. This is likely to be associated with the terrorist attacks of September 2001. If this model has appropriate goodness-of-fit statistics, sensible coefficients, is relatively parsimonious and has white noise residuals then its form can be re-estimated on the whole data series with additional interventions to represent the start of the Agreement, the current economic downturn and, in the case of the focus of this paper the commencement of the Open Skies Agreement at the London airports, in particular London Heathrow (LHR). These interventions can be taken as abrupt changes, as they were when investigating the impact of a low cost carrier's start-up impact on total traffic on a route (Pitfield, 2007a), or as gradual changes with stepped or exponential forms. This was the approach used in trying to discover whether there was an impact on route traffic from alliances entering into code sharing agreements or benefiting from individual country open skies agreements, and so antitrust immunity, with the USA (Pitfield, 2007b).

As the data from 1990 contains a variety of economic cycles, the expectation might be that the current recession may not appear substantially different to any past cycle as it has not had long enough to reflect its impact on the passenger data. The expectation seems to be that the current recession will last longer than many, but in the data set, even though the appropriate start date might be discussed, it only exists in total for some six or seven months. It cannot, therefore, be distinct at present and is expected as a result not to show significance.

Past experience strongly suggests that 9/11 is well modelled by an abrupt intervention and will be strongly significant.

2. Passenger Data

US Bureau of Transportation Statistics (1990) data were downloaded for monthly traffic between the UK and USA for all years from 1990 until 2008 as well as for the first three months of 2009. These data were first filtered to extract the London- New York traffic, that covers LHR, London Gatwick (LGW), London Stansted (STN) and London Luton (LTN) as well as London City (LCY), whereas for New York, both John F. Kennedy (JFK) and Newark (EWR) are covered as they have transatlantic traffic[1]. For Washington, traffic to and from John Foster Dulles (IAD) and Baltimore Washington International (BWI) was filtered and for Chicago, both O'Hare (ORD) and Midway (MDW) were used to represent the destination. Los Angeles has only one international airport serving the UK at Los Angeles

[1] La Guardia only has domestic traffic and London City had no transatlantic traffic at this time.

International (LAX). Traffic recording zero passengers was eliminated from these data and represented freight movements by, for example, Federal Express and positioning movements, for example, by El Al. These resulting data were pasted into new spreadsheets to facilitate the correct calculation of monthly totals and to allow these figures to be pasted into SPSS for time series and graphical analysis. This was not only completed for London - New York but also for London with Washington, Chicago and Los Angeles. In addition, it was also done for LHR - New York, as well as LHR with Washington, Chicago and Los Angeles, although the largest differences in these figures with the all London airports is always for New York. In the other cases, London traffic and LHR traffic are often the same. This step was taken, as apart from the dominance of LHR in this total London traffic, the main changes resulting from Open Skies have taken place at LHR so it was thought sensible to analyse this traffic separately and to investigate the comparability of impacts.

Figure 1 shows both London - New York traffic and LHR - New York traffic where, as would be expected, the two series move closely together over time.

In the processes described above, it appeared that there has been a considerable rationalisation of services offered in London for New York, especially in 2008. In addition, an earlier relative decline in the importance of STN was noted, perhaps as it concentrated on low-cost carriers. Consequently, an exploratory analysis examined shares at LHR over the period and this is shown in Figure 2. In the early 1990s, LHR share was around 70 percent and by 1993 this had risen to the low 80 percents. This is associated with the start and subsequent growth of Virgin Atlantic at LHR as a result of changes in the London traffic distribution rules. It is thought that Lord King, chairman of British Airways at the time, ceased to make financial contributions to the Conservative party as a result of Virgin being allowed to operate at LHR. The next step changes take place between 2001 and 2002 and reflects the greater concentration of services at LHR after 9/11. There is another blip in 2007 when shares at LHR temporarily fall and although the impact of EOS and MAXJet may have contributed to this, much the largest cause is the withdrawal of United from LHR and the corresponding growth of Delta before Open Skies at LGW. Of course, as a result of Open Skies, both Continental and Delta move services to LHR. Traffic with Washington Airports is shown in Figure 3, Chicago in Figure 4 and Los Angeles in Figure 5. EOS and MAXJet also have an impact on the Washington figures, where there also appears to be a rationalisation of traffic at LHR in recent years for both Washington and Chicago. For much of the period there is no difference in the LAX figures for traffic from London and traffic from LHR. In early 2008, as a result of the Agreement, Air France began a service, which has since ceased operations, from LHR to LAX. There were no important new carriers on the other routes although existing carriers could adjust the frequency of service and aircraft size.

3. New York

Following the usual procedures of examining Autocorrelation Functions (ACF) and Partial Autocorrelation Functions (PACF) the most appropriate model for London – New York is an ARIMA(0,1,1)(0,1,1)12 model on the original data. The RMSE is 14174.638 and other goodness-of-fit statistics are shown in Table 1[2]. The impact of 9/11 is significant, but none of the other intervention variables are significant with the correct sign. Neither the Open Skies Agreement nor the advent of recession, however these potential impacts are represented, are significant.

Concentrating on the traffic with New York from LHR only yields similar results. The model has an extra autoregressive parameter as (0,1,1)(1,1,1)12 with RMSE = 17374.620 and again 9/11 is the only significant intervention. This is disappointing as the airline moves to LHR as a result of the Agreement might well have been thought to generate significant new traffic. Even if the actual start at the very end of March is considered, there is still no apparent impact on passenger traffic. The Residual Autocorrelation Functions are shown in Figure 6 and it clear that the residuals are white noise.

The impact of 9/11 is similar in the two models and represents an impact on the whole series that is around 2.4-2.8 percent of total annual traffic on the route in the year 2000.

4. Washington

[2] The basis of the RMSE calculation and Theil's Inequality Coefficient U is with n-k-1 degrees of freedom. Systematic error is shown by U_m, the variance by U_s and the covariance by U_c. Ideally U_m and U_s = 0 and U_c = 1.

For Washington – London traffic an ARIMA(1,0,0)(0,1,1)12 seems to give the best fit with RMSE = 5003.093. The parameters and other goodness-of-fit statistics are shown in Table 2. As with the New York models, no matter how the downturn or the Agreement interventions are specified, they are insignificant. 9/11 seems to have a negative effect of 22,913 which represents 2.04percent of year 2000 total traffic[3].

Focusing on the LHR traffic gives an ARIMA(2,0,1)(0,1,1)12 model; this notation means that the autoregressive parameter is estimated at lags 1 and 2[4]. Parameter estimates and goodness-of-fit are again shown in Table 2. Not surprisingly, the only intervention term of significance is the 9/11 intervention. Given that the large scale changes in carriers on LHR – New York failed to show a significant impact on passenger traffic from the Agreement, then the other US destinations are unlikely to. It is also true that no measure of the economic downturn is significant.

The 9/11 impact here represents 2.22percent of year 2000 traffic which is consistent with the other estimates.

5. Chicago

For Chicago – London traffic an ARIMA(1,1,0)(0,1,1)12 seems to give the best fit with RMSE = 6466.817. The parameters and other goodness-of-fit statistics are shown in Table 3. As with the other models, no matter how the Agreement intervention is specified, it is insignificant. However, the

[3] The constant term is retained in these models as there is no regular differencing.
[4] The first autoregressive parameter is not reported in the table as it is insignificant.

downturn intervention represented as an exponential decline is significant in the second model shown in Table 3 and has a negative impact of 18,373. 9/11 also has an earlier negative effect on the series of between 38,930 and 39,085 which represents 2.65 - 2.66percent of year 2000 total traffic.

Focusing on the LHR traffic gives an ARIMA(1,1,0)(0,1,1)12 model. It is not surprising that the model has the same form as the London model as there are only some notable and sustained differences between London and LHR traffic in the early and mid 1990's. Parameter estimates and goodness-of-fit are again shown in Table 3. As before, apart from the significance of the 9/11 term, the downturn exponential intervention is also significant in one model. The impact of the Agreement is never found to be significant. For 9/11, the intervention varies between 2.61 and 2.64percent of year 2000 LHR traffic and the absolute estimates are both correctly less than the impacts estimated on London.

It is not intuitively obvious why the representation of the downturn is significant on this corridor and although the result is reported it could be spurious.

6. Los Angeles

The results for Los Angeles to London and LHR are shown in Table 4. The ARIMA models differ despite there being little difference in the UK totals from London and LHR except for the early 1990's and mid 2007. In neither model are the representations of the Agreement or the downturn found to be significant and have the correct sign. The 9/11 intervention is consistent with previous estimates and represents between 1.58 and 1.68percent of year 2000 total traffic. These impacts are less presumably because the impacts on the more easterly US destinations from London were higher due to the location of the terrorist activities.

7. Conclusion

Attempts to determine the impact of the EU-US Open Skies Agreement have been presented from London (and separately from LHR) to four major US cities. In no case has a significant impact on passenger numbers been found. This is especially surprising in the LHR – New York case, where new services were initiated at LHR, often moving from other London area airports. However, the variation in airline strategic behaviour implicitly modelled in the time series from 1990 shows that there is nothing significantly different in recent variations in passenger numbers that needs to be explained where these variations may have resulted from the Agreement. No particular boost or discontinuity in passenger numbers was found beyond that which could be explained by airlines' choice of frequency, aircraft size and fare setting already implicit in the model since 1990.

In every route examined, significant impacts were found for 9/11 and were not found for the economic downturn. Both of these findings are expected as 9/11's impact has previously been established and the downturn in the data up to March 2009 will look no different to previous downturns encapsulated in the variation in passenger data from 1990. To establish any impact will require a longer data series.

If this modelling attempt has failed to find an impact on passenger numbers it may be judged that the case that the data initiatives on fares, costs and competition is less compelling.

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Table 1 ARIMA Models of London – New York Passengers, 1990 – March 2009

Model 1 London	Parameters	t tests	Goodness of Fit
MA(1)	0.457	7.563	
SMA(1)	0.423	6.715	Stationary R-Squared = 0.635
Intervention 9/11	-116833.003	-10.914	Normalised BIC = 19.364
			RMSE = 14174.638
			U = 0.023 U_m = 0.000
			U_s =0.024 U_c = 0.962
Model 2 LHR			
MA(1)	0.455	7.099	
SAR(1)	0.575	4.997	
SMA(1)	0.904	9.574	Stationary R-Squared = 0.700
Intervention 9/11	-87183.614	-9.356	Normalised BIC = 19.200
			RMSE = 17374.620
			U = 0.033 U_m = 0.008
			U_s =0.052 U_c = 0.920

Table 2 ARIMA Models of London – Washington Passengers, 1990 – March 2009

Model 1 London	Parameters	t tests	Goodness of Fit
Constant	4689.398	6.438	
AR(1)	0.792	18.880	Stationary R-Squared = 0.710
SMA(1)	0.605	10.028	Normalised BIC = 17.188
			RMSE = 5003.093
Intervention 9/11	-22913.120	-5.886	U = 0.030 U_m = 0.000
			U_s =0.000 U_c = 0.982
Model 2 LHR			
Constant	2670.228	3.645	
AR(2)	0.607	9.052	Stationary R-Squared = 0.746
MA(1)	-0.705	-12.096	Normalised BIC = 17.047
SMA(1)	0.525	8.044	RMSE = 4472.988
			U = 0.028 Um = 0.000
Intervention 9/11	-22658.412	-6.281	Us =0.000 Uc = 0.977

Table 3 ARIMA Models of London – Chicago Passengers, 1990 – March 2009

Model 1 London	Parameters	t tests	Goodness of Fit
AR(1)	-0.268	-3.972	Stationary R-Squared = 0.481
SMA(1)	0.490	7.432	Normalised BIC = 17.677
			RMSE = 6466.817
Intervention 9/11	-39085.018	-7.202	U = 0.032 U_m = 0.000
			U_s =0.004 U_c = 0.982
Model 2 London	Parameters	t tests	Goodness of Fit
AR(1)	-0.258	-3.842	Stationary R-Squared = 0.492
SMA(1)	0.482	7.284	Normalised BIC = 17.686
Intervention Downturn Exponential	-18373.960	-2.115	RMSE = 6415.485
			U = 0.031 U_m = 0.000
Intervention 9/11	-38930.330	-7.232	Us =0.004 Uc = 0.977

Table 3 ARIMA Models of London – Chicago Passengers, 1990 – March 2009 continued

Model 1 LHR	Parameters	t tests	Goodness of Fit
AR(1)	-0.151	-2.166	Stationary R-Squared = 0.582
SMA(1)	0.474	7.306	Normalised BIC = 17.615
			RMSE = 5911.490
Intervention 9/11	-38277.444	-7.508	U = 0.029 U_m = 0.000
			U_s =0.004 U_c = 0.982
Model 2 LHR	Parameters	t tests	Goodness of Fit
AR(1)	-0.253	-3.731	Stationary R-Squared = 0.513
SMA(1)	0.470	7.040	Normalised BIC = 17.709
Intervention Downturn Exponential	-18528.085	-2.129	RMSE = 6539.913
			U = 0.032 U_m = 0.005
Intervention 9/11	-38791.771	-7.226	U_s =0.015 U_c = 0.962

Table 4 ARIMA Models of London – Los Angeles Passengers, 1990 – March 2009

Model 1 London	Parameters	t tests	Goodness of Fit
Constant	4676.319	6.916	Stationary R-Squared = 0.744
AR(1)	0.774	17.152	Normalised BIC = 17.6690
SAR(1)	0.241	2.234	RMSE = 6445.401
SMA(1)	0.821	9.974	U = 0.028 U_m = 0.000
			U_s =0.003 U_c = 0.974
Intervention 9/11	-25267.729	-5.038	

Model 2 LHR	Parameters	t tests	Goodness of Fit
SMA(1)	0.608	10.319	Stationary R-Squared = 0.448 Normalised BIC = 17.659
Intervention 9/11	-26823.224	-4.753	RMSE = 6393.617
			U = 0.029 U_m = 0.000
			Us =0.004 Uc = 0.987

Figure 1: London – New York Passenger Traffic by Month, January 1990 – March 2009

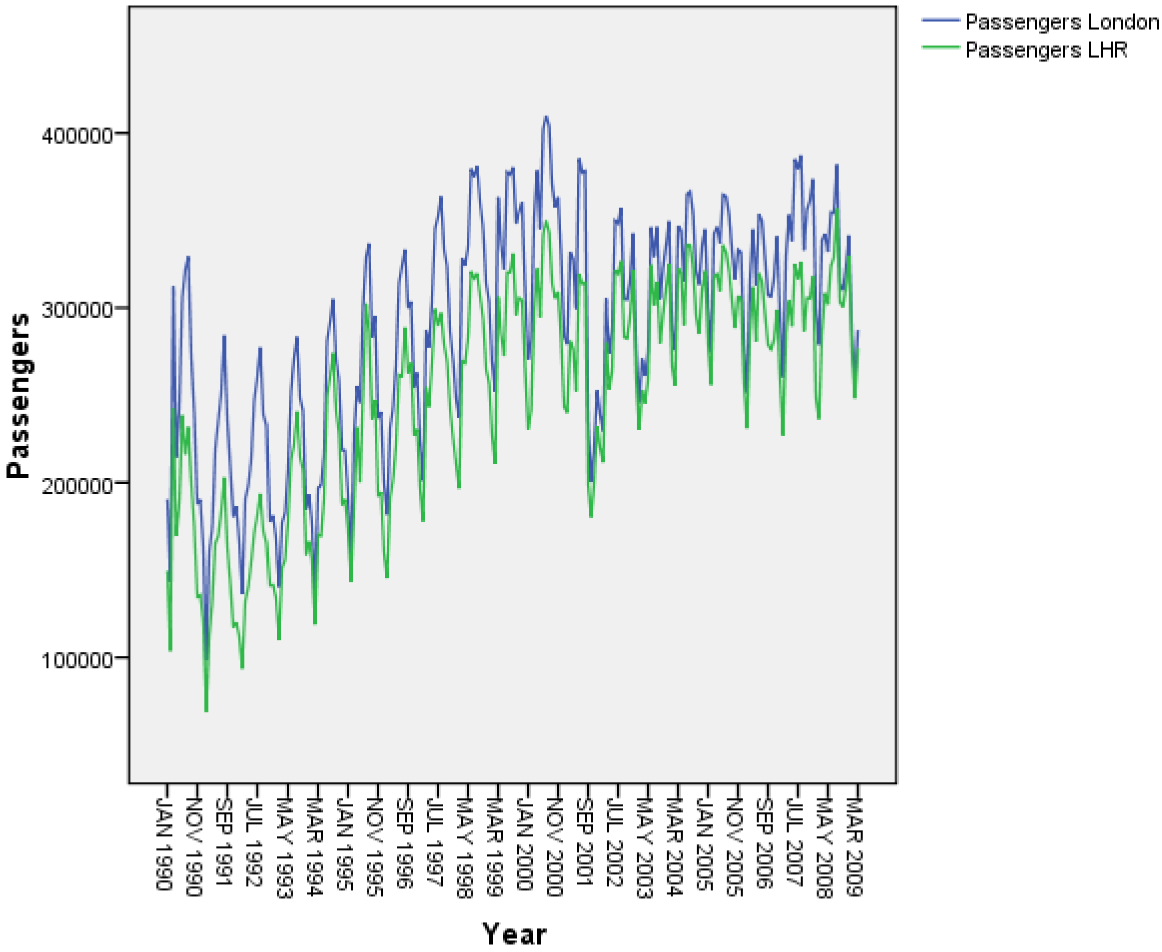


Figure 2: Annual LHR/London % Share of New York Traffic, 1990-2009

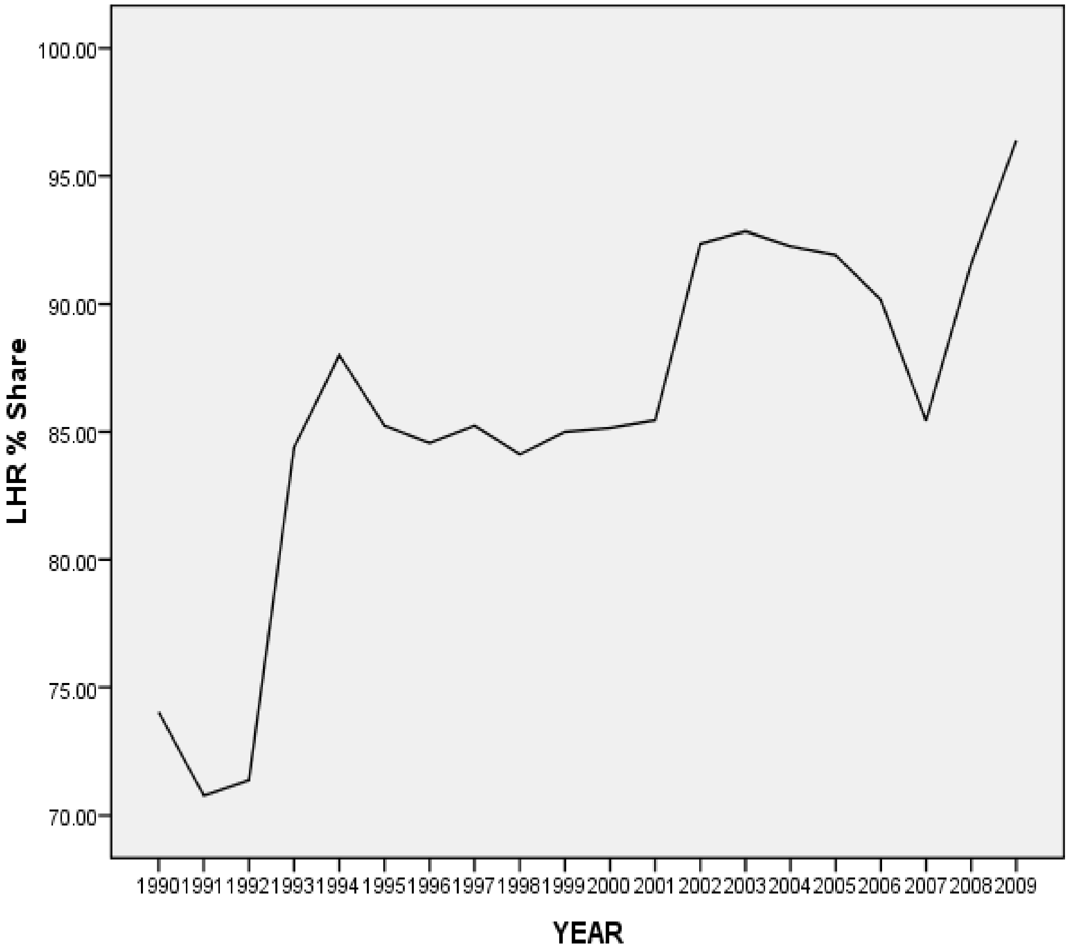


Figure 3: London – Washington Passenger Traffic by Month, January 1990 – March 2009

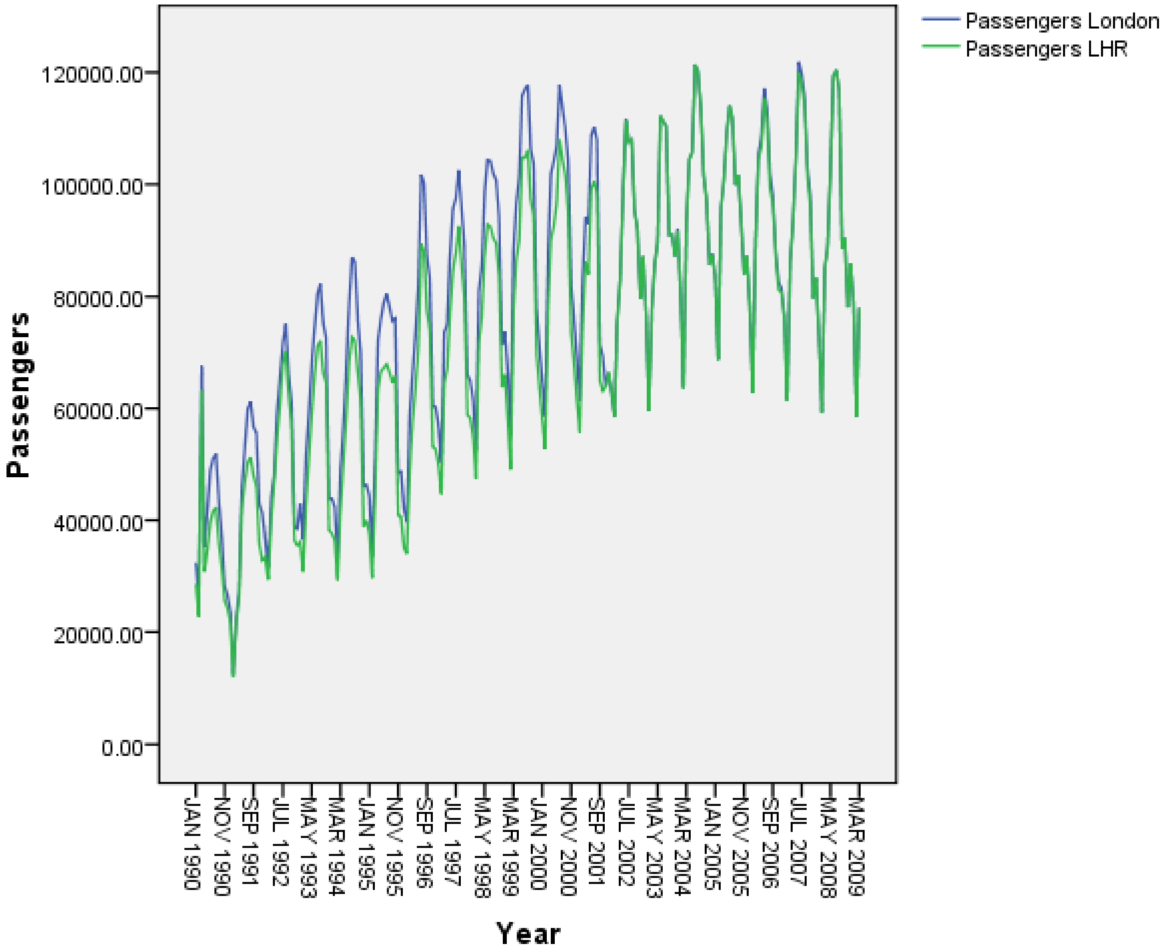


Figure 4: London – Chicago Passenger Traffic by Month, January 1990 – March 2009

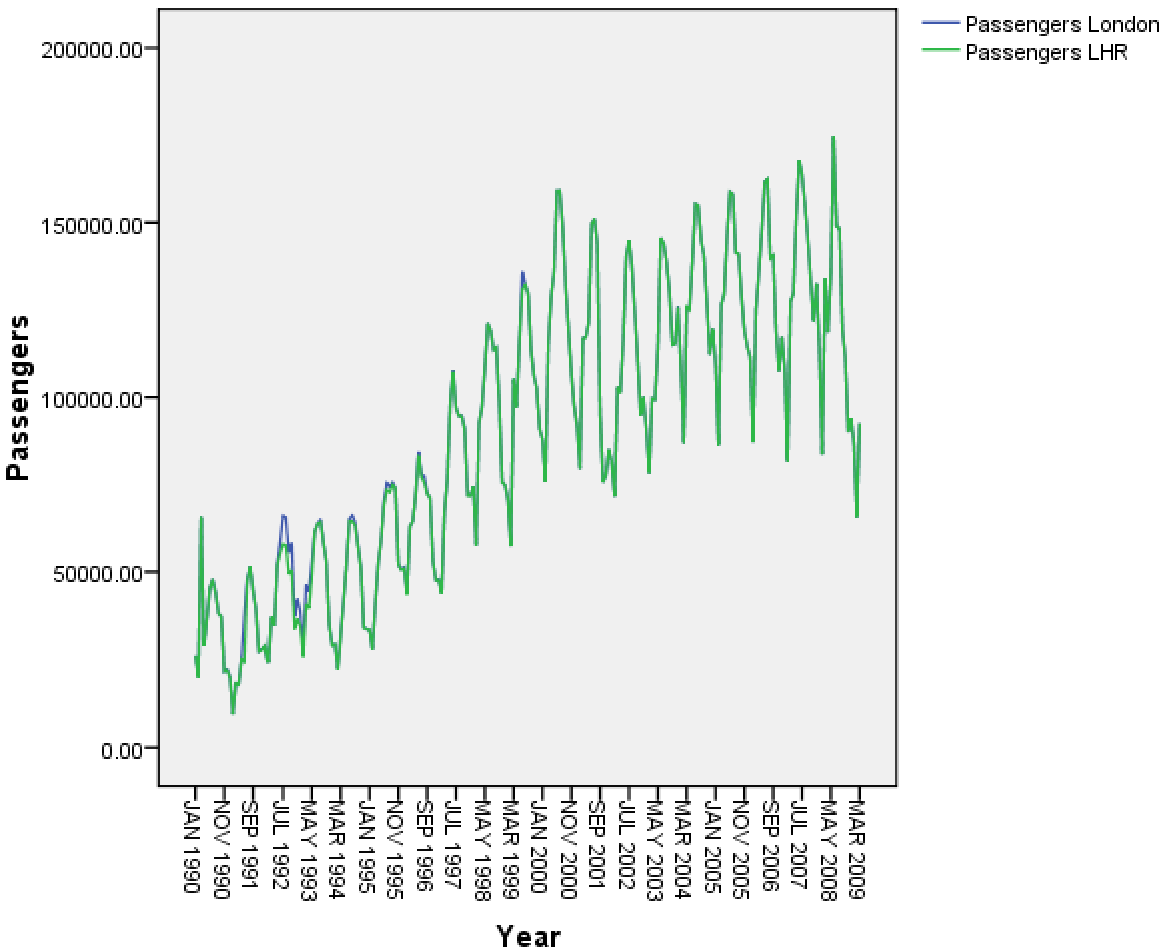


Figure 5: London – Los Angeles Passenger Traffic by Month, January 1990 – March 2009

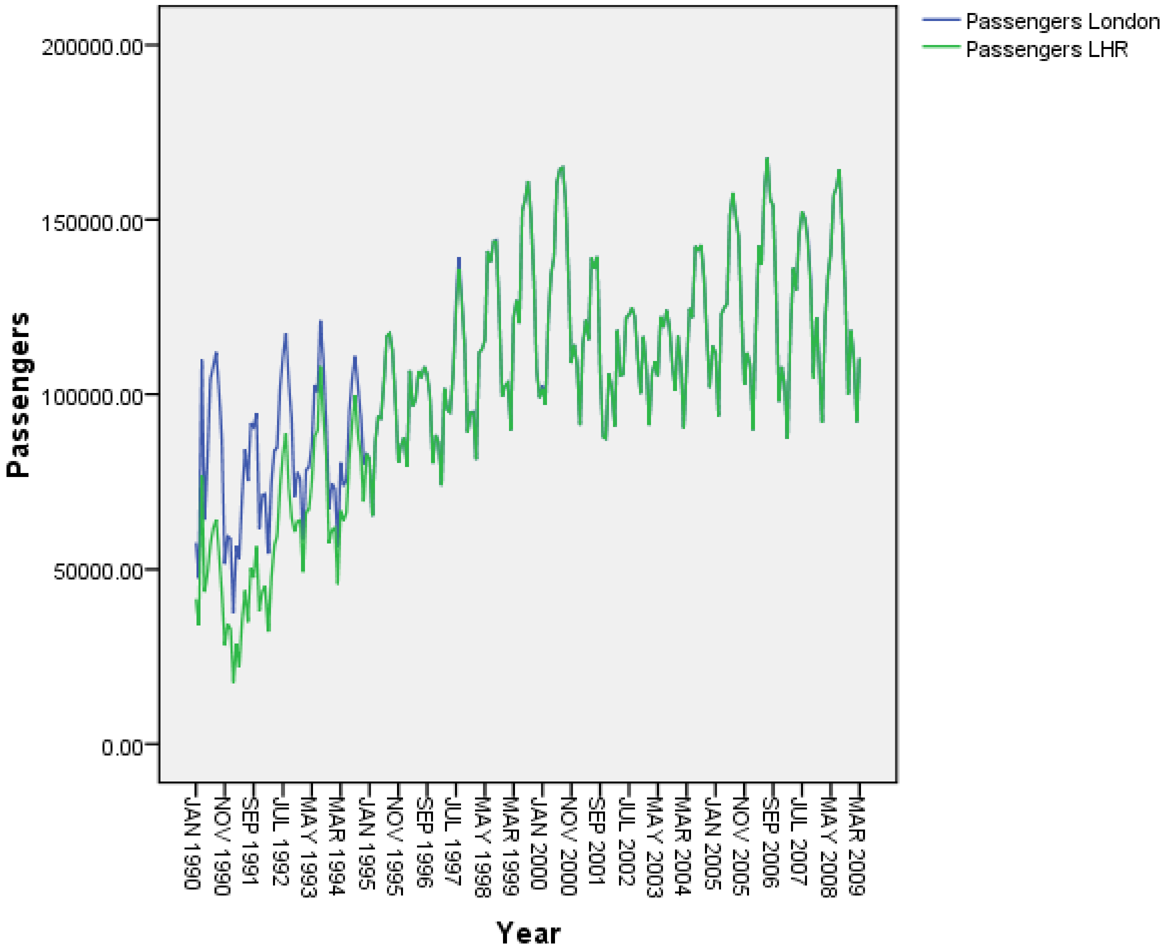
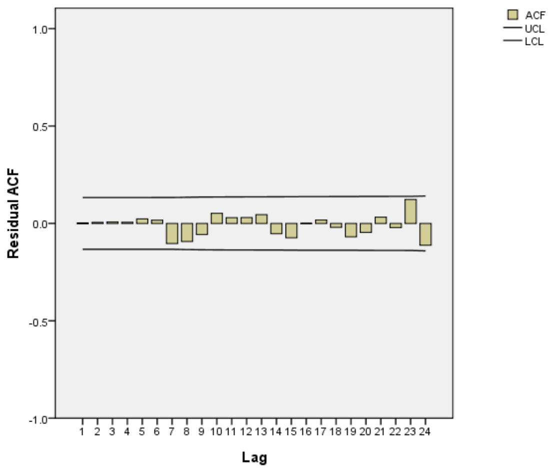


Figure 6: Residual Autocorrelation Functions for New York ARIMA models

Model 1 London



Model 2 LHR

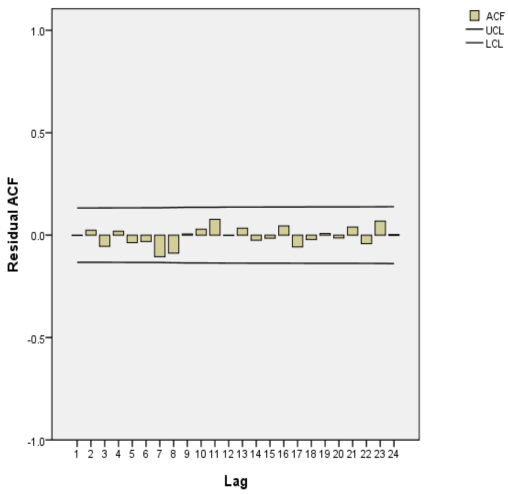
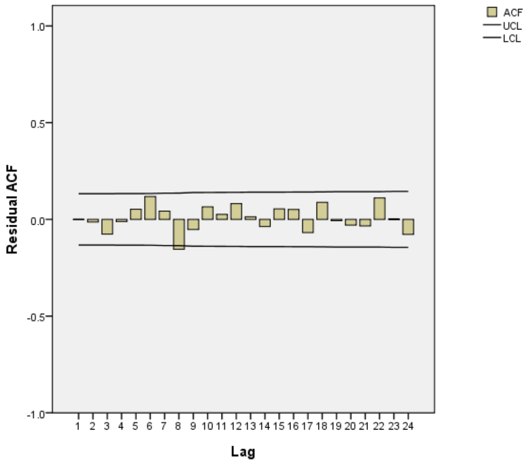


Figure 7: Residual Autocorrelation Functions for Washington ARIMA models

Model 1 London



Model 2 LHR

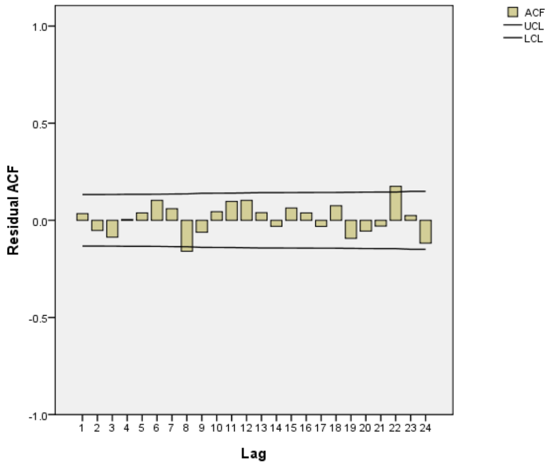


Figure 8: Residual Autocorrelation Functions for Chicago ARIMA models

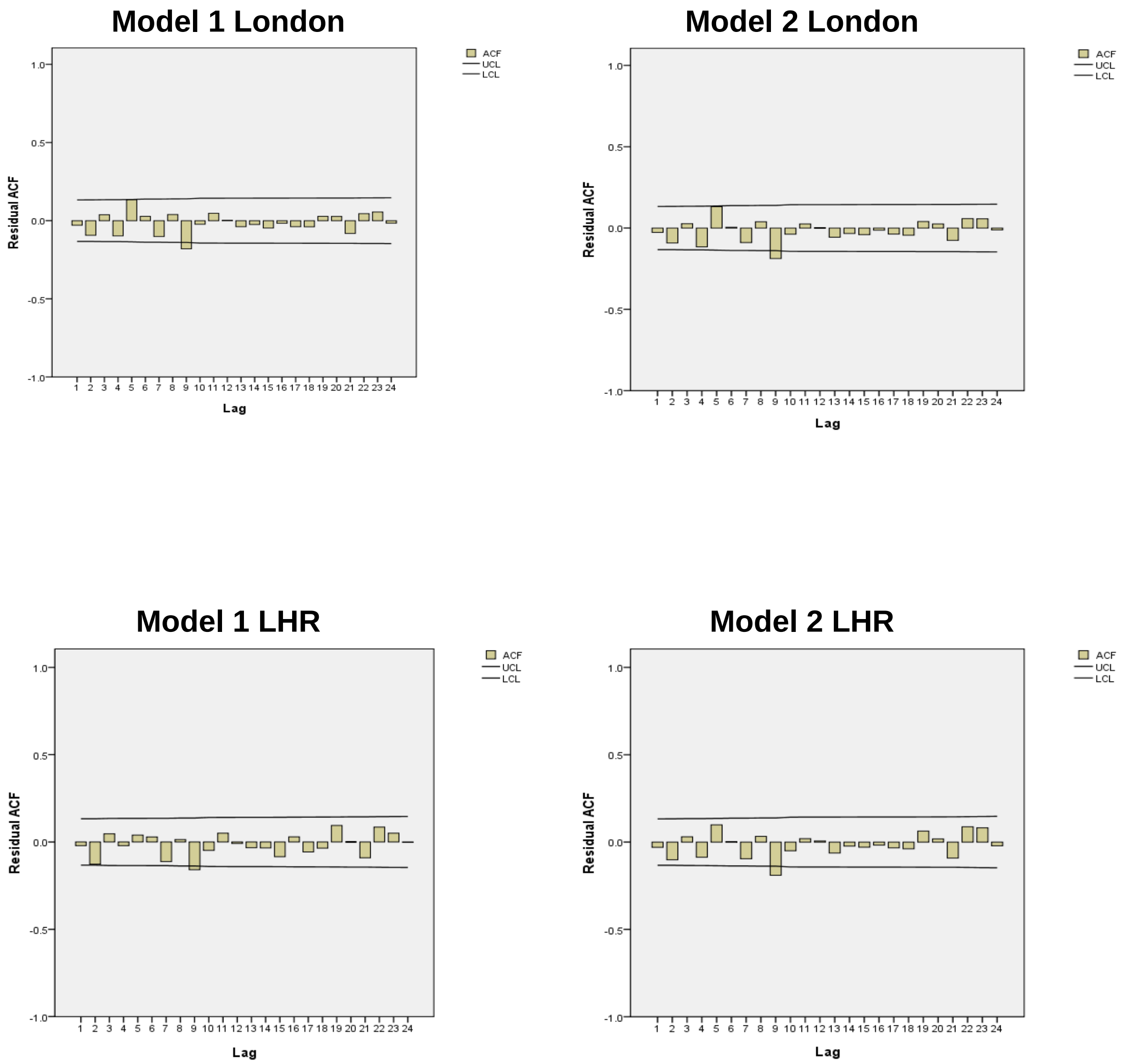
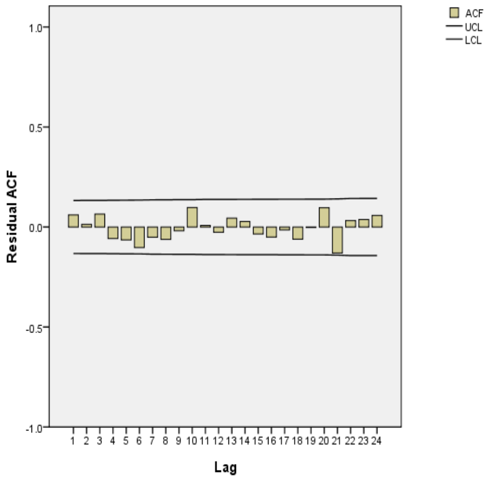


Figure 9: Residual Autocorrelation Functions for Los Angeles ARIMA model

Model 1 London



Model 2 LHR