

## **The Impact of Fear of Flying on Travelers' Flight Choice—Choice Model with Latent Variables**

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### **Abstract**

Flying is an important part of the tourist experience and a substantial component of its cost. While travelers' decision making regarding air travel has been studied, the role of fear of flying (FOF), a very common phenomenon among air passengers, in the process has not been explicitly addressed. Since airline safety levels are difficult to assess passengers who have FOF employ other attributes of the itinerary as a means of alleviating their fear. Based on a stated preference experiment and accounting specifically for FOF as a latent variable, we established that the individuals' level of FOF affects the value they place on attributes of flight itineraries. We show that home carriers, scheduled carriers and non-stop flights are fear-alleviating attributes. We also show that the price elasticities of demand for flights are smaller in absolute terms among people with a high level of FOF compared to their counterparts with low FOF.

**Keywords:** Fear of flying; choice model; latent variable; flight itinerary attribute

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## **1. Introduction**

Flying is an unavoidable component of the tourism experience for many tourist destinations. However, for a growing number of travelers suffering fear of flying (FOF) air-travel is a stressful and unpleasant experience (Van-Gerwen and Diekstra, 2000). According to Capafons et al. (1999), almost half of the population suffers some degree of FOF ranging from slight discomfort to a very intense fear and some of these people will not fly at all. Van Gerwen, Diekstra, Arondeus and Wolfger (2004) have shown that this has been an increasing trend related to terrorism and health concerns, September 11, 2001 (9/11 hereafter) being one of them. Ito and Lee, (2005) who found evidences for an ongoing negative demand shift in air travel after 9/11, presumed it is due to an increased FOF following this event and the vast media exposure it received. We contend that the widespread phenomenon of FOF among air passengers must have an impact on their choice of flights. That is, a large proportion of air passengers will choose flights based not only on price or the level of service and convenience, but also on flight attributes that help alleviate their fear.

## **2. Literature Review**

FOF has long been a topic in the psychological and psychiatric literature, as well as in economic research. The former literature is mainly concerned with the sources and reasons for FOF, as well as possible treatments (Howard et al., 1983; Bor and Van-Gerwen, 2003; Boksberger et al., 2007).

The economic literature has mainly been concerned with the costs of FOF in terms of reduced demand for air travel and with the characteristics of the FOF population. For example, Dean and Whitaker (1982) estimated that in 1978 FOF cost the domestic air travel industry \$1.6 billion in lost revenue. They accounted for FOF by directly asking the respondents: “Are you afraid of flying?” Bosch, Eckard and Singal (1998) and Wong and Yeh (2003) tested the hypothesis that consumers respond by switching to rival airlines and/or flying less, while Ito and Lee (2005) estimated the impact of 9/11 on US airline demand. All three studies assumed that these impacts on demand are directly the result of FOF, although it was not introduced explicitly in their model. Webber (2009) argued that FOF affects the decision to stop flying through its impact on travelers’ perception of risk, and tried to ascertain whether certain personal characteristics are associated with a higher probability of stopping flying after 9/11. He introduced FOF into the model by asking respondents to what extent they felt safe on planes and the number of high-risk incidents on planes in which they had been involved. Carlsson, Johansson-Stenman and Martinsson (2004) also assumed relations between FOF and perceived risks and examined whether people are willing to pay more for a certain (real) reduction in the risk of a fatal accident when flying compared to when traveling by other modes of transportation even after they have been explicitly informed of the true objective risks. They found that people’s willingness to pay (WTP) for a given risk reduction is much larger when traveling by air compared to by taxi. To introduce FOF into their model, they

directly asked respondents if they are afraid to fly (a dummy variable) and applied it directly in Tobit and Probit regressions. Blalock, Kadiyali and Simon (2009) were concerned with other social costs of FOF. They found that travelers' response to 9/11 resulted in the loss of about 1,200 lives in late 2001 as a result of the suboptimal choice of less safe road travel over safer air travel. This behavior was attributed to FOF as well as to the inconvenience resulting from the measures taken to prevent terrorism in air travel. Nevertheless, FOF was not explicitly or implicitly accounted for in their analysis.

The choice of carrier has also received some attention in the literature. This choice is becoming increasingly relevant as globalization and liberalization have resulted in an unprecedented large choice-set of carriers on some routes (Gilbert and Wong, 2003). Related studies have addressed the impacts of airline attributes on the choice of airline, with one of these attributes being safety level. A great deal of the literature has been concerned with the difficulty in assessing airline safety levels (Rose, 1992) and has suggested several proxies from which one can infer the carrier's unobserved safety. These include service quality (Rhoades and Waguespack, 2000), financial condition (Rose, 1990), and safety expenditure and crash history (Hartmann, 2001).

Despite the accumulation of FOF studies, all have neglected to consider the impact of this widespread anxiety on the choice of itinerary. The purpose of this paper is to study the impact of FOF on itinerary choice by air passengers. To achieve this objective, a stated preference experiment was designed and executed that explicitly accounts for a psychological factor such as FOF as a latent variable.

### **3. Research Hypotheses**

It is well established in the literature that individuals' choices are influenced by emotional factors such as fear, worry, and love, rather than being based solely on rational considerations of the likelihood and consequences of different events (Kahneman and Tversky, 2000). As noted by McFadden (1986) and Ben-Akiva et al. (2002), the incorporation of psychological factors leads to a more behaviorally realistic representation of the choice process and consequently has better explanatory power.

We claim that the level of FOF among passengers affects their choice of itinerary. Passengers with FOF seek flight attributes that may be primarily reassuring but do not necessarily change the extremely low actual risk. Considering only factors such as price, service and convenience, and ignoring the impact of FOF might lead to erroneous conclusions. We hypothesize that people with FOF are willing to pay more for flight attributes that help them alleviate their fear. We also hypothesize that due to the importance they attach to different fear-alleviating flight attributes they are less sensitive to changes in price. In particular, we hypothesized the following: 1) we expect that individuals, and in particular those with higher levels of FOF, to have more confidence in scheduled carriers than in low cost carriers (LCCs) or charter operators (O'Connell and Williams, 2005) ; 2) We expect that compared to individuals with a low level of FOF, Israeli respondents with higher levels of FOF would tend to prefer Israeli carriers because the ability to communicate freely with the crew in a language and mentality with which they are familiar would help alleviate their fear (Katz, 2009). Indeed, Lijesen et al. (2005) found evidence for a "home carrier advantage" and attributed it to higher product quality, national pride, language advantages and other cultural elements but not to FOF in particular; 3) We expect that both the size of the plane (Shwager, 1990) and its manufacturer identity (Barnett, Menighetti and Prete, 1992) would affect the

travelers' preferences, in particular those with a higher level of FOF; 4) We expect individuals with higher FOF levels to prefer day over night flights (Dean and Whitaker, 1982); 5) We expect travelers to prefer non-stop flights over connecting flights, and that this preference would be stronger for those with higher FOF levels because take-offs and landings are particularly stressful (Dean and Whitaker, 1982; Shwager, 1990).

#### 4. Sample and Questionnaire Design

The data for this study is based on a random sample of students at the Rehovot campus of the Hebrew University of Jerusalem and the Ben-Gurion University of the Negev campuses; 335 students were chosen randomly on the campuses in June 2009 and were asked to fill out a questionnaire. Preliminary analysis of the data revealed that all of the respondents in the survey stated that they intend to fly in the future; 77% of the respondents had flown at least once during the 5 years preceding the survey and only 4% had never flown at all. Due to the geopolitical situation in Israel, flying is practically the only viable form of transportation for foreign travel. Thus, unlike other regions in the world where the options of car, bus or train travel exist, choosing not to fly for Israelis is, in fact, choosing not to travel abroad.

Therefore, the willingness to fly in Israel, even for those suffering severe FOF, is rather high.

Table 1 summarizes the descriptive statistics of the sample.

Table 1: Descriptive Statistics

Variable	Mean/Median*	S.D.
Gender <sup>a</sup> = 1 if male	0.38	
Age	26	3.99
Single <sup>a</sup> = 1 if single	0.89	
Married no kids <sup>a</sup> = 1 if married with no kids	0.05	
Married with kids <sup>a</sup> = 1 if married with kids	0.06	
Education <sup>b</sup>	4.00	
Household income <sup>c</sup>	3.00	

\* The last two figures represent medians

a) Dummy variable

b) 1 = elementary school; 2 = high school; 3 = vocational school; 4 = undergraduate student; 5 = graduate student studying towards master's degree; 6 = higher degree than masters.

c) 1 = way below average; 2 = below average; 3 = average; 4 = above average; 5 = way above average.

About two-thirds of the respondents were women which is the same proportion as the participation of women in higher education in Israel (CBS, 2010). The income level, either of

the respondents themselves when they sustain their own household or that of their parents for those still living at home, is at the national average.

*Questionnaire Design:*

Data were collected through a questionnaire that included three parts: (i) a stated preference (SP) experiment in which respondents were asked to choose flight itineraries from a menu of available alternatives, (ii) a psychological scale capturing the respondent's level of FOF, and (iii) a set of socioeconomic and demographic questions.

In the SP experiment, each respondent received four menus depicting flight itineraries from Tel Aviv to London and four menus depicting flight itineraries from Tel Aviv to New York City (NYC). From each menu, the respondent had to choose one itinerary out of three alternative ones. The flight alternatives involved the following attributes: 1) The carrier: EL AL, British Airways (BA) and Thomson for London flights, and EL AL, Delta and Israir for New York routes. EL AL, BA and Delta are scheduled airlines. The first two are the national carriers of Israel and the UK respectively. Thomson is a foreign LCC, and Israir is an Israeli-based carrier operating charter flights on the international market. 2) The price: The chosen values were based on actual round trip prices at the time of the survey. A total of six price levels were used in the range of \$504 to \$802 for London and \$1,015 to \$2,100 for NYC. 3) The type of aircraft (Boeing 767, Boeing 757, Airbus 318, and Airbus 330 for London, and Boeing 747, Boeing 777, Airbus 330 and Airbus 340 for NYC). These planes vary in terms of manufacturer identity as well as by their size and number of engines. The Boeing 747 and Airbus 340 are wide-body four-engine jets. The Boeing 767 and 777 and the Airbus 330 are wide-body twin-engine jets. The remaining jets are narrow body twin engine jets. 4) Time of day of the flight: For the London trip, flights were defined as either day or night flights.

5) Non-stop and connecting flights: For the NYC trips, which take 12 hours and cover both day and night hours, itineraries were defined as either non-stop or connecting.

The experiment design was developed using the  $L^{MA}$  method (Hensher et al. 2005). With this approach, rather than developing profiles for each alternative separately, menus are developed at once using all attributes of all alternatives. In the case here, a main effects orthogonal fractional factorial design was generated to create 64 menus of three alternatives each using SPSS (2010). This type of design is generated so that the attributes of the design are uncorrelated. However, these designs do not consider the resulting statistical efficiency of the estimated parameters. Another class of designs known as optimal efficient design (Sandor and Wedel, 2001) produces efficient designs but they are likely to be correlated. The choice of orthogonal fractional factorial design reflects our preference of the property of statistical independence over efficiency. The 64 menus were further grouped in 16 versions of the questionnaire with four menus in each version. Respondents were allocated randomly to one of these versions. Each respondent received four menus with three alternatives for each one of the destinations. Note that a “no-flight” option was not included as the aim of this study was not to develop a demand model for air travel. Instead, we were interested in the travel option that one would choose considering the different flight attributes and accounting for the effect of FOF.

A total of 335 individuals were interviewed yielding 2,680 choice observations: 1,340 (335·4) each for London and NYC routes.

In addition to choosing an itinerary the respondents were asked about their membership in the frequent flyer clubs of the carriers presented in the experiment. Figure 1 shows two example menus: one for the London trip and one for the NYC trip.

Figure 1: Sample Menus

London trip	Alternative 1	Alternative 2	Alternative 3
Carrier	British Airways	Thomson	EL AL
Type of airplane	Boeing 737	Boeing 737	Boeing 757
Time of flight	day	day	night
Frequent flyer membership			
Price in USD	504	548	635

NY trip	Alternative 1	Alternative 2	Alternative 3
Carrier	ELAL	DELTA	ELAL
Type of airplane	Boeing 777	Airbus A340	Boeing 747
Direct flight	Direct flight	Direct flight	Direct flight
Frequent flyer membership			
Price in USD	1700	1015	1500

In the psychological scale part of the questionnaire the respondents were asked to rate their agreement with 11 statements indicating fear on a scale of 1 to 7. The statements and the frequency distribution of the answers are presented in Table 2. The statements were developed based on the literature (Beckham, et al. 1990; Shwager, 1990; Howard et al., 1983), in-depth interviews with five individuals suffering from FOF, and an interview with an EL AL pilot who conducts workshops on overcoming FOF (Katz, 2009).

Table 2: Frequencies of the Answers to Indicators of Fear of Flying (%)

	Absolutely agree .....			Completely disagree			
	1	2	3	4	5	6	7
1. I am afraid of closed spaces	41	16	10	17	10	5	3
2. I am afraid during take-off and landing	30	12	7	14	16	12	8
3. I feel insecure in the air	26	13	11	19	18	7	7
4. I feel I am not in control during the flight	28	13	12	16	14	10	6
5. I am not comfortable when I am not in control	26	16	12	21	12	8	6
6. I do not feel comfortable in high places	30	16	11	19	12	7	5
7. I am stressed when I am in a closed space	39	18	14	10	10	6	3
8. Air pockets make me nervous	17	16	11	12	18	14	13
9. I am afraid to be in places with no easy way out	24	16	13	19	13	9	5
10. I get stressed from being in crowded places	39	15	11	12	11	10	2
11. I feel relieved when the plane touches the ground	9	5	5	18	13	14	36

The responses demonstrated high reliability of the scale, with a Cronbach- $\alpha$  value of 0.917. Exploratory factor analysis of the responses found two underlying FOF factors (with eigenvalues 6.08 and 1.45, explaining 55.3% and 13.1% of the variance respectively). The rotated factors could be interpreted as being related to fear of being in the air, heights and loss of control (high loadings on items 2-6, 8, 11 in Table 2), and to fear of closed spaces (high loadings on items 1, 7, 9, 10). These results are consistent with previous research (Howard, Murphy and Clarke, 1983; Greist and Greist, 1981; Van Gerwen, Spinhoven, Diekstra and Van Dyck, 1997). However, it should be noted that these results were not used in developing the model in the next section; instead, factor loadings were estimated jointly with the other parameters of the model.

The socio-demographic part of the questionnaire solicited information on the respondents' characteristics, such as age, gender and education level. The respondents were also asked about their past behavior and future plans concerning air travel in order to identify respondents who do not fly at all and omit them from the analysis.

## 5. The Model

We present a model of flight itinerary choice which is based on the framework of consumers' discrete choice behavior. The choice of itinerary depends on the attributes of the alternative itineraries, such as cost, schedule and carrier, and on characteristics of the passenger, such as age and gender. Within this framework, we incorporate FOF as a psychological variable.

However, FOF is a latent variable that is not directly observed in the data. It is indicated by the responses to the fear scale (see Table 1). The likelihood function formulation presented below accounts for this and allows joint estimation of all of the model parameters, including those in the utility functions of the alternative itineraries for both London and NYC trips, the FOF indicators, and the latent fear variables.

The choice of travel itinerary is modeled using a mixed logit random utility model. The utility of an alternative is given by:

$$U_{ikn} = \beta X_{ikn} + \beta^* X_{mn}^* + \alpha_i v_n + \varepsilon_{ikn} \quad (1)$$

$U_{ikn}$  is the utility of alternative  $i$  in choice experiment  $k$  to individual  $n$ .  $X_{ikn}$  and  $\beta$  are a vector of explanatory variables and the corresponding parameters respectively.  $v_n \sim N(0,1)$  is an individual-specific error term that captures unobserved characteristics of the decision-maker, and  $\alpha_i$  is the corresponding parameter for a specific alternative.  $X_{mn}^*$  is a vector of latent variables (related to FOF) where  $m$  indicates the specific latent variable.  $\beta^*$  are the parameters that capture the effect of these latent variables on the itinerary choices.  $\varepsilon_{ikn}$  is an i.i.d. random error term, specific to the individual and the alternative, which is assumed to follow a Gumbel distribution.

The latent variables  $X_{mn}^*$  are assumed to depend on explanatory variables:

$$X_{mn}^* = \gamma_m X_{mn} + \alpha_m v_n + \eta_{mn} \quad (2)$$

$X_{mn}$  is a vector of explanatory variables for latent variable  $m$  and individual  $n$ .  $\gamma_m$  and  $\alpha_m$  are the parameters of the model.  $\eta_{mn}$  is a normally distributed random error term.

The responses to the 11 statements in the psychological scale,  $I_m$ , are discrete random variables. It is assumed that they derive from underlying continuous variables  $I_m^*$  through a mapping given by:

$$I_m = \begin{cases} 1 & -\infty \leq I_m^* \leq 0 \\ 2 & 0 \leq I_m^* \leq \tau_{12} \\ \vdots & \vdots \\ J & \tau_{J-1,J} \leq I_m^* \leq \infty \end{cases} \quad (3)$$

$I_m$  and  $I_m^*$  are the discrete responses and the continuous variables, respectively, underlying the responses of individual  $n$  to statement  $r$  in the scale respectively.  $\tau_{j-1,j}$  is the threshold parameter between choosing response levels  $j-1$  and  $j$ .  $J$  is the total number of response levels in the scale (7 in our case).

These continuous variables underlying the responses to the fear scale are affected by FOF and used as indicators of it:

$$I_m^* = \lambda_{mr} X_{mn}^* + \alpha_r v_n + \zeta_m \quad (4)$$

$\lambda_{mr}$  and  $\alpha_r$  are parameter,  $\zeta_m$  is a normally distributed random error term.

The data used to estimate the parameters of this model include the responses  $Y_{kn}$  to the choice experiments and to the FOF indicators  $I_{rn}$ . With the model specified above, the conditional itinerary choice probabilities are given by:

$$p(Y_{kn} | X_{kn}, X_{mn}^*, \nu_n) = \frac{\sum_i \exp(\beta_{ik} X_{ikn} + \alpha_{ik} \nu_n + \beta_{ik}^* X_{mn}^*) Y_{ikn}}{\sum_i \exp(\beta_{ik} X_{ikn} + \alpha_{ik} \nu_n + \beta_{ik}^* X_{mn}^*)} \quad (5)$$

$Y_{kn}$  and  $X_{kn}$  are matrices of the choice indicators and explanatory variables respectively. The choice indicators  $Y_{ikn}$  equal 1 for the chosen alternative and 0 otherwise.

The probability density of the latent fear variables is given by:

$$f(X_{mn}^* | X_{kn}, \nu_n) = \frac{1}{\sigma_m} \phi\left(\frac{X_{mn}^* - \gamma_m X_{mn} + \alpha_m \nu_n}{\sigma_m}\right) \quad (6)$$

$\sigma_m$  is the standard deviation of the error term  $\eta$ .

The probability of a response to a specific indicator is given by:

$$p(I_{rn} = j | X_{mn}^*, \nu_n) = \Phi\left(\frac{\tau_{j,j+1} - \lambda_{mr} X_{mn}^* - \alpha_r \nu_n}{\sigma_r}\right) - \Phi\left(\frac{\tau_{j-1,j} - \lambda_{mr} X_{mn}^* - \alpha_r \nu_n}{\sigma_r}\right) \quad (7)$$

The conditional joint probability of the observed outcomes and the latent variables is given by:

$$f(Y_n, I_n, X_n^* | X_n, \nu_n) = \prod_k p(Y_{kn} | X_{kn}, X_{mn}^*, \nu_n) \prod_r p(I_{rn} | X_{mn}^*, \nu_n) \prod_m f(X_{mn}^* | X_{mn}, \nu_n) \quad (8)$$

The joint probability of the observed outcomes for individual  $n$  is given by:

$$p(Y_n, I_n) = \int \int_{\nu X^*} f(Y_n, I_n, X^* | X_n, \nu) f(X^*) f(\nu) dX^* d\nu \quad (9)$$

Finally, the log-likelihood function is given by:

$$LL = \sum_n \ln [p(Y_n, I_n)] \quad (10)$$

## 6. Results

The model parameters were estimated using GAUSS 8 by maximizing a function implementing the likelihood function defined above.

To simplify the presentation, estimation results for each sub-model are presented and discussed separately. However, we note again that all parameters of the choice models, for both London and NYC trips, the FOF latent variable model and the indicator functions were estimated jointly. Estimation results for the itinerary choice model are presented in Tables 3 and 4 for the London and New York trips respectively. As noted above, the exploratory factor analysis suggested two underlying factors. However, in the estimation only the one related to fear of being in the air, heights and loss of control was significant in the model. Thus, the factor related to fear of closed spaces was not included in the final model. The impact of FOF on the itinerary choice is captured by a single latent variable that interacts with the attributes of the alternative itineraries.

Table 3: London Itinerary Choice Model Estimation Results

Parameter	Estimate	Std. error	p-value
British Airways dummy	-0.325	0.144	0.025
Thomson dummy	-0.973	0.163	<0.001
BA-fear of flying interaction	-0.300	0.112	0.007
Thomson-fear of flying interaction	-0.597	0.130	<0.001
Day flight-fear of flying interaction	0.220	0.065	<0.001
Price	-1.809	0.100	<0.001
Price-fear of flying interaction	0.180	0.055	0.001

Table 4: NYC Itinerary Choice Model Estimation Results

Parameter	Estimate	Std. error	p-value
Delta Airlines dummy	-0.538	0.162	<0.001
Israir dummy	-0.501	0.154	0.001
Delta-fear of flying interaction	-0.380	0.126	0.003
Israir-fear of flying interaction	-0.206	0.117	0.077
Direct flight dummy	0.807	0.130	<0.001
Direct flight-fear of flying interaction	0.163	0.097	0.092
Price	-0.427	0.027	<0.001
Price-fear of flying interaction	0.089	0.019	<0.001

### 6.1 Itinerary Choice Models

In the estimation of the London itinerary choice model (Table 3) EL AL is the reference carrier. The negative coefficients of BA and Thomson imply that, all else being equal, the respondents prefer EL AL to BA and have the lowest preference for Thomson. BA and Thomson's FOF interaction variables capture the effect of FOF on carrier preference. These variables are defined respectively as:

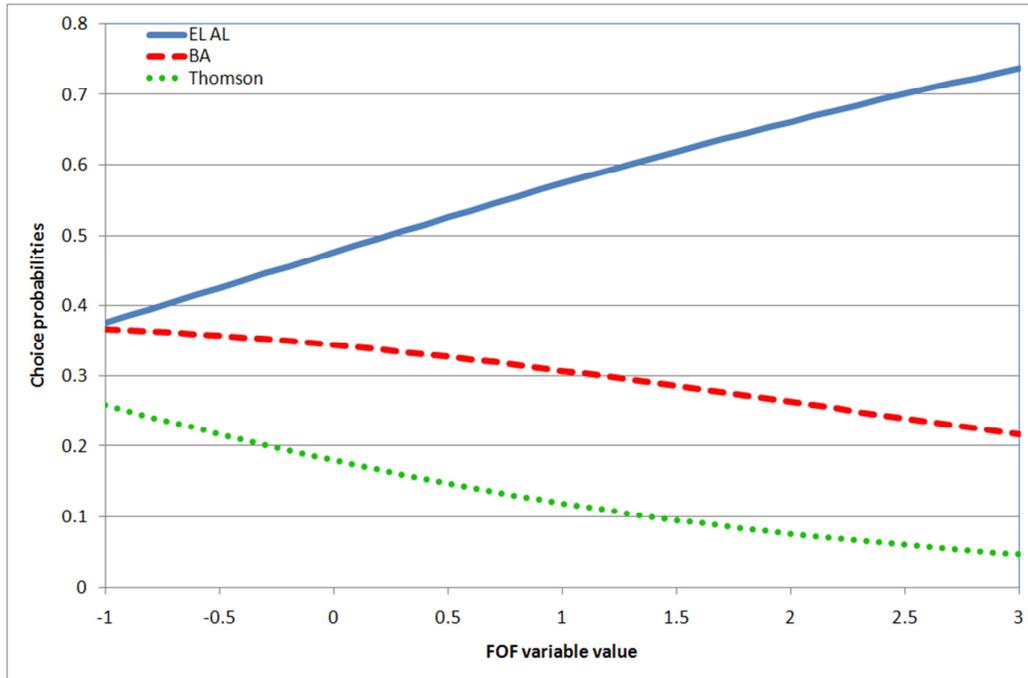
$$\begin{aligned} X_{ikn}^{BA\_FOF} &= \delta_{ik}^{BA} X_n^{FOF} \\ X_{ikn}^{Th\_FOF} &= \delta_{ik}^{Th} X_n^{FOF} \end{aligned} \quad (11)$$

$\delta_{ik}^{BA}$  and  $\delta_{ik}^{Th}$  are indicator variables which take a value of 1 if alternative  $i$  in menu  $k$  is a BA or Thomson flight respectively and 0 otherwise.  $X_n^{FOF}$  is the value of the FOF latent variable for individual  $n$ .

The coefficients of both of these variables are negative in the model, indicating that the preference for EL AL over BA and especially over Thomson is stronger for individuals with higher levels of FOF. Figure 2 shows the choice probability for each airline as a function of FOF level. The three considered alternatives differ only in the carrier identity. They are all daytime flights at a price level of \$600. The figure clearly shows that the probability of choosing EL AL is higher for any FOF level and that the gap between EL AL and the other

airlines increases with FOF level. Moreover, the gap between Thomson and EL AL increases faster than that between BA and EL AL.

Figure 2: Choice Probabilities as a Function of FOF for the London Itinerary.



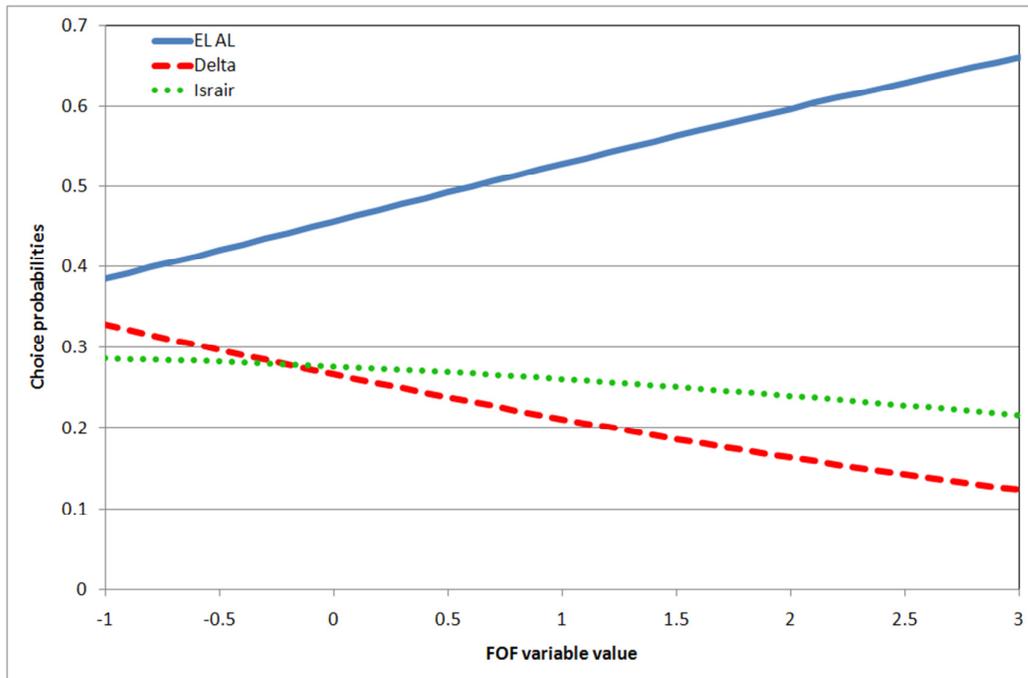
The variable that interacts the day flight attribute with the FOF variable has a positive and significant impact on the flight utility. This implies a preference, which increases with the level of FOF, for day flights over night flights to London.

As expected, the coefficient of the price variable is negative and highly significant. The coefficient of the interaction variable between fear and price is positive, i.e., respondents with higher FOF levels are less sensitive to ticket price. The absolute value of the own price elasticity of demand for EL AL as a function of the level of FOF ranges between 2 for respondents with the least FOF to 0.43 for respondents with the highest FOF. The values are calculated for the same considerations as above, including three alternatives that differ only in the identity of the carrier, and assuming day flights with identical costs of \$600. These

results suggest that absolute value of own price elasticity of demand decreases with increase in FOF.

The results from the New York itinerary model (Table 4) are quite similar to those of the London model although less significant. As in the case of the London itinerary, EL AL is the reference carrier. The negative coefficients of Delta and Israil imply that, all else being equal, EL AL is the most preferred carrier. Delta and Israil's-FOF interaction variables capture the effect of FOF on carrier preference. These variables are defined in a similar way to the BA and Thomson's-FOF interaction variables defined previously. The coefficients of Delta and Israil's-FOF interaction variables imply that respondents with higher FOF levels prefer EL AL in particular. An interesting finding is that although Delta, unlike Israil, is a scheduled airline, respondents with higher levels of FOF preferred Israil over Delta, whereas people with lower FOF levels preferred Delta over Israil (note however that the coefficient of the interaction variable Israil-FOF is significant in 7.7%). This result indicates that intrinsic elements inherent in flying with a home carrier, such as the ability to communicate freely with the crew members in one's native language (Swait and Bernardino, 2000), are important fear-alleviating attributes. This is clearly demonstrated in Figure 3, which shows the choice probabilities as a function of FOF level for a scenario with three alternatives that differ only in the identity of the carrier. All three alternatives are for direct flights, with an identical price of \$1,450. In the figure, the choice probability graphs for Delta and Israil intersect at a FOF level of around -0.2, with Israil becoming more attractive for travelers with higher levels of FOF.

Figure 3: Choice Probabilities as a Function of FOF for the NYC Itinerary



Similar to the case of the London trip, price is the most important variable in the model, with a negative coefficient that decreases with higher levels of FOF. Here also the absolute value of the own price elasticity of demand for EL AL as a function of the level of FOF ranges between 1.2 for respondents with the least FOF to 0.42 for respondents with the highest FOF. In general, the price elasticity is smaller in absolute terms than that for the flight to London.

This negative correlation between distance and price elasticity of demand was indicated by Brons et al. (2002) in their meta-analysis of price elasticities of the demand for air travel. However, they did not find it to be significant.

In addition, an important attribute of the itinerary to NYC was whether or not it involved a connection. The results indicate that while all travelers prefer non-stop, the coefficient of interaction variable *Non-stop flight*-FOF implies that this preference is stronger for

individuals with higher FOF levels (note though that this interaction variable is significant in 9.2% only).

It should be noted that the presented models only include variables that added to the explanatory power of the estimated model. Other variables that were introduced into the choice models in the estimation process, but were dropped in the final models, included type of airplane and frequent flyer membership.

### *6.2 Willingness to Pay (WTP) for Flight Attributes*

The models presented above describe the impact of the itinerary's attributes on the probability of its being chosen. To demonstrate the trade-offs between the various attributes, including itinerary price, and the impact of FOF on these trade-offs, the WTP for the various attributes are presented next. The WTP for an attribute of an alternative is defined by the ratio of the marginal utility of that attribute to the marginal utility of its cost, which in the case of linear-in-parameters utility is the ratio of the attribute coefficient to the cost coefficient (Bateman et al., 2002, p.283). Figures 4 and 5 show the WTP for the various attributes as a function of the value of the FOF variable for the London and NYC itineraries respectively.

Figure 4: Willingness to Pay for the London Itinerary Attributes as a Function of FOF

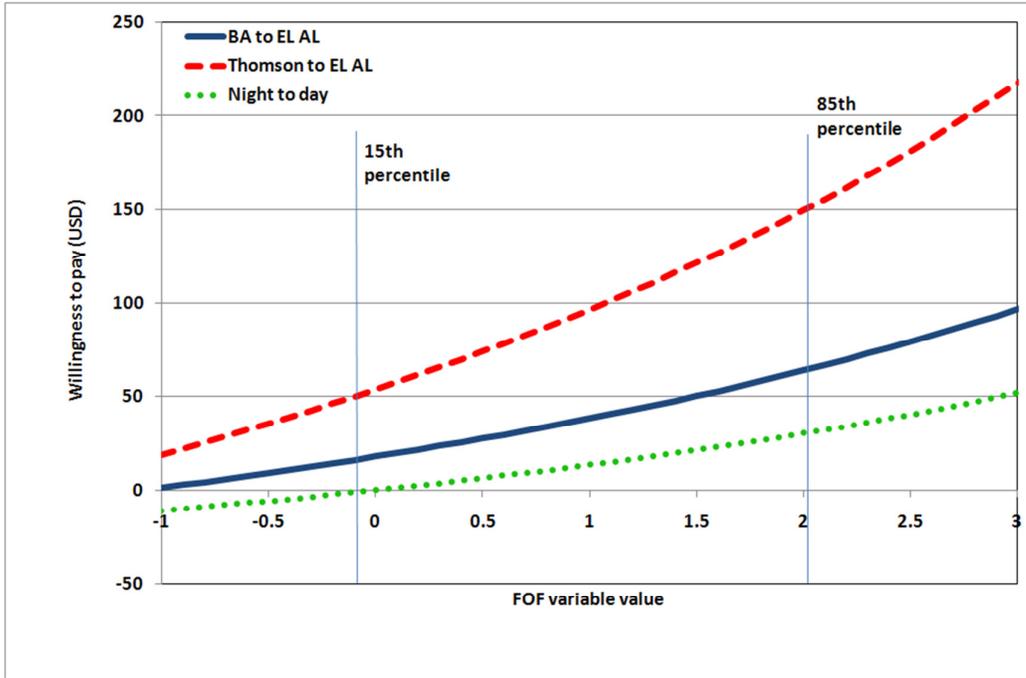
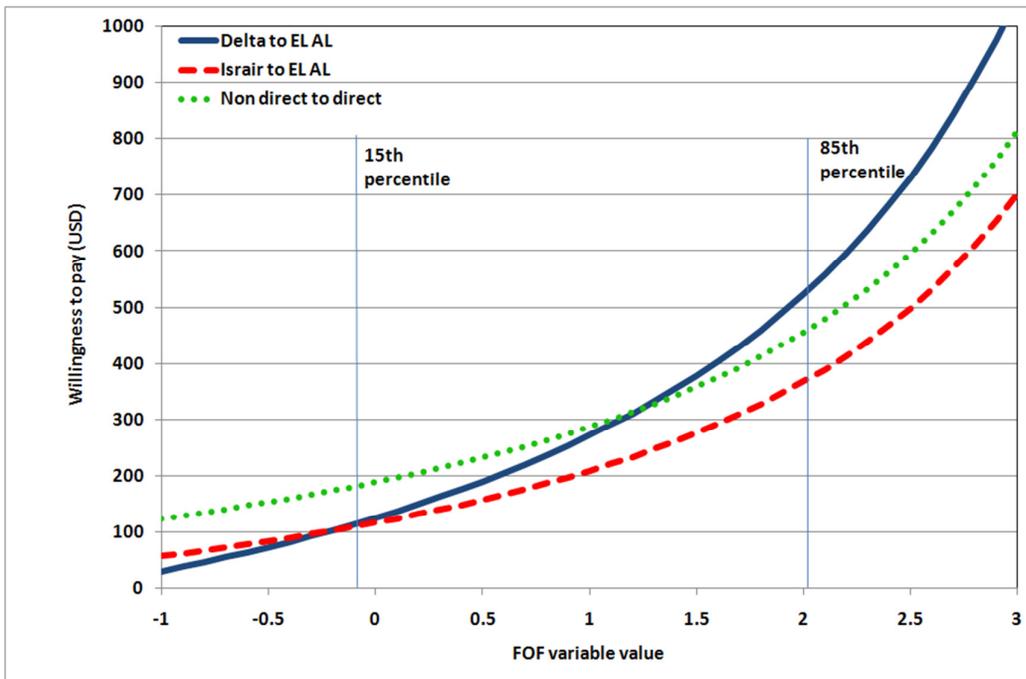


Figure 5: Willingness to Pay for the NYC Itinerary Attributes as a Function of FOF



The results demonstrate that respondents with a high FOF (level in the 85<sup>th</sup> percentile) are willing to pay substantially more for fear-alleviating attributes than those with a low FOF (in the 15<sup>th</sup> percentile). For example, in the London itinerary (Figure 4), individuals with a high FOF level were willing to pay an additional \$66 to fly EL AL instead of BA, compared to only \$16 for individuals with a low FOF level. The differences are even more pronounced for Thomson (\$155 compared to \$50, respectively), which to the Israeli respondents is both foreign and a LCC. The daytime flight attribute was less important in this respect. Its importance was also not as affected by the level of FOF.

In the NYC itinerary (Figure 5), travelers with a high FOF were willing to pay an additional \$558 to fly EL AL instead of Delta, and \$389 for EL AL instead of Israil. In comparison, travelers with low FOF level were only willing to pay an additional \$114 to fly EL AL instead of Delta, and \$110 to fly EL AL instead of Israil. The intersecting lines in the WTP graphs: (the dashed and the straight lines) demonstrate that respondents with low FOF prefer Delta over Israil and those with increased FOF prefer Israil over Delta. Travelers at all FOF levels were willing to pay for non-stop flights over connecting ones. Those with a high FOF level were willing to pay an additional \$479 for a non-stop flight compared to \$181 for travelers with a low FOF level.

### 6.3 FOF latent variable model

The results of this model are presented in Table 5.

Table 5: Fear of Flying Latent Variable Model

Parameter	Estimate	Std. error	p-value
Constant	1.174	0.086	<0.001
Male dummy	-0.569	0.125	<0.001

In the latent variable model, gender is the only significant explanatory variable, with males having lower FOF levels than females. This result is in accordance with Boksberger et al. (2007). Our finding of only one causal variable is not uncommon for latent variable models. Ben-Akiva et al. (2002) presented a few case studies of discrete choice models with latent variables and specifically pointed out the difficulty of finding solid causal variables in the latent variable models.

Finally, it should be noted that in addition to the variables presented above, the overall model included other parameters that we do not present, such as the loadings of latent variables to the various indicators, the thresholds of the indicators' levels and parameters of the various errors, namely standard deviations of the underlying indicator scores, and the parameters of the individual-specific error term in the various components, which dictate the correlations among them.

## 7. Discussion

The share of the population suffering from FOF has increased over the last few decades even though statistics tells us that air travel is the safest mode of travel (IATA, 2009). Since avoiding air travel in this era of globalized economy entails career and social costs, people take different measures to overcome or reduce their fear such as sedatives or workshops dealing with FOF. Based on a SP experiment among Israeli students and accounting specifically for FOF as a latent variable, we assessed the assumption that air passengers suffering from high levels of FOF would also employ other measures, namely, choosing flights with "fear-alleviating" attributes. We established that an individuals' FOF level affects the value they place on attributes of alternative flight itineraries and affects their choice of itineraries accordingly. We showed that the preference for home carriers, scheduled carriers and non-stop flights increases with increasing level of the respondents' FOF.

The preference of passengers with a high level of FOF for the different attributes can stem from different sources. Two of the fear-alleviating attributes may be related to risk reduction: one is likely to be based on actual risk and the second on perceived risk. Preference for non-stop flights over connecting flights may be based on actual risk: 92% of fatal accidents occur during take-off or landing phases (Boeing, 2009). People with high FOF levels are understandably more sensitive to this information, although it implies only a small reduction in an already very low probability of an air traffic accident. On the other hand, the preference for scheduled carriers is likely to be based on perceived risk, i.e. it is based on the notion that scheduled carriers are safer than non-scheduled ones (O'Connell and Williams, 2005).

Despite the fact that this notion is not supported by official data, we show that scheduled airlines are preferred by passengers with a high level of FOF, i.e., they enjoy a safer image.

The third attribute, the home carrier, might also be related to a safer image among passengers

from the same nationality but we believe that its major advantage is the better help these carriers can provide to passengers suffering from anxiety. Passengers with FOF can get more help from a crew from their own country due to better communication. The reduction in barriers such as language and social and cultural norms can be helpful in times of anxiety. By estimating the WTP for the different attributes, we show that people are willing to pay for small reductions in probabilities that are already extremely low (non-stop flight attribute), for an image of safety although it is not based on actual information (scheduled carriers) and for attributes that are primarily reassuring but do little to change the actual risk (home carriers). We also show that the FOF level is a continuous variable and that WTP is monotonically increasing with level of FOF.

We show that individuals with high FOF levels are less sensitive to price changes compared to others. Although the respondents face the same set of flight substitutes, it appears that those with a high level of FOF demonstrate less flexible price elasticities. This means, for example, that a Thomson flight is perceived as a less acceptable substitute for EL AL by passengers with a high FOF versus those with a low FOF.

## 8. Conclusions and Recommendations for Future Research

FOF is a common phenomenon that affects air travelers' behavior and choice of flights. In order to identify the effects of FOF on the choice of flight itineraries we developed a logit kernel discrete choice model with an error structure that is appropriate for panel data and that incorporates a latent FOF variable. Within this model, the factor analytic equations of the latent FOF variable are estimated jointly with the other model parameters based on discrete indicators that were obtained from a questionnaire and on the respondents' stated discrete choices. The estimation of the interaction effects between the psychographic variables, i.e. FOF, and flight attributes allows us to assess our hypothesis that individuals' FOF levels affect the value they place on attributes of alternative flight itineraries and their eventual choices. Despite the numerous studies on carrier and flight choice, this is the first time, to the best of our knowledge, that the psychological factor FOF, estimated as a latent variable, is explicitly introduced into the choice model and is interacted with flights' attributes.

The International Air Transport Association (IATA) forecasts a 29% decrease in 2012 industry-wide profits on the back of a weak global economy and high jet fuel prices (IATA, 2011). Thus, many airlines are in quest for segmentation strategies that will satisfy different target market segments. Based on our findings this study suggests that airlines could segment their market to domestic and non-domestic passengers and conduct price discrimination accordingly. It is a common practice in tourism firms to segment the market when the market segments demonstrate different price elasticities (Shy, 2008). Segments with less elastic demand are charged higher prices than those with a more elastic demand. We showed that the proportion of respondents with FOF preferring to fly El AL is higher on El Al flights than their proportion on non-home carriers. Since those with a high level of FOF have a lower elasticity than those with low FOF and since it is easy to segment passengers based on their

nationality this study suggests that EL AL could charge higher prices to Israelis. It may also be able to increase this price premium by emphasizing its' "feel at home" image for national passengers. Airlines may also be able to increase the preference of foreign passengers towards their flights by measures such as employing crew members that speak the language of the destination countries and are familiar with their cultural norms.

The results of our study also provide support for other studies arguing that public agencies should provide publicly accessible objective information on airline safety levels. As suggested by Knorr (2006), this can be done by enforcing a duty to release all safety-relevant data, including incidents and near accidents. This is because an increasing share of the population is willing to pay a high premium based upon nothing but beliefs or conceptions. Providing objective information may not only help passengers with high levels of FOF to make decisions more easily, it may also induce people suffering from FOF who do not fly to participate in air travel, a much safer mode of transportation than driving.

This study was conducted amongst a specific sample of Israeli students. It is a good exploratory study but it might be revealing to conduct this study in other countries and sample of the whole population since Israelis travelers might be more aware to safety issues and/or have higher FOF levels than travelers from other nations. Also, we think that introducing into the setting of our study information, that will be presented as objective, regarding each alternative accident risks may be instructive in the sense that it may shed some light on the interplay between FOF and actual risk.

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