The Impact of Market Liberalisation on Airfares in the European Union

1. Introduction

Casual observation suggests that deregulation of the European Union airline market has led to lower economy class airfares. Low-cost carriers have entered the market, forcing traditional airlines to reduce their economy fares to compete. By contrast, there is less competition in the business class market, and fares remain high. Business class fares are substantially above economy class fares, despite the seemingly small difference in the cost of supplying the two types of seat. This paper provides empirical evidence in support of these observations. A brief history of the European airline market and 1993 liberalisation process is given, followed by an empirical comparison of the fares of a traditional carrier with those of low-cost carriers. Next, a theoretical model of an airline's cost function is developed, and used to test the hypothesis that mark-ups above cost for economy class airfares are lower on routes in the liberalised EU market than on EU to non-EU shorthaul routes. The latter provide a proxy for EU routes prior to liberalisation since the regulatory structure on these routes now is the same as that which existed in the EU prior to liberalisation. Finally, business class fares are compared with economy class fares, providing evidence that EU business class fares are marked-up substantially above cost, and that competition in the business class market is limited.

2. The Single European Aviation Market and 1993 Deregulation

The airline industry is one of the most international in the world, transporting millions of people and vast amounts of cargo around the globe daily. Historically, the industry has been one of the most heavily regulated though, governed by bilateral air service agreements dictating which airlines can fly between countries, and sometimes what fares they can charge and capacities they can supply. The regulatory system has also required airlines to be substantially owned by the nationals or companies of the countries in which they are based, preventing global mergers and consolidation of carriers, as has happened in other industries. Instead, airlines have been forced to seek "alliances" and make commercial agreements with each other, which leave their ownership structures intact. However, during the 1980s, the then European Community made progress towards liberalising its aviation market, following deregulation of the US domestic market in 1978 by the Carter Administration.

The European deregulation process entailed three packages of measures, culminating in the "Third Package", which totally deregulated air travel between EU member states as of 1st January 1993. The Single European Aviation Market formed by the deregulation includes the fifteen[1] EU member states, plus Norway and Iceland. Full liberalisation of domestic airline markets in EU countries was not completed until 1997 though, so as to allow incumbent carriers, many of which were state owned, to ready themselves for competition. Other things being equal, deregulation of this type would be expected to lead to increased competition and lower fares. This is what

[1] This study was conducted prior to May 2004, when ten new members joined the EU.

happened in the US a decade earlier, where real airfares fell more than a third between 1977 and 1992.

The new EU airline market has the following characteristics:

- Open market access – airlines from member states can operate with full traffic rights on any route within the EU, and without capacity constraints, even on routes outside their own country, provided they meet certain financial and safety criteria.
- There are no price controls.
- Airlines must be majority owned and controlled by any of the member states, their nationals, or companies, but not necessarily nationals or companies of the state within which the airline is registered.

3. Low-Cost Airlines and the EU Aviation Market

Following market liberalisation, so called "low-cost" carriers entered the EU airline market, initially in the UK and Ireland, and subsequently in other countries as well. Low-cost airlines have the characteristics listed below, which allow them to keep costs down relative to traditional scheduled airlines.

Sales Process

- Mostly direct sales to customers via the internet or phone, avoiding travel agent fees and the use of expensive computer reservation systems.
- Simple yield management systems, leading to simpler pricing structures, and lower costs. This is possible because all passengers are point-to-point traffic, and hence no consideration has to be given to transfer passengers feeding onto longhaul services.
- Do not issue paper tickets.

Operating Characteristics

- Operate one type of aircraft, leading to lower maintenance costs and homogeneous crew[2].
- Fly aircraft for longer per day.
- Do not allocate seats.
- Do not serve in-flight meals, meaning fewer cabin crew are needed, and reducing turnaround times because less time is spent cleaning and loading/unloading catering onto aircraft.
- Put more seats on aircraft, achieved by lower seat pitch (space between seats), and putting seats in space saved by not having a galley.
- Often operate from less congested, cheaper airports.
- Do not "night stop" their crews (ie all flights return to base on the same day).

4. Comparison of Traditional Carrier Fares and Low-Cost Carrier Fares

Low-cost airlines aim to charge fares below traditional carriers when they compete on the same city-pair routes. To examine this price difference, fares from London to 20 EU destinations were collected for a traditional carrier, British Airways, and for low-

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[2] easyJet started operating Airbus A319's as well as Boeing 737's in 2004.

cost carriers easyJet and Ryanair, one of which also flies to each of the 20 destinations (easyJet flies to 17 of the destinations, while Ryanair flies to the remaining three). British Airways flights operate from Heathrow and Gatwick airports, while easyJet and Ryanair flights operate from Stansted. Full details of the fares can be found in Appendix 1. The prices are one-way fares excluding passenger taxes, though to qualify for these fares with British Airways, it would have been necessary to book a return flight.

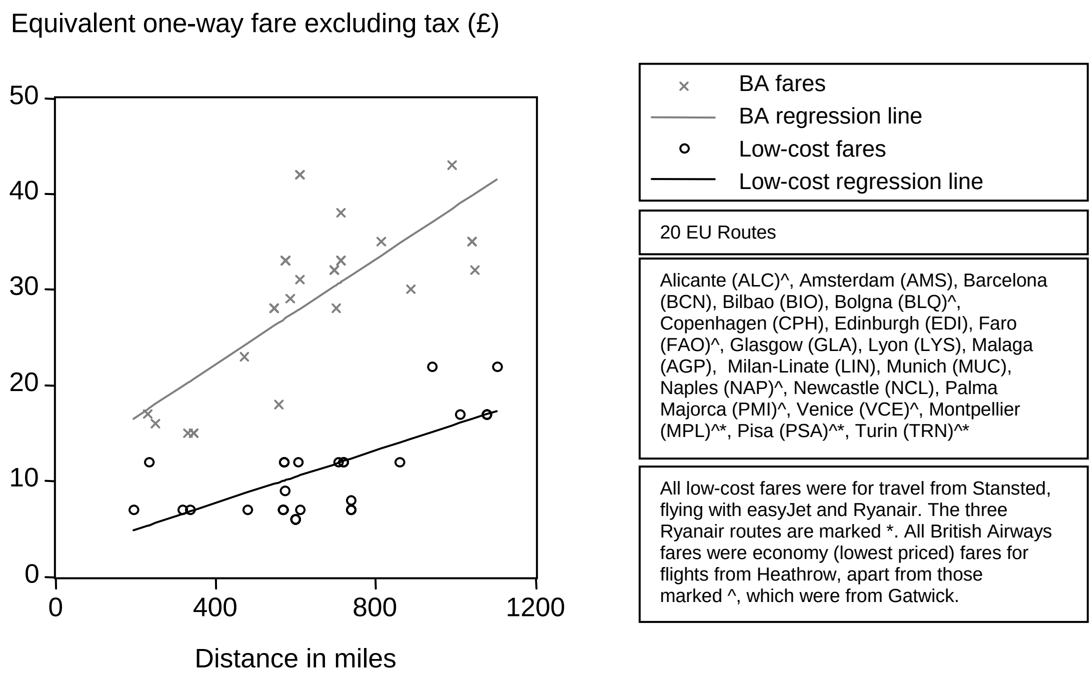
On average, the British Airways fare was 2.8 times the low-cost carrier fare to the same destination, ranging from a multiple of 1.3, to a multiple of 4.7. Regression analysis was used to estimate a linear relationship between route distance[3] and fare for each type of carrier. The following OLS regression model was estimated:

$$P = \alpha_0 + \beta_0 X + \alpha_1 D + \beta_1 DX + \varepsilon$$

Where:
P = one-way fare excluding tax
α_0 = fixed cost per ticket of low-cost carriers
β_0 = cost per mile of low-cost carriers
X = route distance in miles
D = BA dummy (0 if observation is for a low-cost carrier and 1 if for BA)
α_1 = additional fixed cost of BA fare above low-cost fare
β_1 = additional cost of BA fare per mile above low-cost fare per mile
$\varepsilon \sim iid(0, \sigma^2_\varepsilon)$ = disturbance term

The regression results are presented below, with p-values in brackets.

$$\underset{(0.457)}{P = 2.18} + \underset{(0.002)}{0.0137X} + \underset{(0.040)}{8.98D} + \underset{(0.031)}{0.0137DX} \qquad R^2 = 0.84$$



[3] Route distances are for great circle flight paths in miles, and were obtained from www.gc.kls2.com.

The results show that on average BA charges a fixed £8.98 more per ticket than the low-cost carriers, plus an additional 1.4 pence per mile travelled. All the coefficients are significant at the 5% level, apart from α_0. Both analyses show that BA charges more than the low-cost airlines when operating on the same city-pair routes. However, the results say nothing about mark-ups over cost since the higher prices charged by BA could be entirely attributable to the higher costs associated with the BA product. BA flights include in-flight catering and seat allocation, and depart from Heathrow and Gatwick airports, which are more costly to operate from than Stansted.

5. Theoretical Model of Cost Structure for Operations on a Single Air Route

To help analyse the impact that market structure has on prices, the cost function for an airline operating on a given route is developed below:

$$C(Q,X) = (N*(FC_1 + FC_2(X)) + Q*(MC_1 + MC_2(X))$$

Where:
$C(Q,X)$ = total cost of transporting Q passengers on a route of distance X miles
N = number of flights = Round-up(Q/K) where K = capacity of one aircraft
FC_1 = fixed cost per aircraft independent of route distance
$FC_2(X)$ = fixed cost per aircraft dependent on route distance
MC_1 = marginal cost per passenger independent of route distance
$MC_2(X)$ = marginal cost per passenger dependent on route distance
$FC_2(X)' > 0$ and $MC_2(X)' > 0$ (first derivatives with respect to route distance)

Fixed costs independent of route distance (FC_1):
- Insurance
- Landing charges
- Fuel used for take-off and landing for aircraft with only crew on it.
- Airport service charges
- Maintenance
- Aircraft depreciation

Fixed costs dependent on route distance ($FC_2(X)$):
- Flight and cabin crew costs - longer flight distances increase flight time, requiring crew to be on the aircraft for longer, and resulting in higher crew costs.
- Return on capital (aircraft), which depends upon how long the aircraft is used for, and hence the route distance.
- Fuel used for flying X miles between airports for aircraft with only crew on it.

Marginal cost per passenger independent of route distance (MC_1):
- Catering (for traditional airlines)
- Baggage handling costs
- Ground handling costs
- Lounge costs (for business class passengers)
- Additional fuel used for take-off and landing per passenger.

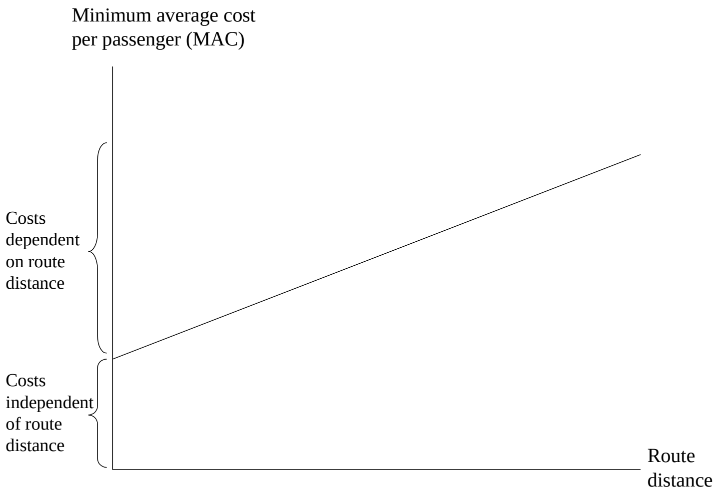
Marginal cost per passenger dependent on route distance ($MC_2(X)$):
- Additional fuel used for flying X miles between airports per passenger.

The minimum average cost (MAC) per passenger is defined as the average cost per passenger for a full aircraft, and is a function of the route distance (X):

$$\begin{aligned} MAC(X) &= (FC_1 + FC_2(X))/K + MC_1 + MC_2(X) \\ &= [FC_1/K + MC_1] + [FC_2(X)/K + MC_2(X)] \\ &= \alpha + G(X) \\ &= \alpha + \beta X \quad \text{(assuming that } FC_2(X) \text{ and } MC_2(X) \text{ are linear functions of X)} \end{aligned}$$

Hence, the MAC increases linearly with route distance.

Figure 1: Minimum Average Cost Per Passenger (MAC) and Route Distance



Given the cost function developed above, the market equilibrium price on a particular route depends upon the type of competition which takes place on that route. For a market comprising many routes, each route can be classified as follows:

1. *Competitive routes:* Routes on which there are no barriers to entry, and additional airlines can operate on them if they wish to. Mark-ups on these routes will be low as competition pushes fares down toward MAC.

2. *Routes that are not competitive due to barriers to entry:* Routes on which barriers to entry prevent additional airlines operating on them. The main barriers to entry would be lack of slot availability at one or both of the airports on a route, or bilateral air service agreements which restrict the carriers allowed to operate on a route. Either will limit the number of carriers operating on a route, and also prevent new carriers entering the route. Tacit collusion between carriers is more likely on these routes, which will result in prices being set above MAC. The level of mark-up depends upon demand conditions on the route.

3. *Routes that are not competitive due to small market:* Thin routes on which demand will not profitably support more than one carrier (that is, demand would be less than one full plane of passengers per day if price were set at MAC). This leads to a natural monopoly for one carrier, and prices being set above MAC.

6. Competition in the European Airline Market

Liberalisation of the European airline market should have led to four events:

- An increase in the number of airlines operating on routes which are not thin and whose only barrier to entry prior to liberalisation was bilateral service agreements.
- An increase in the number of airlines operating in the EU as new airlines enter the market.
- A reduction in fares and increase in passengers on routes which are not thin and whose only barrier to entry prior to liberalisation was bilateral service agreements.
- A reduction in the average mark-up over MAC for the EU market as a whole due to lower fares on routes which are not thin, and whose only barrier to entry prior to liberalisation was bilateral service agreements.

Analysis by the CAA[4] shows that new airlines have indeed entered the EU aviation market since liberalisation in 1993. The CAA reports that there were 141 airlines providing scheduled air services within the EU in 1997, up from 126 in 1992, a rise of 12%. Furthermore, CAA analysis of competition at the route level shows that the number of airlines has increased on some routes within the EU, both domestic and international. In December 1997, 31 of the 119 densest international EU routes had three or more airlines operating on them, up from 14 routes in December 1992.

However, it should be noted that for *all* international routes (566), the vast majority (529 or 93%) still only had one or two airlines operating on them in 1997, implying that there are a very large number of routes which have barriers to entry on them, or are thin routes. The main barrier to entry is the availability of take-off and landing slots at Europe's congested airports. Slots are governed by the system of "grandfather rights", under which incumbent airlines retain slots provided they use them enough times each year. Low-cost carriers avoid this problem by flying from less congested airports which are not slot-constrained, and also cheaper to operate from.

Change in competition on EU air routes between 1992 and 1997

Domestic Routes	Monopoly	Two or more competitors	*Total*
December 1992	673 (90%)	73 (10%)	*746 (100%)*
December 1997	675 (81%)	154 (19%)	*829 (100%)*
International Routes	One or two competitors	Three or more competitors	*Total*
December 1992	478 (96%)	22 (4%)	*500 (100%)*
December 1997	529 (93%)	37 (7%)	*566 (100%)*
119 Densest International Routes	One or two competitors	Three or more competitors	*Total*
December 1992	105 (88%)	14 (12%)	*119 (100%)*
December 1997	88 (74%)	31 (26%)	*119 (100%)*

Source: CAA (CAP 685)

[4] "The Single European Aviation Market: The First Five Years" (CAP 685)

7. Empirical Analysis of Economy Class Fares in the EU

The above figures show that entry has occurred in the EU airline market and that competition has increased on some routes. Consequently, the average mark-up over MAC for intra-EU routes (henceforth referred to as EU routes) should have fallen. By contrast air services on shorthaul EU to non-EU routes, such as to the Eastern European[5] and north African countries, are still governed by bilateral air service agreements, and hence proxy for the regulatory structure in the EU prior to liberalisation. These routes are mostly *de facto* duopolies which hold back competition, and make tacit collusion between carriers more likely. As such, mark-ups above MAC on EU routes would be expected to be lower than on non-EU routes. The model below can be used to test this hypothesis.

Formally,

Equation (1): Fare on a route P = (1 + mark-up) * MAC

Non-EU routes: $P_{non} = (M + \varepsilon_{non}) * (\alpha_{non} + \beta X + v_{non}) = M\alpha_{non} + M\beta X + u_{non}$

EU routes: $P_{eu} = (M + k + \varepsilon_{eu}) * (\alpha_{eu} + \beta X + v_{eu}) = (M + k)\alpha_{eu} + (M + k)\beta X + u_{eu}$

Where:

$u_{non} = Mv_{non} + \varepsilon_{non}\alpha_{non} + \varepsilon_{non}\beta X + \varepsilon_{non}v_{non}$

$u_{eu} = (M + k)v_{eu} + \varepsilon_{eu}\alpha_{eu} + \varepsilon_{eu}\beta X + \varepsilon_{eu}v_{eu}$

$E(u_{eu}) = E(u_{non}) = 0$ (For proof see Appendix 2)

P = fare excluding tax
M = 1 + average mark-up over MAC achieved on non-EU routes[6]
k = difference in average mark-up over MAC between EU and non-EU routes[7]
$\varepsilon \sim N(0, \sigma^2_\varepsilon)$ represents variation in mark-up around average
α = average MAC per passenger independent of route distance
$v \sim iid(0, \sigma^2_v)$ represents variation in MAC per passenger independent of route distance around average
β = MAC per passenger per mile
X = route distance
ε and v are independent

The subscripts denote whether an observation relates to an EU or a non-EU route. Equation 1 states that the fare on a given route is the MAC per passenger on that route plus some mark-up above MAC. The size of the mark-up is the average mark-up for the market as a whole, plus a random element (ε) which depends upon the type of competition on the route. The difference between the average mark-up in the EU

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[5] Prior to 1st May 2004 when ten new members joined the EU. The airfares used for this study were collected in January 2004, and were for travel in March 2004.
[6] For example, if non-EU fares were on average marked up 20% above MAC, then M = 1 + 0.2 = 1.2
[7] For example, if EU fares were on average marked up 10% above MAC, and non-EU fares were on average marked up 20% above MAC, then k = 0.1 - 0.2 = -0.1

market and the non-EU market is k. The MAC per passenger independent of route distance for a route is equal to the average for the market as a whole, plus a random element (v) which depends upon the level of airport charges on the route. For the EU market the average MAC per passenger independent of route distance is α_{eu}, while for the non-EU market the average is α_{non}. By contrast, it is assumed that the MAC per passenger per mile of route distance (β) is constant for a given airline for both markets, since crew and fuel costs do not vary between the two markets[8]. If market liberalisation has led to lower average mark-ups on EU routes compared with non-EU routes, then k will be less than zero. The regression model below can be used to test this hypothesis.

$$P = M\alpha_{non} + M\beta X + ((M + k)\alpha_{eu} - M\alpha_{non})D + k\beta DX + u$$

OR

$$P = \gamma_0 + \gamma_1 X + \gamma_2 D + \gamma_3 DX + u$$

Where:
D is a dummy variable (0 if route is non-EU and 1 if route is EU)
$u = u_{non}$ if $D = 0$ and $u = u_{eu}$ if $D = 1$
$E(u) = 0$
$\gamma_0 = M\alpha_{non}$
$\gamma_1 = M\beta$
$\gamma_2 = (M + k)\alpha_{eu} - M\alpha_{non}$
$\gamma_3 = k\beta$

To test whether k is significantly different from zero, which would imply that mark-ups are different on EU routes to non-EU routes, we should test whether γ_3 is significantly different from zero. If γ_3 is less than zero, then the average mark-up on EU routes is lower than the average mark-up on non-EU routes, implying that market liberalisation has led to lower airfares in the EU.

Equation (2): $$\text{Var}(u) = M^2\sigma^2_v + \alpha^2\sigma^2_\varepsilon + \beta^2X^2\sigma^2_\varepsilon + \sigma^2_\varepsilon\sigma^2_v + 2\alpha\beta X\sigma^2_\varepsilon$$

(For proof see Appendix 2)

Equation (2) implies that the variance of the disturbance term (u) is a function of route distance, and hence that the model will suffer from heteroscedasticity. To correct for the implied heteroscedasticity, the model was estimated using the generalised least squares procedure outlined below.

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[8] In reality, fuel costs do vary between airports, but provided the *average* fuel cost is the same on EU and non-EU routes, the regression results will not be affected. Furthermore, it seems reasonable to assume that any variation in the average between the two markets will be small.

Step 1: Run the OLS regression:

$$P = \gamma_0 + \gamma_1 X + \gamma_2 D + \gamma_3 DX + u$$

Step 2: Run two auxiliary OLS regressions, one relating to the sub-sample of EU destinations, the other to the sub-sample of non-EU destinations:

$$\sigma^2_{i,eu} = \delta_{o,eu} + \delta_{1,eu} X_i + \delta_{2,eu} X^2_i + w_{i,eu}$$

$$\sigma^2_{i,non} = \delta_{o,non} + \delta_{1,non} X_i + \delta_{2,non} X^2_i + w_{i,non}$$

Where:
$w_{eu} \sim iid(0, \sigma^2_{w,eu})$

$w_{non} \sim iid(0, \sigma^2_{w,non})$

$\sigma^2_{i,eu}$ is estimated by the squared residual for EU observation i from equation in step 1.

$\sigma^2_{i,non}$ is estimated by the squared residual for non-EU observation i from equation in step 1.

Step 3: Calculate the fitted value of σ^2_i for each observation using the equations estimated in step 2.

Step 4: Estimate the GLS regression:

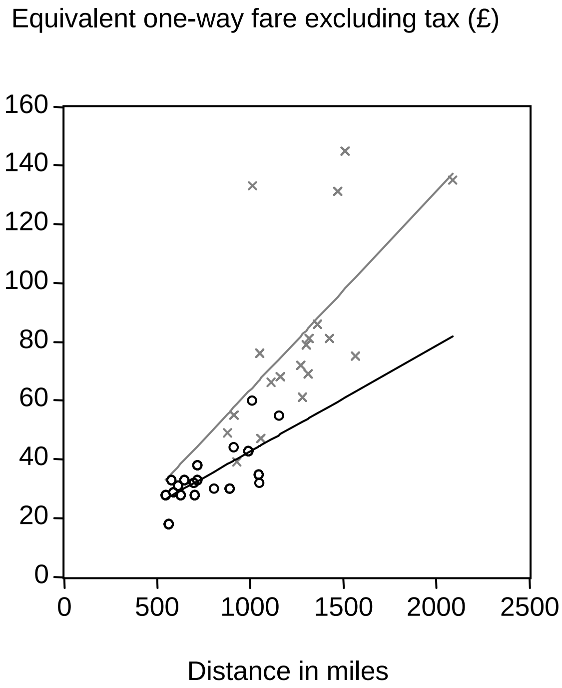
$$\frac{P}{\hat{\sigma}_i} = \gamma_0 \frac{1}{\hat{\sigma}_i} + \gamma_1 \frac{X}{\hat{\sigma}_i} + \gamma_2 \frac{D}{\hat{\sigma}_i} + \gamma_3 \frac{DX}{\hat{\sigma}_i} + \frac{u}{\hat{\sigma}_i}$$

The GLS model outlined above was estimated separately for the four largest airlines in the EU – British Airways, Lufthansa, Air France and KLM. For each airline, fares were collected for an equal number of EU and non-EU routes. Comparing EU and non-EU fares on an airline-by-airline basis means that the coefficient β should be equal for both EU and non-EU routes, as discussed above. For each airline, the GLS regression results are presented below, with White heteroscedasticity consistent p-values in brackets. A graph of the fitted GLS equation for each airline is shown, along with the R^2 values.

1). *British Airways (38 routes)*

$$P = -4.04 + 0.0676X + 10.80D - 0.0317DX \qquad R^2_{OLS} = 0.71 \qquad R^2_{GLS} = 0.77$$

(0.825) (0.000) (0.588) (0.057)



× Non-EU fares
Non-EU regression line
o EU fares
EU regression line

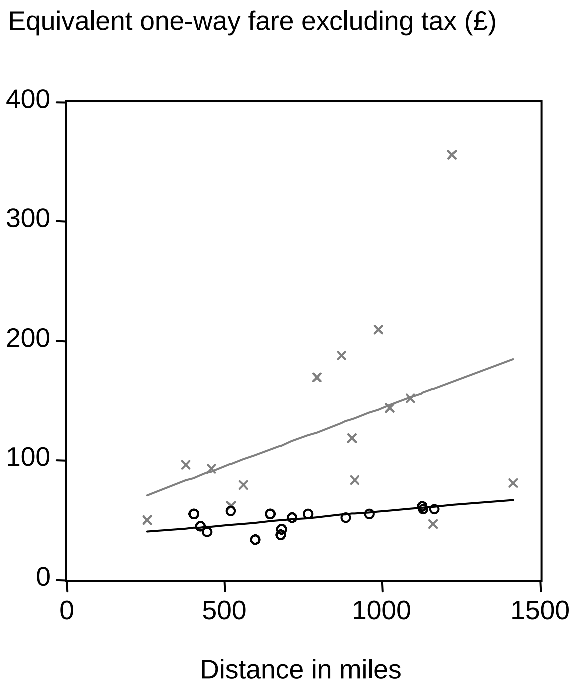
EU Routes	Non-EU Routes
Alicante (ALC)*, Verona (VRN)*, Barcelona (BCN), Bilbao (BIO), Bologna (BLQ)*, Genoa (GLA)*, Faro (FAO)*, Seville (SVQ), Malaga (AGP), Milan-Linate (LIN), Munich (MUC), Naples (NAP)*, Valencia (VLC)*, Venice (VCE)*, Montpellier (MPL)*, Pisa (PSA)*, Turin (TRN)*, Stockholm (ARN), Helsinki (HEL)	Sofia (SOF), Budapest (BUD), Riga (RIX), Malta (MLA)*, Krakow (KRK)*, Warsaw (WAW), Bucharest (OTP), Istanbul (IST), Belgrade (BEG), Kiev (KBP), Algiers (ALG)*, Alexandria-Borg El Arab (HBE), Pristina (PRN)*, St Petersberg (LED), Tripoli (TIP), Agadir (AGA)*, Casablanca (CMN), Marrakesh (RAK), Tunis (TUN)*

Flights from Heathrow (LHR), apart from those marked *, which are from Gatwick (LGW).

2). *Lufthansa (30 routes)*

$$P = 45.89 + 0.0979X - 11.95D - 0.0746DX \qquad R^2_{OLS} = 0.45 \qquad R^2_{GLS} = 0.99$$

(0.048) (0.024) (0.605) (0.081)



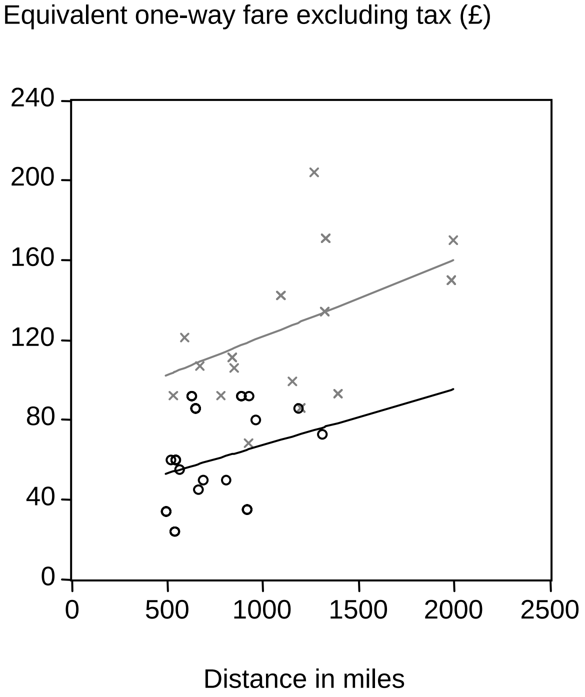
× Non-EU fares
Non-EU regression line
o EU fares
EU regression line

EU Routes	Non-EU Routes
Rome (FCO), Edinburgh (EDI), Athens (ATH), Barcelona (BCN), Dublin (DUB), Lisbon (LIS), Madrid (MAD), Manchester (MAN), Malaga (AGP), Copenhagen (CPH), Stockholm (ARN), Bolgna (BLQ), Helsinki (HEL), Nice (NCE), Bilbao (BIO)	Sofia (SOF), Budapest (BUD), Bucharest (OTP), Istanbul (IST), Kiev (KBP), Casablanca (CMN), Tunis (TUN), Warsaw (WAW), Zagreb (ZAG), Ljubljana (LJU), Prague (PRG), St Petersberg (LED), Riga (RIX), Malta (MLA), Tripoli (TIP)

All flights from Frankfurt (FRA).

3). *Air France (32 routes)*

$$P = 83.42 + 0.0382X - 44.18D - 0.0102DX \qquad R^2_{OLS} = 0.63 \qquad R^2_{GLS} = 0.89$$
$$\quad (0.000) \quad (0.000) \quad (0.014) \quad (0.440)$$



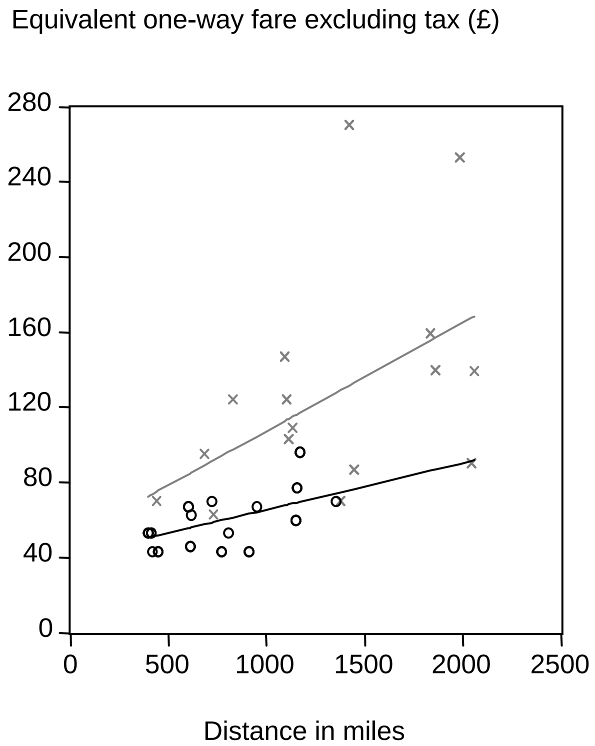
× Non-EU fares
—— Non-EU regression line
o EU fares
—— EU regression line

EU Routes	Non-EU Routes
Rome (FCO), Edinburgh (EDI), Athens (ATH), Barcelona (BCN), Dublin (DUB), Lisbon (LIS), Glasgow (GLA), Madrid (MAD), Malaga (AGP), Vienna (VIE), Copenhagen (CPH), Naples (NAP), Stockholm (ARN), Bolgna (BLQ), Helsinki (HEL), Seville (SVQ)*	Sofia (SOF), Budapest (BUD), Beiruit (BEY), Bucharest (OTP), Istanbul (IST), Kiev (KBP), Algiers (ALG), Casablanca (CMN), Marrakesh (RAK), Cairo (CAI), Tunis (TUN), Warsaw (WAW), Zagreb (ZAG), Ljubljana (LJU), Prague (PRG), St Petersberg (LED)

Flights from Charles de Gaulle (CDG), apart from those marked *, which are from Orly (ORY).

4). *KLM (32 routes)*

$$P = 49.68 + 0.0576X - 9.03D - 0.0329DX \qquad R^2_{OLS} = 0.53 \qquad R^2_{GLS} = 0.94$$
$$\quad (0.018) \quad (0.012) \quad (0.660) \quad (0.163)$$



× Non-EU fares
—— Non-EU regression line
o EU fares
—— EU regression line

EU Routes	Non-EU Routes
Rome (FCO), Edinburgh (EDI), Athens (ATH), Barcelona (BCN), Lisbon (LIS), Glasgow (GLA), Madrid (MAD), Munich (MUC) Malaga (AGP), Vienna (VIE), Copenhagen (CPH), Nice (NCE), Stockholm (ARN), Bolgna (BLQ), Helsinki (HEL), Seville (SVQ)	Sofia (SOF), Larnaca (LCA), Paphos (PFO), Prague (PRA), Cairo (CAI), Budapest (BUD), Tel Aviv (TLV), Riga (RIX), Beiruit (BEY), Tripoli (TIP), Cassablanca (CMN), Warsaw (WAW), Bucharest (OTP), St Petersberg (LED), Istanbul (IST), Kiev (KBP)

All flights from Amsterdam (AMS).

For all four airlines, the estimate of γ_3 is less than zero, implying that mark-ups above MAC, and hence fares, are lower on EU routes than on non-EU routes. For British Airways and Lufthansa, γ_3 is significantly different from zero at the 10% level. The reason that the estimates for Air France and KLM are not significant may be that many of the EU routes that these airlines operate on still have barriers to entry, or are thin routes, and hence that market liberalisation has had only a limited impact on their average mark-ups. By contrast, a low-cost carrier operates on the majority of the city-pairs analysed for British Airways, providing competition.

8. Empirical Analysis of Business Class Fares in the EU

Business class airfares in the EU remain substantially above economy class fares, despite market deregulation and the seeming lack of difference in cost of supplying the two types of product. On most routes the national carriers are the only airlines which offer business class seats, giving the carriers market power, and making tacit collusion more likely. The reason that competition remains limited is that business class travellers prefer to fly from cities' main airports, which in turn tend to have high barriers to entry due to severely limited slot availability. Consequently it seems that business class fares are marked-up above MAC on both EU and non-EU routes.

One way to analyse mark-ups of business class fares above cost is to compare them with economy class fares on a route-by-route basis. If the economy class market is competitive then economy class fares should represent MAC. On shorthaul aircraft, each business class seat takes up the space of about two economy class seats, and hence absorbs twice the fixed cost of each economy class seat. If the marginal cost of a business class seat is exactly twice the marginal cost of an economy class seat, then the MAC of a business class seat will be twice the MAC of an economy class seat. If the economy class market is competitive, then economy fares will represent the MAC of economy class seats, and hence the MAC of a business class seat will be twice the economy class fare. If the marginal cost of a business class seat is more than twice the marginal cost of an economy class seat, then the MAC of a business class seat will be more than double the economy fare.

Ratio of Business Class to Economy Class Fares

	EU Routes			**Non-EU Routes**		
	Minimum	Maximum	Average	Minimum	Maximum	Average
British Airways	3.7	7.6	5.9	2.2	9.7	5.9
Lufthansa	6.1	11.2	8.9	1.5	12.1	4.5
Air France	4.3	14.0	7.4	2.9	6.9	4.7
KLM	4.0	8.7	5.8	2.7	10.7	4.4
ALL	*3.7*	*14.0*	*7.0*	*1.5*	*12.1*	*4.9*

The marginal cost of a business class seat is higher than the marginal cost of an economy class seat due to superior in-flight catering, lounge access at airports, a higher cabin-crew-to-passenger ratio, and reward point programmes. If the marginal cost of a business class seat is significantly more than twice the marginal cost of an economy class seat, then the MAC of a business class seat could be as high as four times the MAC of an economy class seat. By comparison, the fares data show that on average, business class fares on EU routes are 7 times economy class fares, with a maximum multiplier of 14. Hence, if economy class fares represent cost, then EU business class fares are marked-up significantly above cost. If economy class fares themselves are marked-up above cost, then business class fares are marked-up even more above cost.

9. Conclusions

This paper has examined the impact that market liberalisation has had on airfares in the EU. The empirical analysis undertaken leads to four main conclusions:

1. Low-cost carriers have entered the market, and charge lower fares than traditional airlines when operating on the same city-pair routes, but also provide a different type of product.

2. Market liberalisation has resulted in an increase in the number of scheduled airlines operating in the EU, and an increase in the number of airlines operating on some routes, both international and domestic.

3. Mark-ups above cost are lower on intra-EU routes than on non-EU routes. The latter have the same regulatory structure now as intra-EU routes did prior to deregulation. This suggests that increased competition has seen average mark-ups above cost, and hence airfares, fall within the EU. Barriers to entry exist on many EU routes due to lack of availability of take-off and landing slots at Europe's busy airports. This holds back competition, and keeps fares high on many routes.

4. Market liberalisation has had little impact on business class airfares in the EU, which remain substantially above cost due to lack of competition. Competition has been held back by slot availability at the airports which business class passengers wish to fly from.

Market liberalisation has led to lower economy class airfares in the EU by increasing competition, as economic theory predicts. However, a large number of routes within the EU still suffer from a lack of competition, seemingly due to barriers to entry on them. The biggest barrier to entry is lack of access to slots at Europe's increasingly congested airports. Consequently, the full benefits of market liberalisation are not yet being enjoyed. Unless new airlines can gain access to slots, or airports are expanded to increase the total number of slots available, this will continue to be the case. At the same time, consideration has to be given to the environmental consequences of more air travel though. Addressing the issue of how to allocate slots efficiently would provide scope for even greater competition in the EU aviation market, which could lead to lower fares for passengers on even more routes within the EU, and allow the full benefits of market liberalisation to be reaped.

Appendix 1

All of the fares used in this study were collected from the airlines' websites on Saturday 24th January 2004, and were for outbound travel on Wednesday 17th March 2004, and return travel on Wednesday 24th March 2004. In some instances flights were not available on these days, and a flight on the nearest available day was used instead. A flight on a near day (not including weekends) was also used if a substantially cheaper fare was available. The fares were obtained from the airlines' home country websites to eliminate any price discrimination which might occur for bookings made outside the airline's home country. Where fares were quoted in euros they were converted to sterling at the exchange rate on Saturday 24th January 2004, which was 1.445 euros per pound. For all the traditional airlines, only return fares were available at the cheapest tariff. These were divided by two to give the cost of one leg of the journey, and it was this price which was used in the analysis. All the fares used were excluding passenger taxes, and hence represent revenue to the airlines. Details of the types of fare for each of the traditional carriers are below:

British Airways	www.ba.com	Economy (lowest priced) and business (restricted) fares
Lufthansa	www.lufthansa.com	Economy (flexible) and business (flexible) fares
Air France	www.airfrance.com	Economy and business fares
KLM	www.klm.com	Economy and business fares

Appendix 2

$$u = Mv + \varepsilon\alpha + \varepsilon\beta X + \varepsilon v$$

$$\begin{aligned} E(u) &= E(Mv + \varepsilon\alpha + \varepsilon\beta X + \varepsilon v) \\ &= E(Mv) + E(\varepsilon\alpha) + E(\varepsilon\beta X) + E(\varepsilon v) \\ &= M[E(v)] + \alpha[E(\varepsilon)] + \beta X[E(\varepsilon)] + E(\varepsilon)E(v) \qquad (\varepsilon \text{ and } v \text{ are independent}) \\ &= M[0] + \alpha[0] + \beta X[0] + [0][0] \\ &= 0 \end{aligned}$$

$$Var(u) = Var(Mv + \varepsilon\alpha + \varepsilon\beta X + \varepsilon v)$$

$$= Var(Mv) + Var(\varepsilon\alpha) + Var(\varepsilon\beta X) + Var(\varepsilon v) + 2Cov(Mv,\varepsilon\alpha) + 2Cov(Mv,\varepsilon\beta X) + 2Cov(Mv,\varepsilon v) + 2Cov(\varepsilon\alpha,\varepsilon\beta X) + 2Cov(\varepsilon\alpha,\varepsilon v) + 2Cov(\varepsilon\beta X,\varepsilon v)$$

$$= M^2[Var(v)] + \alpha^2[Var(\varepsilon)] + \beta^2X^2[Var(\varepsilon)] + E(\varepsilon^2v^2) + 2M\alpha[Cov(v,\varepsilon)] + 2M\beta X[Cov(v,\varepsilon)] + 2M[Cov(v,\varepsilon v)] + 2\alpha\beta X[Var(\varepsilon)] + 2\alpha[Cov(\varepsilon,\varepsilon v)] + 2\beta X[Cov(\varepsilon,\varepsilon v)]$$

$$= M^2\sigma^2_v + \alpha^2\sigma^2_\varepsilon + \beta^2X^2\sigma^2_\varepsilon + E(\varepsilon^2)E(v^2) + 2M\alpha[0] + 2M\beta X[0] + 2M[E(\varepsilon)E(v^2)] + 2\alpha\beta X\sigma^2_\varepsilon + 2\alpha[E(\varepsilon^2)E(v)] + 2\beta X[E(\varepsilon^2)E(v)]$$

$$= M^2\sigma^2_v + \alpha^2\sigma^2_\varepsilon + \beta^2X^2\sigma^2_\varepsilon + [Var(\varepsilon)][Var(v)] + 2M[0]\sigma^2_v + 2\alpha\beta X\sigma^2_\varepsilon + 2\alpha[\sigma^2_\varepsilon][0] + 2\beta X\sigma^2_\varepsilon[0]$$

$$= M^2\sigma^2_v + \alpha^2\sigma^2_\varepsilon + \beta^2X^2\sigma^2_\varepsilon + \sigma^2_\varepsilon\sigma^2_v + 2\alpha\beta X\sigma^2_\varepsilon$$

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www.gc.kls2.com - source of great circle flight path distances between airports