Who Stopped Flying around September 11th?

Abstract

This paper presents the first set of empirical results on the effects of the events of September 11th, 2001, on individual flying demand using data collected before and after these atrocities.

JEL Classification: C25; D12

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1. Introduction

On September 11th, 2001 (hereafter 9/11), two passenger jets crashed into the World Trade Centre in New York, USA. A third plane crashed into the Pentagon and a fourth was forced to the ground near Pittsburgh. These events were the result of hijackings that are believed to have been organised in various countries around the world under the guise of *al-Qaeda*. They affected people's perceptions of aviation safety which influenced people's flying demand.

This paper presents an empirical investigation into the probability that an individual stopped flying around 9/11; this is important as a) it captures the likelihood of demand cessation should similar events occur in the future, b) changes in the demand for one mode of transport have repercussions on the demand for other modes and c) the decision not to travel would have impacted on the demand for goods at destination and origin.

The data was collected via a survey in summer 2001 with the purpose of identifying frequent flyers' perceptions of aviation safety and from a recirculation of the same survey, to the same respondents, in 2002. With the events of 9/11 in mind, the empirical investigation seeks to ascertain whether a) personal characteristics are associated with higher probability of flying cessation, b) factors influencing stopping behaviour differ according to country of origin and c) the importance of these factors changed between the two sweeps.

2. Theory

Fear of flying has long been a topic of economic research,[1] and work often stems from the differences between perceptions and reality of aviation safety. There is an important difference between experts' and the average consumer's perception of risk (Slovic, 1990), which can be explained partly by the difficulty in communicating effectively heath or safety related issues. If the perceived risk of flying increases then the demand for flying is likely to fall.

Ito and Lee (2005) decompose the 9/11 terrorist attacks' effects into transitory and ongoing components of airline demand. Their principle conclusion is that the effects of these terrorist acts on global flying demand is subtle and complex, which depend crucially on the travellers' perceptions of risk: differences in risk perceptions can generate important differences in demand patterns. Recent studies in industries other than aviation have revealed that factors such as gender, race, political worldviews, emotional state and trust are strongly correlated with risk perceptions; equally important is that these factors influence the decisions of experts (and frequent flyers might consider themselves as experts) as well as of lay-people (Slovic, 2000).

The 9/11 attacks generated risk adverse choices and affected people's flying demand. Dumont *et al*. (2003, p. 1512) suggest that if people can relate to those who perished then emotional reactions will have affected behaviour: "making perceivers' Westerner identity salient will lead them to appraise the events as targeting both Americans and Europeans [or Westerners in general]".

[1] See Rose (1992) for a literature review and discussion of relevant topics.

An act of terrorism is just one reason why planes crash; accidents, freak weather incidents, pilot errors, radar malfunctions, electrical faults and mid-air collisions have all resulted in aviation fatalities. Recognising that the events of 9/11 could have been prevented by locked cockpit doors or ‘air marshals’ can influence one’s perceptions of aviation safety and the need to improve aviation safety. Air travel is widely recognised as being the safest mode of transport with one fatality per three billion passenger kilometres, but this is not a widely held perception. In what follows we seek to identify the effect that socio-economic and psychological factors had on the demand for flying around the events of 9/11.

3. Data

The data employed in this statistical analysis comes from a questionnaire that was distributed in two sweeps, pre-9/11 (May/June 2001) and post-9/11 (February/March 2002). The data were collected via the International Airline Passengers Association (IAPA) website (www.iapa.com) and forms the basis of the Lawrence *et al*. (2006) study. The responses of 520 people from 62 countries are analysed here, which represents the full sample of responses based on the competition of the questionnaires in both sweeps.

Because of their familiarity with IAPA, the respondents are likely to be people interested in and familiar with flying and are more likely to have aviation perceptions that are relatively safe. Nevertheless this is likely to be a unique data set that can permit the identification of a) how the demand for flying altered around 9/11 and b) groups of people whose aviation safety perceptions were most affected. The appendix provides a breakdown of their county of origin. Data definitions are presented in Table 1.

{Table 1 about here}

4. Modelling Approach

The dependent variable is whether the respondent stopped flying; it is appropriate to employ a logit modelling framework and assume a variance in the distribution of $\pi^2/3$. The discrete dependent variable, s_i, can be defined as:

$$s_i = \begin{cases} 1 & \textbf{\textit{if the individual stopped flying between the two sweeps}} \\ 0 & \textbf{\textit{if the individual did not stop flying between the two sweeps}} \end{cases}$$

The logit model is therefore the following:

$$\log \frac{p_i}{1-P_i} = \beta_0 + \sum_{j=1}^{k} \beta_j x_{ij}$$

where the left-hand side of this equation is the log-odds ratio, P_i is the probability that the individual stopped flying, β are coefficients and x_{ij} are independent explanatory variables grounded in the two sweeps, i and j.

The empirical estimation follows two strands: first we seek to ascertain whether certain personal characteristics are associated with a higher probability of stopping flying and, second, whether the events of 9/11 changed the importance of some variables. To test whether $\beta_{2001} = \beta_{2002}$, we estimate $s_{it} = \beta X_{it}$ and employ dummy variables to identify whether the explanatory variables had different effects before and after 9/11. Hence we estimate the following model:

$$p_{it} = \alpha + \beta X_i + \beta_2 X_i D_{2002}$$

If there has been no change in the parameter estimates between the two sweeps then the parameters on the dummy variables should be insignificantly different from zero. Maximisation of the likelihood function of $L = \prod_{s_i=1} P_i \prod_{s_i=0} (1 - P_i)$ is accomplished by nonlinear estimation methods using STATA version 7.0.

5. Results

Individuals were pooled to create the first set of results, which are presented in column 1 of Table 2. In subsequent sets of estimations the respondents are split according to groups of countries of origin. All regressions are ordinary logits where the dependent variable has a value equal to one if the individual can be identified as having stopped flying between the two sweeps and equal to zero otherwise; we explicitly assume that if anyone stopped flying between the two sweeps then this stopping behaviour is a direct result of 9/11.

{Table 2 about here}

Chow tests are employed to identify whether the impact of each variable was statistically significantly different in the second sweep (see Gould, 1999). All regressions are estimated and then reestimated following a general to specific variable deletion method applying likelihood ratio (chi^2) tests for excluded variables using group and individual variable deletions. The results for the reduced model juxtapose the full set model for each sample group in Table 2. All results were reestimated using the robust command to identify whether the errors were independently distributed; in all cases, the robustness checks indicate that heteroskedasticity was not affecting the results.

In Table 2, the explanatory variables are grouped according to a) personal characteristics, b) personal flying characteristics, c) attitude to media sensationalisation of aviation incidents, d) personal experiences of aviation safety incidents and e) indirect experiences of aviation safety incidents (i.e. respondents reporting that their immediate friends or family had experienced specific aviation safety incidents); explanatory variable groups d) and e) capture psychological effects.

The results for the whole sample indicate the following. Personal characteristics were important: males and those with a higher degree were less likely to have stopped flying because of 9/11. Americans were much more likely to have stopped flying than non-Americans. These results are in line with Lerner *et al*. (2003) who found Americans overestimated the likelihood of being hurt following 9/11.

In all samples, not being relaxed on a plane had a negative and highly statistically significant effect. The negative effect from being higher educated appears to be primarily associated with those in the US and the UK. Whether this is because of the respective educational systems, the relatively flexible labour market or something else is worthy of further research.

Europeans appear to have been influenced by their own experiences of low risk aviation safety events: having experienced a low-risk event increased their likelihood of stopping flying. The converse is found for high-risk events experienced by Westerners: their experiences of high-risk events, and the fact that they must have survived them in order to respond to the questionnaire, increased the perception of aviation safety and reduced their likelihood of stopping flying because of the events of 9/11; the opposite result is found if the respondent's family or friend experienced a high-risk aviation incident. These results suggest there is a complex interaction of socio-economic and psychological factors that shape aviation safety perceptions and influence the demand for flying, supporting the results of Ito and Lee (2005) and Dumont *et al*. (2003).

Interestingly, perceptions of the extent that TV and aviation journal sensationalisation occurred for aviation safety incidents did not affect stopping behaviour and this did not appear to have changed because of 9/11.

Of particular interest is whether the events of 9/11 changed the impact of any of these explanatory variables. In the majority of cases it appears that 9/11 did not change the impact of these explanatory variables on the likelihood of stopping flying, suggesting that the same types of people might react in a similar way should a similar event occur in the future. The exception is a media related variable: in sweep 2 (post-9/11), Westerners and US/UK respondents who perceived that TV news did sensationalise aviation safety related issues were less likely to have stopped flying.

6. Conclusions:

This paper has presented an analysis into the probability of a traveller stopping flying because of the events of 9/11. The results suggest there are significant differences depending on gender, education and country of origin. Traveller’s direct and indirect experiences of low and high risk incidents affected the probability of stopping flying because of the events of 9/11. Little evidence is found of a change in the influence of the explanatory variables suggesting that similar reactions might occur in the future if similar events transpire.

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Appendix:

Respondents originated from the following countries (numbers of respondents from each county in brackets): Algeria (1), Argentina (2), Australia (21), Austria (5), Bahamas (1), Bangladesh (1), Belgium (22), Botswana (1), Brazil (5), Bulgaria (1), Cameroon (1), Canada (5), China (3), Cyprus (1), Czech Republic (2), Denmark (9), Egypt (1), Finland (7), France (12), Germany (20), Greece (5), Hong Kong (6), Hungary (4), Iceland (3), India (28), Indonesia (6), Ireland (5), Israel (5), Italy (26), Japan (9), Jordan (3), Kenya (2), Korea (Rep.) (3), Kuwait (1), Lebanon (3), Luxembourg (1), Malaysia (11), Mauritius (1), Mexico (3), Nepal (1), Netherlands (30), New Zealand (4), Nigeria (3), Norway (11), Pakistan (1), Panama (1), Philippines (25), Poland (4), Portugal (10), Russia (1), Singapore (10), Slovakia (1), South Africa (5), Spain (2), Sri Lanka (3), Sudan (1), Sweden (15), Switzerland (15), Taiwan (6), Thailand (2), Trinidad and Tobago (1), Turkey (5), Uganda (2), United Kingdom (151), United States (31), Venezuela (1), Yugoslavia (2), Zimbabwe (3)

Table 1: Data Definitions

Names of Variables	Definitions
Stopped	= 1 if they stopped flying; = 0 else
Male	= 1 if Male; = 0 if female
Age	= 4 if the respondent is aged over 50; = 3 if the respondent is aged between 36 and 50; = 2 if the respondent is aged between 25 and 35; = 1 if the respondent is aged less than 25;
Degree	= 1 if the respondent has a university/college degree; = 0 else
Higher Degree	= 1 if the respondent has a higher degree (Masters/PhD/…); = 0 else
Travel Class	= 4 if the respondent travels first class; = 3 if the respondent travels business class; = 2 if the respondent travels premium economy class; = 1 if the respondent travels economy class
Westerner	= 1 if the respondent is from an EU country, the USA, Canada or Australasia; = 0 else
American	= 1 if the respondent is from the USA; = 0 else
Frequent Flyer	= 5 if the respondent makes more than 20 round trips per year; = 4 if the respondent makes between 16 and 20 round trips per year; = 3 if the respondent makes between 11 and 15 round trips per year; = 2 if the respondent makes between 6and 10 round trips per year; = 1 if the respondent makes between 0 and 5 round trips per year [Round trips can include several flight legs]
Relaxed on Plane	The respondents were asked their extent of agreement with the statement: "I always feel relaxed once in the aircraft". The value = 5 if the response was 'strongly agree'; = 4 if the response was 'agree'; = 3 if the response was 'neither agree nor disagree'; = 2 if the response was 'disagree'; = 1 if the response was 'strongly disagree'.
Fly National Carriers	The respondents were asked their extent of agreement with the statement: "I usually fly on national carriers". The value = 5 if the response was 'strongly agree'; = 4 if the response was 'agree'; = 3 if the response was 'neither agree nor disagree'; = 2 if the response was 'disagree'; = 1 if the response was 'strongly disagree'.
TV Sensationalise	The respondents were asked for their response to the following statement: "Do you think that TV news, such as CNN/BBC, tends to exaggerate or sensationalise aviation safety issues?". The value = 5 if the response was 'many times'; = 4 if the response was 'sometimes'; = 3 if the response was 'occasionally'; = 2 if the response was 'infrequently'; = 1 if the response was 'very infrequently'.
Aviation Journals Sensationalise	The respondents were asked their extent of agreement with the statement: "Do you think that aviation journals, such as Aviation Week, tend to exaggerate or sensationalise aviation safety issues?". The value = 5 if the response was 'many times'; = 4 if the response was 'sometimes'; = 3 if the response was 'occasionally'; = 2 if the response was 'infrequently'; = 1 if the response was 'very infrequently'.
Experience Low Risk	= the number of experiences of the respondent of relatively 'low-risk' aviation incidents as a passenger on a commercial aircraft. These include: in-flight turn-back, turbulence, and unruly passenger behaviour.
Experience High Risk	= the number of experiences of the respondent of relatively 'high-risk' aviation incidents as a passenger on a commercial aircraft. These include: engine failure, lightning strike, aborted takeoff, failure of cabin pressure, and aborted landing.
Friends / Family Exp Low Risk	= the number of experiences the respondent reports his/her friends or family have experienced of relatively 'low-risk' aviation incidents as passengers on a commercial aircraft. These include: in-flight turn-back, turbulence, and unruly passenger behaviour.
Friends / Family Exp High Risk	= the number of experiences that the respondent reports his/her friends or family have experienced of relatively 'high-risk' aviation incidents as passengers on a commercial aircraft. These include: engine failure, lightning strike, aborted takeoff, failure of cabin pressure and aborted landing.

Table 2: Ordinary Logistic Regression: Who Stopped Flying?

Variable	(1) All Countries		(2) US and UK		(3) Westerners		(4) European (non-UK)	
	Full Set	Reduced Set	Full Set	Reduced Set	Full Set	Reduced Set	Full Set	Reduced Set
n	1186		364		860		436	
Male	-1.033 (0.301)***	-0.854 (0.281)***	-0.838 (0.704)		-0.803 (0.398)**	-0.751 (0.375)**	-0.888 (0.651)	-0.954 (0.555)*
Age	0.139 (0.173)		0.374 (0.418)		0.026 (0.208)		-0.445 (0.313)	-0.499 (0.278)*
Degree	0.490 (0.363)		0.158 (0.626)		0.516 (0.447)		0.153 (0.955)	
Higher Degree	-0.654 (0.252)***	-0.540 (0.238)**	-1.271 (0.602)**	-1.164 (0.545)**	-0.486 (0.303)		0.231 (0.451)	
Travel Class	0.184 (0.126)		-0.020 (0.273)		0.135 (0.151)		0.167 (0.224)	
American	1.166 (0.394)***	1.079 (0.381)***	1.954 (0.567)***	1.727 (0.492)***	1.212 (0.412)***	1.160 (0.398)***	-	-
Frequent Flyer (01)	0.193 (0.098)**		0.203 (0.234)		0.213 (0.121)*	0.186 (0.098)*	0.162 (0.184)	
Frequent Flyer (DUM)	-0.178 (0.141)		0.030 (0.322)		-0.116 (0.172)		-0.377 (0.266)	
Relaxed on Plane (01)	-0.605 (0.189)***	-0.583 (0.130)***	-0.926 (0.395)**	-0.727 (0.270)***	-0.649 (0.222)***	-0.583 (0.153)***	-0.872 (0.356)**	-0.728 (0.212)***
Relaxed on Plane (DUM)	0.042 (0.261)		0.498 (0.571)		0.159 (0.301)		-0.273 (0.471)	
Fly National Carriers (01)	-0.283 (0.169)*		-0.004 (0.351)		-0.205 (0.198)		-0.498 (0.333)	
Fly National Carriers (DUM)	0.162 (0.233)		-0.403 (0.521)		0.167 (0.278)		0.513 (0.440)	
TV Sensationalise (01)	0.169 (0.163)		0.093 (0.333)		0.156 (0.193)		0.274 (0.318)	
TV Sensationalise (DUM)	-0.372 (0.231)		-0.751 (0.487)	-0.556 (0.293)*	-0.500 (0.269)*	-0.291 (0.175)*	-0.458 (0.422)	
Aviation Journals Sensationalise (01)	0.011 (0.176)		-0.013 (0.400)		0.005 (0.226)		-0.143 (0.351)	
Aviation Journals Sensationalise (DUM)	0.142 (0.236)		-0.060 (0.557)		0.082 (0.300)		0.534 (0.452)	
Experience Low Risk (01)	0.355 (0.228)***		0.119 (0.502)		0.321 (0.270)		0.645 (0.396)	0.568 (0.278)**
Experience Low Risk (DUM)	-0.392 (0.298)		-0.751 (0.699)		-0.384 (0.375)		-0.319 (0.531)	
Experience High Risk (01)	-0.415 (0.181)	-0.215 (0.114)*	-0.100 (0.340)		-0.291 (0.202)	-0.243 (0.134)*	0.249 (0.304)	
Experience High Risk (DUM)	0.197 (0.234)		-0.343 (0.449)		-0.016 (0.269)		0.156 (0.420)	
Friends / Family Exp Low Risk (01)	-0.147 (0.210)		-0.511 (0.446)		-0.110 (0.247)		-0.109 (0.384)	
Friends / Family Exp Low Risk (DUM)	0.356 (0.289)		0.905 (0.598)		0.416 (0.347)		0.267 (0.538)	
Friends / Family Exp High Risk (01)	0.281 (0.159)***	0.281 (0.090)***	0.277 (0.332)		0.198 (0.185)	0.234 (0.104)**	0.144 (0.286)	
Friends / Family Exp High Risk (DUM)	-0.051 (0.209)		0.193 (0.436)		0.033 (0.242)		0.055 (0.381)	
Constant	-2.335 (0.483)***	-1.868 (0.286)***	-2.238 (0.889)**	-2.954 (0.311)	-2.737 (0.600)***	-2.179 (0.383)***	-3.404 (1.087)***	-3.019 (0.760)***
Log-likelihood	-291.054	-300.143	-71.522	-77.167	-202.152	-206.963	-91.712	-96.702
Likelihood Ratio Chi^2	74.66***	56.65***	33.85*	22.56***	51.36***	41.74***	35.05*	25.07***
Pseudo R^2	0.114	0.086	0.191	0.128	0.113	0.092	0.160	0.115
Likelihood Ratio Chi^2 Test for Excluded Variables (Prob > Chi^2)	-	18.18 (0.444)	-	11.29 (0.938)	-	9.62 (0.919)	-	9.98 (0.953)

Notes: The dependent variable in each regression is *Stopped*. Standard errors are in parentheses. Robustness checks indicate that heteroskedasticity is not affecting the results.