THE DEVELOPMENT OF AIRPORT CHOICE MODELS USING STATED PREFERENCE DATA: AN EAST MIDLANDS CASE STUDY

Dr Lisa Davison and Dr Tim Ryley

Transport Studies Group, Loughborough University, Leicestershire, LE11 3TU, UK

ABSTRACT

Stated choice models have been developed across a variety of aviation applications including flight choice, airline choice, airport choice, and whether to fly or not. In the context of airport choice, the focus of this paper, models can determine the value individuals put on attributes such as parking and retailing, distance and travel time from home, available flight destinations, flight cost and their expectation of queues at the airport, and the trade-off values at which individuals would choose an alternative, competing airport. This is of paramount importance to airports and airlines; examples include route and facility development and customer service offers. Airports need to know the effect on their infrastructure, parking and retail revenues of each carrier or destination offering. They also need to know what reduces passenger desire to fly from their airport (perhaps to another competing airport), and the factors that reduce revenue per passenger.

This paper examines data from an air travel household survey conducted in the East Midlands region of the United Kingdom during Autumn 2007 and Spring 2008 (after a pilot survey in August 2007). Air travel survey questionnaires were posted out to residents of the following East Midlands Local Authority areas: Northampton, North East Derbyshire, Hinckley & Bosworth, Newark & Sherwood and Nottingham. The resultant sample consists of 605 households. The East Midlands air travel survey questionnaire contains a vast array of variables relating to air travel attitudes and behaviour, together with background socio-economic and transport information. It also includes two stated preference experiments, the first relating to the air flight choice of respondents for a low cost journey to the respondents' preferred destination (one of the eight presented).

The focus of this paper is the second stated preference experiment, concerning the airport choice of respondents. Respondents chose between three flights from three different airport alternatives. The three airport alternatives presented to respondents were their three nearest airports from the following five airports: East Midlands airport, Birmingham International Airport, Luton airport, Manchester airport and Leeds Bradford airport. Each alternative varied by the following three attributes (each at two levels): return flight price (between £39 and £60 inclusive), cost of parking per day (between £3 and £15 inclusive), and Friday departure time from the UK airport (between 700 and 1900 inclusive). The return flight price covers all air travel costs per person, including all taxes and charges. The journey specified was to the respondent's preferred destination (one of eight presented: Edinburgh, Dublin, Prague, Rome, Berlin, Alicante, Malaga and Faro), and for either a week-long holiday or weekend break (both leaving Friday and returning Sunday).

Multinomial logit models are estimated to analyse the airport choice decision-making of respondents. In addition to air fare, the importance of departure time and airport parking cost when making air travel decisions is highlighted in the estimation process. Models are run for different residential areas and destination choices of respondents, as well as for statistically determined market segments (e.g. 'Employed frequent flyers', 'Retired annual holiday makers'). It is demonstrated that respondents living in less deprived areas are more mobile and thus more able to trade between airports. Across all models, parking costs and flight departure time have a greater and more significant influence on choice than air fare. This shows that in a low cost airline market passengers can and do trade-off between airports (and airlines) in order to meet their travel demands, such as an early morning flight to maximise time at a resort.

Keywords: airport, choice, modelling

INTRODUCTION

Airport choices: the United Kingdom context

Historically, under municipal ownership, strategic decisions supported airports over periods where they operated at a loss, rather than consolidating activities with those in a neighbouring municipal area. Whilst this had been viewed as an inefficient use of resources, the extra capacity now available could absorb increasing demand by offering an alternative to primary airports as they reach capacity (Humphreys, 1999; Humphreys and Francis, 2002). As a result, airport catchments often overlap and passengers can often choose between two or more airports pairs. For example, in the East Midlands passengers have easy access to Birmingham International and East Midlands airports plus Manchester and Leeds Bradford airports to the north of the region and London Luton airport to the south. Such airports can complement and/or compete with one another. To an extent this is dictated by the history and design of the airport, how accessible it is, surrounding land use and catchment population; it is also influenced by commercial interests, airport capacity and passenger throughput and the current business model of each airport, including route and airline choice availability (Humphreys and Francis, 2002).

By 2000, as a result of the 1986 Airports Act, 45 airports had been transferred to commercial ownership, reflecting an increasing turnover for regional airports, especially following the liberalisation of the European aviation market, which has given airlines greater freedom. These market conditions have increased availability from the regions and resulted in passenger growth at regional airports exceeding that of the London airports (Civil Aviation Authority, 2005). The Air Transport White Paper (Department for Transport, 2003, page 10) recognises the role of regional airports in providing for air travel demand:

> "The Government wishes to encourage the growth of regional airports in order to support regional economic development, provide passengers with greater choice, and reduce pressures on more over-crowded airports in the South East."

This also influences surface access, impacting on the strategic, and in some cases local, road networks and steering rail and bus provision. Using 2006 data obtained from the Civil Aviation Authority, Table I demonstrates the catchments of both Birmingham International airport and East Midlands airport for the purpose of leisure travel, in terms of home and 'start address' the address at which the individual started their journey. Each predominate their own region (the West Midlands and East Midlands respectively), but each are also used by UK passengers living in another region plus passengers who have travelled into the region to take a flight. There is a leeching effect from the neighbouring region, in particular the West and East Midlands, given strong road and public transport links. Additionally, East Midlands airport exerts a pull on the Yorkshire and Humberside population, and Birmingham International airport upon the Southern regions.

Table I – Leisure travel catchment areas for Birmingham International airport and East Midlands airport

	Home region		Start address region	
	Birmingham International airport	East Midlands airport	Birmingham International airport	East Midlands airport
East Anglia	42 (1%)	47 (1%)	45 (1%)	48 (1%)
East Midlands	1258 (16%)	3717 (59%)	1304 (16%)	4014 (63%)
North West	124 (2%)	96 (2%)	45 (1%)	89 (1%)
Northern	31 (0%)	29 (0%)	17 (0%)	26 (0%)
Northern Ireland	196 (2%)	109 (2%)	1 (0%)	0 (0%)
Scotland	422 (5%)	206 (3%)	2 (0%)	3 (0%)
South East	286 (4%)	71 (1%)	303 (4%)	64 (1%)
South West	400 (5%)	81 (1%)	356 (4%)	54 (1%)
Southern Ireland	13 (0%)	8 (0%)	0 (0%)	1 (0%)
Wales	174 (2%)	30 (0%)	147 (2%)	26 (0%)
West Midlands	4768 (60%)	999 (16%)	5399 (68%)	1031 (16%)
Yorkshire and Humberside	147 (2%)	956 (15%)	132 (2%)	968 (15%)
Total	7967 (100%)	6350 (100%)	7967 (100%)	6350 (100%)

Source: 2006 Civil Aviation Authority data for the two airports

Generated access travel to each airport summarised in Table II based on a sample of leisure travellers during 2006. Across each airport car travel dominates, during 2006 the majority of passengers parked at East Midlands, whereas the majority are dropped off at Birmingham, a similar share access each airport by minicab or taxi. The 'Kiss and fly' concept (where passengers are dropped off or picked up by friends or family) is a particular concern as it generates up to double the travel impact of passengers choosing to drive and park. Public transport does not feature heavily for either airport but a greater proportion access Birmingham by train given the direct link.

Table II – Generated access travel data for Birmingham International airport and East Midlands airport

	Birmingham International airport	East Midlands airport	Both airports
Car (private, hire or rental) parked at or near airport	2,114 (27%)	3,533 (56%)	5,602 (39%)
Kiss and fly (private or rental)	3,190 (40%)	1,241 (20%)	4,431 (31%)
Minicab / taxi	1,758 (22%)	1,218 (19%)	2,976 (21%)
National Railways	378 (5%)	38 (1%)	416 (3%)
Local bus companies	119 (1%)	133 (2%)	252 (2%)
Coach	88 (1%)	71 (1%)	159 (1%)
Shuttle Bus / rail link	56 (1%)	54 (1%)	110 (1%)
Other	32 (0%)	34 (1%)	66 (0%)
Total	7,967 (100%)	6,350 (100%)	14,317 (100%)

Source: 2006 Civil Aviation Authority data for the two airports

The development of airport choice models

Stated choice models have increasingly been applied to air travel applications. They tend to focus on flight choice (e.g. Proussaloglou and Koppelman, 1999), airline choice (e.g. Hensher et al, 2001) or airport choice (e.g. Hess and Polak, 2005). With the rapidly changing aviation industry, increasing work has been undertaken updating and extending research into the development of air travel stated choice models. An example of the usefulness of the models is their great value in the support of airline decisions regarding pricing, flight scheduling, seat allocation, and ticket restrictions. Aviation-based stated choice models have been developed based on revealed and/or stated preference data. Either secondary data, such as ticketing information, can be modelled using readily-available revealed choice data, or primary data can be collected from a stated choice survey. The benefits of using stated choice experiments in air travel relate to the ability of being able to model un-chosen alternatives, in terms of explanatory variables as well as availability (Hess et al, 2007). There can be issues getting data: security issues, where to interview respondents (on-board, arrival, departure). This is part of the reason why for this research, interviews were conducted away from airports with households.

In the context of airport choice, the focus of this paper, models can determine the value individuals put on attributes such as parking and retailing, distance and travel time from home, available flight destinations, flight cost and their expectation of queues at the airport, and the trade-off values at which individuals would choose an alternative, competing airport. This is of paramount importance to airports and airlines; examples include route and facility development and customer service offers. Airports need to know the effect on their infrastructure, parking and retail revenues of each carrier or destination offering. They also need to know what reduces passenger desire to fly from their airport (perhaps to another competing airport), and the factors that reduce revenue per passenger.

Evidence has shown that passengers prefer the airport nearest to their home, as well as larger airports (Hess, 2010). The former is tested in this research; the latter is not as relevant given the East Midlands regional airport context. Passengers have tended to be segmented in airport choice modelling case studies according to the most common aviation traveller dichotomy, leisure and business travellers (Hess and Polak, 2005; Loo, 2008), although Marcucci and Gatta (2009) also consider travellers split by low cost airline and regular airline use. For this segmentation, waiting time was shown to be more important for regular passengers than users of low cost airlines.

This paper focuses on behavioural insights from multinomial logit model estimations using airport choice stated preference data. Although not the focus of this paper, more advanced modelling techniques have been applied to the airport choice context, including mixed logit models that allow for a random distribution of tastes across decision makers (e.g. Hess and Polak, 2005) and nested structures that allow for joint representation of inter-alternative correlation along the three choice dimensions of airport, airline and access mode choice (e.g. Hess et al, 2010).

This paper examines data from an air travel household survey conducted in the East Midlands region of the United Kingdom during autumn 2007 and spring 2008; the resultant sample consists of 605 households. The focus of this paper is on a stated preference experiment within the survey concerning the airport choice of respondents. Respondents chose between three flights from three different airport alternatives. The three airport alternatives presented to respondents were their three nearest airports from the following five airports: East Midlands airport, Birmingham International airport, Luton airport, Manchester airport and Leeds Bradford airport. Multinomial logit models are estimated to analyse the airport choice decision-making of respondents.

RESEARCH DESIGN

Questionnaire design

Data collection for the East Midlands air travel survey used postal questionnaires, a low cost method that does not involve high personnel travel costs. That said, there can be difficulties with postal questionnaire surveys in obtaining a representative sample due to low response rates. A self-completion questionnaire was posted out to each household sampled, together with a pre-paid return envelope. The request was for one adult within the household to complete the questionnaire and return it in the envelope provided.

Survey design was informed by the Charnwood air travel household survey, conducted in October 2006 (Ryley and Davison, 2008). In addition, a pilot postal survey with 67 household responses was conducted in August 2007, sampling the towns of Barrow-upon-Soar and Woodhouse Eaves within the Charnwood Borough Council area.

The survey questionnaire contains a vast array of variables relating to air travel attitudes and behaviour, together with background socio-economic and transport information. Table III details the variables within the questionnaire, split according to the five Sections:

Table III – Variables within the East Midlands air travel survey questionnaire

Section	Variables
Air travel experience	Number of flights the previous year (leisure/business), usage of airlines, details of the most recent return flight, usage of various UK airports
Air travel experience from nearest regional airport	Number of flights the previous year, travel mode to/from nearest airport, eight specified destinations travelled to/from nearest airport (Edinburgh, Dublin, Prague, Rome, Berlin, Alicante, Malaga and Faro). 'Nearest airport' included in questionnaires were those served by low-cost airlines to a range of destinations
Future air travel choices	Experience & ranking of eight specified destinations, reasons for 1st choice destination, flight choice stated preference experiment, likelihood of travel for this trip, number of people (if any) respondent would travel with, airport choice stated preference experiment, air travel changes in response to varying price
Attitudes to air travel	Agreement of respondents to statements about what influences air travel choices, agreement of respondents with five statements on economic and environmental issues associated with air travel
Household variables	Age band, gender, number of adults in household, number of children in household, current status (e.g. employed, retired), personal income

Sample selection

The sampling strategy for the air travel survey was to select two sub-areas within each of five local authorities in the East Midlands. The five sampled local authorities were: Hinckley & Bosworth, Newark & Sherwood, Northampton, North East Derbyshire, and Nottingham. A quota was set for sampling both the local authority and sub-areas. The criteria for the local authority was to sample at a range of distances from East Midlands airport, the most central airport in the region; to get a mixture of urban and rural districts (at least one of each, where Nottingham, Leicester, Derby, Northampton and Lincoln were classed as urban districts within the East Midlands); and not to select adjacent authorities.

The sub-areas were selected to include a range of different socio-economic characteristics, reflecting England and Wales (given the lack of East Midlands data); again adjacent areas were rejected. Overall levels of deprivation were used as an indicator for socio-economic characteristics of the selected postcodes (Office for National Statistics, 2004). The index of multiple deprivation (IMD) includes income, employment, health, education, housing and service provision, crime levels and living environment, by Super Output Area (SOAs, first used in 2004, have a consistent number of houses and boundaries which do not change, so are designed to overcome related concerns with ward level data, when used for statistical applications). Ten sample sites were selected evenly split across quintiles, two from the 20% most deprived SOAs (quintile 1) to two from the least deprived (quintile 5); within the local authority each sub-area could not be within the same quintile, furthermore one needed to be from quintiles 1-3 and the other from quintiles 3-5.

The sampling frame was the Electoral Register, the record of everyone living within the Council area eligible to vote. The edited version of the Electoral Register was obtained from each of the given Local Authorities. The edited Electoral Register does not include individuals who requested removal of their names from the version given to outside organisations, an option which has been available since 2002. The 2005 Electoral Register included approximately 70% of those on the full register; a proportion which has reduced annually since 2002 (Information Commissioners Office, 2006).

Stated preference airport choice experiment

The stated preference experiment in the 'Future air travel choices' section varied according to sample sub area. The stated preference experiment concerns the airport choice of residents for a low cost journey to the respondents' preferred destination, split into 2 blocks of 6 scenarios across questionnaires as part of a fractional factorial design. Respondents chose between flights from their three nearest airport alternatives to a given range of European cities and resorts, varying by the attributes of total return cost (between £39 and £60), cost of parking per day (between £3 and £15) and Friday departure time from the three nearest airports with regular low cost flights from more than one airline to a range of European destinations. In terms of generating attribute levels, it is desirable to have fewer levels with a wide range from a behavioural perspective (although not too wide that they are unrealistic). To generate such levels, a review of low-cost air travel practice in the East Midlands region was undertaken. This review included airports accessible to East Midlands residents, typical low-cost airline destinations, the low-cost airline fares on offer, typical airport parking charges, and the flight arrival / departure times at the airports under consideration. An example scenario is included in Figure I.

	Luton airport	Birmingham International airport	East Midlands airport
Cost of flight per person	£54	£47	£39
Cost of parking per day	£15	£12	£6
Departure time on Friday	7:00	17:30	8:30
Please tick one box for your preferred flight	☐	☐	☐

Figure I – An example of an airport choice stated preference scenario within the survey

The three nearest airports with more than one low cost airlines that serve a range of destinations, according to sample area are included in Table IV and Figure II demonstrate the location of the sample sites and airports. Due to the large geographical area of the East Midlands, the three nearest airports differed between the five sampled areas. It should be noted that the airport review highlighted that five airports were of a sufficient size to provide the eight low-cost airline destinations on offer; although Coventry airport and Robin Hood Doncaster Sheffield airport were accessible to East Midlands' residents, they were not able to offer the full range of low-cost airline destinations.

Table IV – The three nearest airports for the five sample areas

	Hinckley and Bosworth	Newark and Sherwood	North East Derbyshire	Northampton	Nottingham
First nearest airport	Birmingham International	East Midlands	East Midlands	Luton	East Midlands
Second nearest airport	East Midlands	Birmingham International	Manchester	Birmingham International	Birmingham International
Third nearest airport	Luton	Leeds Bradford	Leeds Bradford	East Midlands	Leeds Bradford

Figure II – Map illustrating the sample areas and nearest airports (not to scale)

THE SAMPLE

Sample response

Of the 5,000 questionnaires posted out in autumn 2007, 517 usable questionnaires were returned. This represents an overall response rate of 10%; lower than expected (postal survey questionnaires tend to have response rates of between 10% and 25%). Table 1 shows the response by sub-area, together with deprivation level. It shows that, as expected, there are lower response rates for higher deprivation areas; for instance the two sub-areas with the highest deprivation levels (quintile 1) have the lowest response rates (both 6%). To overcome the bias of low response by sub-area, further surveys were sent to those with less than 50 responses. This boost considered the existing response rate and the number of surveys required to reach 50 in each. In total, 1,300 further surveys were posted during spring 2008, of these 88 (7% response rate for the boost) were returned, resulting in 605 overall returns (10% response rate). Response rate remains lowest in the areas with higher deprivation.

Table V – Response rate by sample area, sub-area and IMD quintile

Area (Electoral Register)	Sub-area (main Ward area)	Multiple deprivation	Initial sample size	Responses received initial survey	Boost sample size	Responses received boost	Total number of questionnaires received
Hinckley and Bosworth	Barwell	Quintile 3	500	48 (10%)	100	12 (12%)	60 (10%)
Hinckley and Bosworth	Clarendon	Quintile 5	500	46 (9%)	100	15 (15%)	61 (10%)
Newark and Sherwood	Boughton	Quintile 1	500	29 (6%)	450	21 (5%)	50 (5%)
Newark and Sherwood	Lowdam	Quintile 4	500	80 (16%)	-	-	80 (16%)
North East Derbyshire	Tupton	Quintile 2	500	49 (10%)	100	15 (15%)	64 (11%)
North East Derbyshire	Eckington	Quintile 5	500	63 (13%)	-	-	63 (13%)
Northampton	St David's	Quintile 1	500	31 (6%)	450	15 (3%)	46 (5%)
Northampton	Nene Valley	Quintile 4	500	59 (12%)	-	-	59 (12%)
Nottingham	Leen Valley	Quintile 2	500	48 (10%)	100	10 (10%)	58 (10%)
Nottingham	Bulwell Forest	Quintile 3	500	64 (13%)	-	-	64 (13%)
Total			5,000	517 (10%)	1,300	88 (7%)	605 (10%)

Airport use and preference

Respondent choice of airport demonstrate a willingness to travel to airports outside the East Midlands region, in particular to Birmingham and London Heathrow and Gatwick as demonstrated in Table VI Recently this trend has also extended to Manchester and Stansted.

Table VI – Use of a range of UK airports

	Used previously	Used in the last 12 months
Birmingham International	424 (78%)	148 (27%)
Coventry	60 (13%)	30 (6%)
East Midland	483 (87%)	232 (43%)
Gatwick	359 (70%)	55 (10%)
Heathrow	359 (70%)	89 (17%)
Leeds Bradford	50 (11%)	10 (2%)
Liverpool	32 (7%)	10 (2%)
Luton	292 (58%)	53 (10%)
Manchester	349 (69%)	79 (15%)
Robin Hood	55 (12%)	30 (6%)
Stansted	218 (44%)	53 (10%)

As demonstrated in Table VII respondents generally favoured their nearest airport. Exceptions to this are for the Hinckley and Bosworth and the Northampton respondents. One reason for the Hinckley and Bosworth sample is that the 'second' airport was, in some cases, equidistant or easier to get to. The Northampton sample also had relatively small increase in distance for both alternative airports. Reasons given for not selecting the nearest airport include ease of access with less risk of delays, (including good train access for Birmingham), parking facility design and cost, terminal design, size and operation.

Table VII – Airport preference by sample area

	Hinckley and Bosworth	Newark and Sherwood	North East Derbyshire	Northampton	Nottingham	Total
Nearest	47 (43%)	110 (97%)	101 (88%)	45 (50%)	107 (97%)	410 (76%)
Second nearest	61 (56%)	2 (2%)	10 (9%)	27 (30%)	2 (2%)	102 (19%)
Third nearest	1 (1%)	1 (1%)	4 (4%)	19 (21%)	1 (1%)	26 (5%)
Total	109 (100%)	113 (100%)	115 (100%)	91 (100%)	110 (100%)	538 (100%)

Despite clear preferences, response to the stated preference scenarios demonstrated a willingness of individuals to trade between airports. Of the respondents completing the airport choice stated preference experiment, 67% traded between airports. Of the traders, only a small proportion focused on one attribute across scenarios: less than 1% focussed on a later departure; less than 1% focussed on flight prices, always selecting the cheapest flight; less than 2% focussed on the cheapest parking costs and just over 3% always selected the earliest flight to maximise time at destination.

Air travel population segments

Spatial variations in access and destination preference are not the only variables to influence airport choice, socio-demographic and behavioural characteristics also exert influence upon choice, for example retired people may have a particularly strong preference for the nearest airport and families may opt for flights which limit disturbance to a daily routine. Rather than looking at each of these elements separately response to the East Midlands air travel survey was segmented using hierarchical cluster analysis. The purpose of this was to develop air travel population segments according to categorical air travel behaviour and household characteristics (for further methodological details see Ryley and Davison, 2008). Ward's method was used for the final cluster solutions because it minimises within group variation, therefore resulting in clusters of a similar size. Variables informing the cluster analysis were air travel behaviour (frequency of flying and purpose of trip) and household / individual characteristics (gender, age, children in household, status, personal income and multiple deprivation quintile of sub-area), thus incorporating the effect of life stage into the segments. From the 418 individuals who had responded to each variable included, the following seven segments were identified[1]:

- Retired annual holiday makers 99 (25%)
- Less mobile, low earners 78 (20%)
- Working women who take annual holiday 75 (19%)
- Employed frequent flyer 73 (18%)
- Family orientated, female, holiday makers 37 (9%)
- High income, frequent flyers 20 (5%)
- Retired frequent flyers 14 (4%)

The air travel population segments include a small segment of 14 individuals to differentiate between retired frequent flyers and retired annual holiday makers. The four largest segments are incorporated into the modelling process.

[1] A further, small cluster of 22 respondents whose status was classed as 'other' was excluded due to this being the influencing variable

MODELLING AIRPORT PREFERENCE

Discrete choice models were applied to the data initially to determine how airport choice varies according to model attributes, then to explore how spatial, attitudinal, behavioural and socio-demographic attributes influence choice. This was achieved through the application of multinomial logit (MNL) models applied to the whole dataset and then to segments of the dataset using BIOGEME (Bierlaire, 2003). Model output includes identified goodness of fit and the relative influence of attributes.

Airport access and preference

Model runs first explored the impact of distance to airport and preference for airport in defining coefficients. The resultant coefficient values and t-statistics are included in Table VIII. The initial run demonstrates a clear preference for the nearest airport; the Alternative Specific Constants (ASC) are significant negative values for the two airports further away from home.

The second model incorporates alternative specific terms to consider the impact of preferred airport on airport choice. Table VIII demonstrates that while the majority of respondents prefer their nearest airport, this is not the case for everyone; this is also apparent in the estimated coefficients. Preference for each airport shows significant positive coefficients, in particular for the nearest airport. This addition has a strong influence on the ASCs, the first ASC now holds a positive value and the second is insignificant. The third model run considers distance travelled to the airport, which has a similar effect across each of the three airports on offer; increased distance decreases the utility of the airport.

When both preference and distance are considered in the fourth run, model fit increases further and significant values are generated for each coefficient. Across the models, parking cost has a high impact upon airport cost followed by departure time and flight cost, highlighting that low cost airlines often depend on other attributes than fare when in such a competitive market.

When examining relative attribute values, parking cost exerts the greater influence on respondent choice, followed by departure time. Given that all air fares were designed to be ‘low cost’ this demonstrates individual willingness to trade between airports to find the flight that best suits their requirements. It also highlights the growing impact of ‘auxiliary costs’, such as parking, when selecting and designing the whole holiday experience, in situations when international travel costs are negligible.

When considering the attitudinal attribute of airport preference, preference for the nearest airport has an impact, this is particularly the case when distance is also included in the model. When just distance is considered, an increase in the unit of distance has a similar impact upon the probability of choosing that airport, though for the two airports that are the greatest distance from the respondent, the t-statistic demonstrates a more significant relationship. When both preference and distance are considered, the influence that preference for the closest airport has upon choice results is a higher, more significant impact than the distance between the second and third nearest airports.

Table VIII – Outputs of airport choice models incorporating distance and preference

Model Attribute	Airport choice	Airport choice and preferred airport	Airport choice and distance	Airport choice, preferred airport and distance
Flight cost	-0.0222 (-4.38)	-0.0234 (-4.47)	-0.0226 (-4.27)	-0.0240 (-4.4.6)
Parking cost	-0.120 (-13.37)	-0.119 (-12.95)	-0.123 (-13.02)	-0.122 (-12.79)
Departure time	-0.0960 (-9.56)	-0.101 (-9.67)	-0.0996 (-9.57)	-0.103 (-9.68)
ASC (Mid airport compared to nearest)	-0.872 (-5.80)	0.958 (3.85)	0.414 (0.75)*	1.54 (2.66)
ASC (Furthest airport compared to nearest)	-1.86 (-12.37)	0.152 (0.67)*	0.411 (0.58)*	2.15 (3.02)
Nearest airport preferred	-	2.68 (8.90)	-	2.27 (7.74)
Mid airport preferred	-	1.19 (5.78)	-	0.859 (3.84)
Furthest airport preferred	-	1.29 (5.06)	-	0.931 (2.91)
Distance to nearest airport	-	-	-0.0536 (-3.89)	-0.0346 (-2.78)
Distance to mid airport	-	-	-0.0569 (-8.57)	-0.0367 (-5.31)
Distance to furthest airport	-	-	-0.0563 (-8.08)	-0.0486 (-6.66)
Goodness of fit statistics				
Adjusted Log likelihood	*-2295.703*	*-2164.894*	*-2182.167*	*-2106.524*
Adjusted rho-square	*0.306*	*0.344*	*0.339*	*0.361*

* Not significant at the 0.05 level

- Not relevant

Examining the influence of socio-demographics and behaviour on choice

The influence of socio-demographics and behaviour upon airport choice is also examined as part of this paper. Exploratory model runs have been applied to examine the influence of:

- Airport use within the next 12 months;
- The sample area, including both a spatial and socio-demographic influence
- An index of multiple deprivation
- Air travel population segment (the four largest segment identified from a priori cluster analysis)

These categorical attributes have been applied as dummy variables in the model runs. Model estimation including whether the respondent had used the airport in the previous 12 months significantly improved model fit. One outcome from this model estimation is a positive relationship between recent use of the airport furthest away from the respondent and the probability of choosing that option again. This identifies a population segment with a habit of travelling longer distances to access preferred flights.

Sample area did not have a further significant impact upon airport choice; this could be viewed as unsurprising given that the three nearest airports were area specific. One aspect that did result in a significant model fit improvement is the index of multiple deprivation. There are five quintile categories: quintile 1 denotes the 20% most deprived super output areas (SOAs) in England and quintile 5 the 20% least deprived. In the sampling process, two sample sub-areas were selected in each of the five quintiles. Of these, quintiles 3 to 5 demonstrate a significant increased propensity to travel to benefit from their preferred flight, suggesting that higher levels of mobility allows for greater flexibility in flight and airport choice.

Segment specific airport choices

Whilst the air travel population segments did not significantly improve model fit for the whole dataset, model runs applied to respondents within the four largest segments (as shown in the 'Air travel population segments' Section) have been undertaken to examine differences in coefficient values across attributes. The four segments are: retired annual holiday makers; less mobile, low earners; working women who take annual holiday; and employed frequent flyers are explored. Results are shown in Table IX; the rho-squared values suggest a fair goodness of fit.

When reviewing the airport attributes, all segments are influenced by parking costs, but the 'retired annual holiday makers' are more influenced by this, particularly given that of the segments they are most likely to holiday for a week rather than a weekend (Davison and Ryley, 2010). 'Employed frequent flyers' and 'less mobile, low earners' are most interested in departure time, favouring early flights to maximise time at destination. Whilst each air travel population segment has a preference for the nearest airport, this influence is most evident for respondents in the 'working women who take annual holidays' segment (followed by the 'retired annual holiday makers') as a function of ease of access. Distance to furthest airport, is significant across all segments model and mid-distance airport across most; of the segments, 'less mobile, low earners' are most likely to be negatively affected by airport distance.

Table IX – Outputs of airport choice models by air travel population segment

Segment Attribute	Retired annual holiday makers	Less mobile, low earners	Employed frequent flyers	Working women who take annual holidays
Flight cost	-0.0363 (-2.25)	-0.048 (-3.3)	-0.00241 (-0.18)*	-0.0356 (-2.69)
Parking cost	-0.166 (-5.85)	-0.0947 (-3.67)	-0.122 (-5.45)	-0.111 (-4.61)
Departure time	-0.0614 (-2.41)	-0.101 (-3.65)	-0.153 (-4.88)	-0.0982 (-3.57)
ASC (Mid airport compared to nearest)	0.458 (0.26)*	-0.301 (-0.17)*	2.76 (1.96)*	1.27 (0.81)*
ASC (Furthest airport compared to nearest)	1.92 (0.9)*	3.78 (1.41)*	2.95 (1.75)*	0.881 (0.65)*
Nearest airport preferred	2.33 (2.42)	1.78 (2.58)	1.52 (2.22)	1.52 (2.35)
Mid airport preferred	1.93 (2.61)	1.56 (2.4)	1.26 (2.07)	0.419 (0.59*)
Furthest airport preferred	1.6 (1.79)*	-0.622 (-1.38)*	0.65 (1.07)*	-0.379 (-1.45)*
Distance to nearest airport	-0.0408 (-1.07)*	-0.0653 (-1.76)*	-0.00716 (-0.23)*	-0.0464 (-2.02)
Distance to mid airport	-0.0407 (-2.13)	-0.0325 (-1.68)*	-0.0494 (-2.92)	-0.0458 (-2.16)
Distance to furthest airport	-0.0651 (-3.43)	-0.0958 (-2.98)	-0.0506 (-3.49)	-0.0358 (-2.71)
Goodness of fit statistics				
Adjusted Log likelihood	*-286.764*	*-300.392*	*-310.625*	*-331.15*
Adjusted rho-square	*0.46*	*0.323*	*0.32*	*0.267*

Discussion and conclusion

Revealed and stated preference data from the air travel survey demonstrates individuals' willingness to trade between airports is attracted not only by the flights available but also other airport attributes, such as surface access and airport facilities. However, this data also demonstrates that the majority of respondents have a preference for the nearest airport; exceptions include when surface access is easier to a competing regional airport, or if the choice of flights better meets their needs. The stated preference models quantified the impact upon choice of both preference and distance to the airport from the respondent's home address; these followed an expected trend.

When exploring the relationship between airport choice, and both socio-demographic information and behavioural segments from the sample, it became clear that previous use of the airport furthest from the sample area can be habit-forming and that this affected willingness to select it for future choices. It has also been demonstrated that respondents living in less deprived areas are more mobile and thus more able to trade between airports. Modelling of segments population identified using cluster analysis also demonstrates that the 'less mobile, low earners' are more reticent to travel to the furthest airport. This supports the view that affluence has a greater impact upon mobility and choice, than cheaper flights have in attracting individuals with lower dispensable income to an airport further from home. The 'retired annual holiday makers' are most concerned by parking cost, perhaps as they have the greatest preference for week-long holidays.

Across all models, parking costs and flight departure time have a greater and more significant influence on choice than air fare. This demonstrates that in a low cost airline market passengers can and do trade-off between airports (and airlines) in order to meet their travel demands, such as an early morning flight to maximise time at a resort. It also highlights the proportional impact that airport-related costs, such as car parking, can have upon choice. This provides a challenge to airports that act as a low cost airline interchange, because whilst low cost airlines erode the airports aeronautical revenue, the airport is also under pressure to maintain low parking and service costs, thereby limiting sources of non-aeronautical revenue.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Engineering and Physical Sciences Research Council who have funded the 'Propensity to Fly' project. They would also like to thank the Civil Aviation Authority for enabling purchase of the Origin-Destination data for East Midlands airport and Birmingham airport.

REFERENCES

Bierlaire, M (2003). BIOGEME: A free package for the estimation of discrete choice models. Proceedings of the 3rd Swiss Transportation Research Conference, Ascona, Switzerland.

Civil Aviation Authority (2005). UK Regional Air Services', Civil Aviation Authority Report CAP 754.

Davison, L. J. and T.J Ryley (2010). Tourism destination preferences of low-cost airline users in the East Midlands, Journal of Transport Geography, 18 (3), 458-465.

Department for Transport (2003). The Future of Air Transport. Air Transport White Paper. HMSO, London.

Hess, S. T., Adler, T. and J. W. Polak (2007). Modelling airport and airline choice behaviour with the use of stated preference survey data. Transportation Research Part E, 43, pp 221-233.

Hess, S and J. W. Polak (2005). Mixed logit modelling of airport choice in multi-airport regions. Journal of Air Transport Management, 11, pp 59-68.

Hess, S., Ryley, T.J., Davison, L.J. and T. Adler (2010). Improving the Quality of Demand Forecasts through Cross-Nested Logit: A Stated Choice Case Study of Airport, Airline, and Access Mode Choice. Paper presented at the 89th Annual Meeting of the Transportation Research Board, Washington, DC, 10-14 January 2010.

Humphreys, I (1999). Privatisation and commercialisation: Changes in UK airport ownership patterns', Journal of Transport Geography, 7(2), 121-134.

Humphreys, I and G. Francis (2002). 'Policy issues and planning of UK regional airports', Journal of Transport Geography, 10(4), 249-258.

Loo, B.P.Y (2008). Passengers' airport choice within multi-airport regions (MARs): some insights from a stated preference survey at Hong Kong International Airport, Journal of Transport Geography, 16, 117-125.

Information Commissioners Office (2006). Data Protection Act 1998: supervisory powers of the Information Commissioner, Enforcement Notice. [http://www.ico.gov.uk/upload/documents/library/corporate/notices/b4u_enforcement_notice_130706.pdf, accessed 21-05-2010]

Marcucci, E and V. Gatta (2009). Passengers' airport choice within multi-airport regions (MARs): some insights from a stated preference survey at Hong Kong International Airport, Journal of Transport Geography, Article in Press, Corrected Proof.

Office for National Statistics (2004). Neighbourhood Statistics. [http://www.neighbourhood.statistics.gov.uk/dissemination/, accessed 21-05-2010]

Proussaloglou K. and F.S. Koppelman (1999). Mixed logit modelling of airport choice in multi-airport regions. Journal of Air Transport Management, 5, 193-201.

Ryley, T.J. and L.J. Davison (2008). UK air travel preferences: Evidence from an East Midlands household survey. Journal of Air Transport Management, 14(1), pp.43-46.