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Paying for Status? - The effect of frequent flier program member status on air fare choice

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Abstract:
Frequent flier programs (FFPs) are said to affect airline customer behaviour such that revenue of sponsoring airlines increases. To this end prior research relies on assumptions of competition, lock-in effects and variations in scale and scope of FFPs. Whether a FFP by itself induces a price premium remains unanswered. In an effort to shine some light on this question, we apply discrete choice analysis to a new proprietary data set of actual frequent flier member flight behaviour (fares paid, FFP points received) over a 12-months period. We take advantage of the variations in the structure of FFPs (Gold, Silver and Bronze tier levels), to assess both the existence of a FFP price premium and the price premiums average monetary value in US$ per FFP member. Our findings suggest that FFP members are willing to pay a price premium of up to six percent, which is directly attributable to the FFP.

Keywords: discrete choice analysis, loyalty programs, relationship marketing, price premium, frequent flier program, CRM

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INTRODUCTION

Frequent Flier Programs (FFP) have been part of the global airline industry for three decades and their basic premise of rewarding repeat airline patronage has remained virtually unchanged over time. Although initially derided as short-lived marketing gimmicks, FFPs matured from a narrowly targeted marketing device into an essential part of most airlines' product offering. Currently 200 such programs exist, with all major carriers and a large number of low cost carriers offering some form of FFP.[1] This development begs the question why FFPs have become so immensely popular in a notoriously cash tight industry, such as the global airline industry. Anecdotal evidence[2] suggests that FFPs engender behavioural changes by giving airline customers incentives to consolidate air travel with one sponsoring airline, to buy more flights from that airline and to buy more expensive airfares.

Prior research has found some evidence that FFPs may lead to entry-deterrence (see Borenstein 1989 and 1996), switching costs (see Klemperer 1987a and 1987b), flight consolidation at hub airports (see Lederman 2007 and 2008) and a higher willingness-to-pay for air fares (see Morrison et al. 1989, Morrison and Winston 1995 and Nako 1992). These insights were unanimously derived using the choice between competing airlines and structural variations within the FFP, such as increases in scale and scope of FFPs, as the main drivers of the above mentioned effects. Whether a FFP is intrinsically sufficient to impact the conditional choice of fare type leading to an increase in revenue per FFP member has not yet been borne out by the evidence. Data limitations to date have made it impossible to estimate this particular impact of a FFP on the air fare choices of FFP members. The puzzling question therefore still remains whether FFPs increase the revenue derived from FFP members of an airline.

Our conditionally negotiated access to the FFP database of a major airline allows us to answer this question. None of the previous work in this field has had access to actual FFP data from an airline. This is, to our knowledge, the first time that an airline has allowed their FFP data to be used externally for research purposes making this study unique. Our data allows us to exploit variations within the structure of a FFP itself to determine how FFP members of an established airline (whose identity must remain undisclosed and hence is hereafter called airline X) choose between different fare types. The findings presented indicate that airline X's FFP positively impacts the probability that a member chooses a more expensive fare when faced with a menu of five increasingly expensive fare types. Our findings suggest that airline X's FFP members are willing to pay a price premium of up to 6 percent per trip and between 2 and 4 cents (American Dollars, 2008) per FFP point awarded to the traveller. Seen in the light of the broader research on FFPs impact on competition in the airline industry our findings provide additional evidence that a FFP effect exists. We show that this effect is measurable and positive. Our results hold without assumptions about market conditions and external variations, but merely due to variations in the structure of the FFP itself.

The remainder of this article is structured as follows. The next section provides a background discussion of FFPs and literature. In section 3 we introduce our empirical framework and section 4 describes the data. Section 5 presents our estimation results, which we use in section 6 to determine the fare premium and willingness-to-pay for a FFP point. We conclude with a general discussion of our findings in section 7.

BACKGROUND: FFPs AND THEIR IMPACT ON AIR TRAVELLER BEHAVIOUR

The structure of FFPs has a seemingly unrelated precursor in the Sperry & Hutchinson (S&H) Green Stamps Company, a manufacturer of 'loyalty' stamps and pasting booklets in the late 19th century. S&H Green stamps rapidly gained popularity as consumer retention strategies adopted by grocery stores, which give the stamps to shoppers as purchase rewards (Schuman 1986). Shoppers collected the stamps in pasting booklets and once a set number of stamps had been reached, the filled booklets could be exchanged against white goods. Shopping at non-affiliated stores meant forgoing stamp collection and hence pushing award collection into a more distant future. By the 1960's however the S&H loyalty scheme had largely run its course and for the next two decades loyalty schemes were at fringes of consumer retention strategies. The deregulation of the domestic aviation industry in the US in 1978 and the simultaneous advent of mass computerisation and data storage facilities gave rise to a resurrection of this century old scheme. Physical stamps and pasting books became digital savings accounts and loyalty cards. The first, as such recognisable, FFP was AAdvantage introduced by American Airlines in 1981, which was quickly copied by all major US carriers.[3] Within a few years the FFP phenomenon crossed the Atlantic to Europe. British Airways was the first European carrier to introduce a program in direct response to their American competitors. The technology boom of the 1990's finally allowed for an exponential expansion of loyalty programs across a wide range consumer markets globally. At present more than 120 million people are enrolled in one or more of the 200 FFPs globally. The acquisition of Northwest Airlines by Delta in 2008 created what is currently the largest FFP in the world with 74 million members.

Basic mechanism - The underlying mechanics and structures of all FFPs have remained largely unchanged over time. The airline traveller enters into a contractual membership agreement with the airline, in which the airline awards the member a pre-determined number of award tokens (e.g. miles, points, etc) per paid and taken flight. The member accumulates these tokens and once a pre-determined threshold number is reached these award tokens can be redeemed against “free” flights or other goods and services. Up to this point FFPs are very similar to bulk discounts (second degree price discrimination). However over time the majority of airlines have introduced two different types of award tokens: ‘Standard’ and ‘Status’ points/miles (for reasons of ease we will use ‘point’ from hereon in), which airlines strongly distinguish from each other (e.g different accounting systems). The standard point can be earned through both flying and non-flight transactions, for example the use of an affiliated credit card (e.g. Miles and More Visa). The number of standard points earned per transaction will often depend in a linear fashion on the monetary amount spent in the transaction. It is the standard points that are form the ‘loyalty currency’ used by members to to redeem against goods and service, e.g. the famous free flight or upgrade. What sets most FFPs apart from simple bulk discounting is however that members are also often credited ‘Status Points’ on top of standard points. Status points are exclusively earned through actual flying on the sponsoring airline and the amount of status points earned often depends on a combination of distance flown and air-fare paid. Status points cannot be used as loyalty currency. They are flag posts to both the airline and the member that a specific points threshold has been reached, which entitles the member to “status” levels within a program (e.g Bronze, Silver, Gold). Traditionally FFPs have a hierarchical pyramid structure with three increasingly elite status tier levels (see Figure 1). The percentage of FFP members in each level depends on the ease of earning status points, a variable which is controlled exclusively by the sponsoring airline. In general the percentages of FFP members across airlines are close to the ones shown in Figure 1.

Insert Figure 1 about here

As outlined above, only the accrual of status points leads to a move from one status membership tier level to the next. Importantly, status levels give rise to both an increasing number of priority treatments to elite FFP members (e.g tangible perks such as loung access) and accelerated (non-linear) standard points accrual. It is this non-linearity in standard points accrual that has been recognised as leading to anti-competitive effects of FFPs. Klemperer (1987) for example shows that the non-linear standard points accrual introduces and increases switching costs to members at an increasing rate the higher that member's status within a FFP. The stylised process of moving from one elite tier level to the next over a set period of time is shown in Figure 2. A clear understanding of this process is necessary because any FFP related increase in the willingness-to-pay for air fares should be highest once a FFP member is close the next tier level. As shown in Figure 2, both status and standard points are earned over time, however the validity period of status points does often not coincide with the validity period of standard points. While a member gets automatically upgraded to a higher membership tier once the necessary status points are reached it is only at the annual status points review date that it is determined whether a member remains in a membership tier or gets downgraded.

Insert Figure 2 about here

Once a traveller is engaged in a FFP, the system of tiers and non-linear standard points accrual creates tangible switching costs to the FFP member. Any forgone flights with the sponsoring airline results in both forgone standard and status points and ultimately a tangible loss of benefits to the FFP member.

Literature – Although the marketing literature has long been investigating FFPs[4], the question whether FFPs induce by their mere existence a tangible price premium remains an open one. Indeed the few existing theoretical articles treating FFPs as competitive devices that may impact airfares in the airline market are in the economics literature. These articles however generally make strong initial assumptions such as the existence of a perfectly competitive market structure, or at the very least airline duopolies, to explain the advent, expansion and attractiveness of FFPs to both airlines and travellers (e.g. Banerjee and Summers, 1987; Basso et. al, 2009). The strength of the incentive changing nature of FFPs and hence possible price premium is largely explained through the afore mentioned switching costs and the associated lock-in effects of the non-linear nature of FFPs points earnings schedules. Airline network effects (e.g. where the airline flies to and how many partners they have) are seen as enhancing FFPs in both scale and scope. This in turn is supposed to lead to increases in the underlying value of FFPs to its members (e.g Lederman, 2007). The larger the flight network of an airline, the more earning and award possibilities for FFP members exist, which makes the FFP more valuable. Theory suggests that FFPs ultimately either negatively affect competition in the airline industry, as they raise barriers to entry, or alternatively erode airline profitability because airlines are caught in a prisoners dilemma type situation (see Banerjee and Summers 1987 and Basso, Clements, and Ross 2009).

The few existing empirical studies investigating the possible impact of FFPs on customer behaviour find that the existence of fare premiums are caused by both competition effects and network effects. Nevertheless the lack of data generally limits the understanding of the influence that FFPs have on their own on fare type choices and FFP induced fare premiums. The first empirical fare type choice study was undertaken by Nason in 1980, a year before the introduction of FFPs. Although FFP membership is not one of the explanatory variables in Nason 's (1980) empirical framework, it warrants mention, as his approach analysed the fare type choice problem at the individual traveller level. The choices a traveller makes before buying a fare type are seen in terms of the trip-planning process and the trip and fare type combinations (Nason 1980).

Empirical studies can be classified according to data sources into revealed or stated preference studies and applied econometric techniques. Revealed preference studies use data on actual transactions, such as actual sales data (e.g. the U.S. Department of Transport (DoT) 10% domestic fare sample), whereas stated preference studies use data collected from customer surveys and interviews. All empirical work focuses on the North American airline market employing disaggregate data from an array of different US carriers. The commonality in their findings suggest that FFPs affect air traveller choices to varying degrees , which translates into a range of different values of the resulting FFP induced price premium.

Table 1 presents a synopsis of the empirical literature applicable to our research. We adjusted the FFP related price premiums of each study into 2008 US$ levels per single trip to compare with our results. Nako (1992), Proussaloglou and Koppelman (1995 and 1999) and Hess, Adler, and Polak (2007) all investigate the relationship between FFP membership and fare premiums. Morrison et al. (1989) and Morrison and Winston (1995) explore the FFP mileage times the number of cities served by a carrier as an explanation for existence of a FFP premium. They argue that if more cities are served FFP mileage becomes more valuable. However, by combining FFP mileage and cities served into one explanatory variable, the separate effect of each factor cannot be disentangled. So, the individual effect of FFP mileage remains unclear. In two separate studies, Lederman (2007 and 2008) uses an increase in eligible partner flights and an extension of the dominant airline's FFP as the cause for FFP induced price premiums.

Insert Table 1 here

Morrison et al. (1989) are the first to show, using the U.S. DoT Origin and Destination data that FFP membership has a considerable impact on airline choice. They estimate that an airline offering FFP mileage could increase the average airfare by US$ 30 for an average single trip. Borenstein (1989) hints that approximately two percent point of a given fare premium might be attributable to a FFP effect. Building on the findings of Morrison et al. (1989), Nako (1992) used disaggregated corporate level data to further quantify the effects of FFPs on fare premiums. He found that an airline offering a FFP can increase its average airfare by US$ 30. In a follow-up study Morrison and Winston (1995) show that a traveller's valuation of additional FFP points is aligned with the airlines' FFP point award schedules. FFP members, who have accumulated almost enough miles for a free trip, place a higher marginal value on additional points (between US$ 17c and US$ 28c per point) than those who are further away from the points threshold. The average they find is 12c per point. Travellers close to receiving a free trip experience a stronger lock-in effect and may be willing to pay a higher fare premium in return for additional points. Proussaloglou and Koppelman (1995) found that carrier choice is influenced by FFP membership. FFPs were found to better predict carrier choice than schedule convenience, low fares and timeliness. They conclude that any major changes to well-established FFPs may have serious implications for the airline's customer base. In a later study, Proussaloglou and Koppelman (1999) estimate three FFP price premium levels for travelling on preferred carriers in whose program a member most actively accumulates points. Their results suggest that business travellers are willing to pay an average premium of US$ 39 to travel with a carrier in whose program they participate if they are low-frequency travellers whereas they would pay US$ 54 premium if they are high frequency travellers.

Most recently Hess, Adler, and Polak (2007) used stated preference data from a survey undertaken in the San Francisco Bay to estimate the premium on fares where the traveller holds FFP-memberships. They found that business travellers are willing to pay a premium of US$ 75 to fly on an airline where they hold an elite frequent-flier account. Lederman (2007) used the publicly available 10% domestic ticket sample data of the U.S. Department of Transport to estimate the FFP induced fare premium of an airline dominant at a hub airport. She found that offering FFP points increases the average fare by between 3.5% and 5% and the most expensive 80th percentile fare by between 7% and 9%. Using the same data set as in Lederman (2007), Lederman (2008) found that the FFP premium per single trip is US$ 8, which translates to 3.8% of the average fare.

With the notable exception of Nako (1992) all RP studies base their analysis and results on crucial assumptions regarding FFP memberships of travellers. The non-availability of data on individual traveller memberships across airlines results in an oversimplification of the assumed FFP membership. For example, Lederman (2008) uses the sponsoring carrier's level of dominance at the departure airport as a proxy for the probability that a traveller is a FFP member with the specific carrier. Another concern is the fact that in the above discussed literature the explanatory variables capturing the effect of FFPs are combined with a network (hub) effect. This combination makes it impossible to disentangle the two separate effects. To address this issue, our work shows that the effect of FFP can be estimated without assuming a network (hub) effect.

In summary most prior RP empirical literature relies both on strong assumptions regarding FFP membership status of travellers, hub effects, variations in the networks of carriers and data gathered across airlines operating within quasi-competitive markets in order to show the existence of a FFP fare premium. Although theoretical work has established that the very structure of FFPs (i.e. non-linearity of redemption and earning schedules) leads to the lock-in effect of FFPs and ultimately to price premiums, the existence of directly FFP induced price premiums has not been explored empirically. To address this gap in the literature, our work shows that such price premiums do exist and are directly derived from the mere existence of a multi-tiered FFP.

EMPIRICAL APPROACH

We apply discrete choice modelling to explore the effect of FFP on consumer behaviour and to identify FFP induced price premiums. Discrete choice models are standard in the analysis of consumer behaviour (e.g. Morrison et al. 1989). The implicit ordering of fare types dictates our use of the discrete choice model. Ordered logit models cannot be applied as these models cannot take into account alternative specific attributes. For that reason, we apply the multinomial logit model as our reference model. We show that the random parameter variant of the model is most suitable to control for potential correlation in error terms between the different alternatives and between multiple observations per person.

Multinomial logit - We define the basic MNL model as used in prior empirical studies (e.g. Nako 1992 and Morrison and Winston 1985). The indirect utility function associated with choosing fare type j for FFP member n is hence:

(1) $$U_{nj} = \beta' x_{nj} + \gamma' z_n + \varepsilon_{nj}.$$

The utility function includes a systematic component, $\beta' x_{nj} + \gamma' z_n$, and a stochastic part, the error term, ε_{nj}.[5] The vector of observed alternative specific variables, including fare and fare interaction terms, is given by x_{nj} whereas z_n represents the vector of observed individual specific variables. Finally, the vectors β and γ contain the parameters of interest (e.g. fare and tier membership parameters). The individual traveller is assumed to be a rational decision maker who selects the fare type that maximizes his utility.

Mixed multinomial logit - As the assumption of independent, uncorrelated, error terms, ε_{nj}, is crucial to the multinomial logit model, we use mixed multinomial logit to test the hypothesis that due to the implied ordering of fare types the error terms are correlated. Mixed multinomial logit modelling relaxes three principal assumptions of the standard logit model. First, it allows for unrestricted substitution patterns between all alternatives. Second, random taste variation among respondents can be accounted for. Third, mixed logit modelling can account for unobserved factors over time. All assumptions play a key role in our analysis and are therefore important in determining the effect of FFP programs and the identification of FFP price premiums. By including an error component structure that creates correlations among the utilities for different alternatives one can account for the ordered structure of the responses without relying on predefined assumptions about the ordering. The error component structure version of the model of equation (1) is as follows:

(2) $$U_{nj} = \beta' x_{nj} + \gamma' z_n + \mu_n' \delta_{nj} + \varepsilon_{nj}.$$

The variables are defined as above, with μ_n representing a vector of random terms with zero mean. The terms in δ_{nj} are error components that, along with ε_{nj} define the stochastic part of the utility (Train 2003). Depending on the specification of δ_{nj} we can account for correlation in the unobserved parts of the utility function among the alternatives. For example if we assume that alternatives i and j are correlated in unobserved effects, we include in both utility functions the same $\mu_{ij}\delta_{nij}$ term, where μ_{ij} has zero mean. Our hypothesis is that the error terms of adjacent fare types are correlated, so fare type one is related to two, and three is related to two and four. The model can be expanded further with individual specific parameters. In this way, heterogeneity of preferences of the frequent flyer members is tested and can be accounted for.

The third important property of the mixed logit model is that it can account for multiple observations per FFP member in our data set. Correlation between individual-specific error terms over subsequent responses can be incorporated via panel mixed logit. The panel mixed logit application of the model as presented in equation (2) is as follows:

(3) $$U_{njt} = \beta_n^{'} x_{njt} + \gamma^{'} z_{nt} + \mu_n^{'} \delta_{njt} + \varepsilon_{njt}.$$

The variables are defined as above. The vector of β parameters is adjusted into individual specific parameters. Hence, this utility function is now specific for each alternative, individual and choice situation, t. Since mixed logit probabilities are the integrals of standard logit probabilities over a density of parameters, simulation techniques are required to estimate the model. Therefore, the probability that person n chooses alternative j in time period $\mathbf{i}=\{i_1,\ldots,i_T\}$ is defined as:

(4) $$\mathrm{P}_{n\mathbf{i}} = \int \mathbf{L}_{n\mathbf{i}}\left(\beta\right) f\left(\beta\right) d\beta,$$

with

(5) $$\mathbf{L}_{n\mathbf{i}}\left(\beta\right) = \prod_{t=1}^{T}\left(\frac{\exp\left(\beta_{n}^{'} x_{njt} + \gamma^{'} z_{nt} + \mu_{n}^{'} \delta_{njt} + \varepsilon_{njt}\right)}{\sum_{i} \exp\left(\beta_{n}^{'} x_{nit} + \gamma^{'} z_{nt} + \mu_{n}^{'} \delta_{nit} + \varepsilon_{nit}\right)}\right).$$

The panel mixed logit formulation as depicted in equations (4) and (5) enables us to test our hypothesis that correlation between error terms of adjacent alternatives is present. If the estimated variance of the error component is significant, correlation between error terms of adjacent alternatives is present i.e. the alternatives are ordered and we cannot use the simple MNL model to determine the FFP related fare premium.

DATA

Data on actual fare type choices are taken from a proprietary dataset. The dataset is provided by airline X on a confidential basis, which restricts us from naming either the FFP or our airline partner.[6] Airline X is an established carrier with an extensive domestic and international network. It is engaged in alliances with a number of other large international carriers. Airline X's FFP has from its inception been growing strongly in member numbers, currently approximately two million, and revenues. Airline X's FFP is recognized as being amongst the most innovative FFPs in the industry. The data covers a 5% representative sample of active FFP members of airline X. Active members are defined as customers of airline X, who have flown at least once within a given 12 months period. It includes all domestic flights active FFP members took during a twelve months period beginning on the 1st of January and ending on the 31st of December 2008. We restrict our analysis on domestic flight activity because research suggests that FFPs will be a more important choice variable on domestic flights than international flights, where the two most important choice variables for travellers have been repeatedly found to be flight schedule and price (e.g Sharp and Sharp, 1997; Toh et.al, 1988). Furthermore, all FFP related activities (earning and redemption of points) as well as member characteristics are included in our dataset. Airline X offers five different fare types per flight and its FFP program involves three status tier categories e.g. Bronze, Silver and Gold. We include only trips for which we can establish an average one-way trip fare paid for each fare type. After removal of incomplete trip observations the sample contains 60 782 trips, which is 45% of the original sample. In total 13 148 individual FFP members are included in the dataset. On average, each member made 4.6 (standard deviation 7.0) trips in 2008. Table 2 summarizes the categorical variables in the dataset, whereas the summary statistics for all other variables appear in Table 3.

Insert Table 2 about here

Insert Table 3 about here

Flight variables - We calculate the average fare paid per trip, which is used as a proxy for the airfare at the time of booking. This average fare is specific in origin-destination, days booked in advance, and departure time.[7] The average fare per fare type in 2008 US$ is reported in Table 3. The fare types are ordered from lowest to highest fare type. The average distance (in miles) is increasing in fare type. The variable “Fare conditions” is our proxy for quality. We compute a score based on the conditions attached to each fare type, i.e. whether the fare type is transferable, refundable and/or cancellable. The restricting conditions attached to the airfare, the higher the quality of the fare. The cheapest fare type is attributed the lowest score, 1, whereas the two most expensive fare types have the maximum score, 4. This implies that quality for fare types 4 and 5 are the same, which is actually the case for airline X's menu of fares. Since price differences are present between fare type 4 and 5, one difference between these fare types is the accrual of FFP (status) points. Furthermore, we create a variable, "Within 10% of next tier level", indicating whether the FFP member at the moment of purchase is, based on accumulation of status points, within 10% to be qualified for the next tier level. In line with Morrison and Winston (1995) we expect an increase in the willingness-to-pay for FFP mileage if a person is close to the next elite tier level.

Tier variables - The variable "Tier" in Table 2 shows that the vast majority of members are in the lowest tier showing that the exclusivity principle of the FFP remains present. Table 2 shows tier levels at 31st of December 2008 whereas in the estimation we use tier level at the time of purchase. Furthermore, "FFP member other airline" highlights that half of the members also participate in the FFP program of the major competing airline. "FFP tier status other airline" reflects the status level of members in that specific FFP program. Prior research, e.g. Toh and Hu (1988), states that a large majority of FFP members hold simultaneous memberships in multiple FFPs, although often one FFP is more actively used. The effect of membership in another FFP is difficult to determine *a priori*. For instance, multiple memberships may indicate that the passenger is a frequent business traveller choosing more often a higher quality fare type. On the other hand, being a member of another FFP decreases the incentive to buy more expensive fare types at airline X since the majority of the points might be earned and accumulated via travelling with the competing airline.

Socio-economic variables - We include socio-economic characteristics as control variables. In particular, gender, job and age are taken into account. Table 2 shows a summary for the categorical variables gender and job, whereas Table 3 summarizes the statistics for the age variable.

Two more issues warrant attention. First, we do not include FFP points accrual as a flight type characteristic. Airline X's FFP points accrual is linearly correlated with the average fare per fare type. Hence, we cannot include both average fare and FFP points accrual and need to exclude both standard and status points awarded per trip as an explanatory variable. Secondly, discrete choice modelling requires defining the relevant choice set for each observation. We assume that at the time of purchase all five fare types are available. This implies that members purchasing expensive fare types do so because it maximizes their utility. In reality, these people might buy these fare types because cheaper alternatives were unavailable at the time. This may imply a bias towards more expensive fare types. To define the applicable choice set Suzuki (2007) proposes a two-step procedure. Unfortunately, our data is insufficient to follow this approach, e.g. information about capacity restrictions at the time of purchase is not available. We include the variable "Days booked in advance" to control for the potential bias.

EMPIRICAL RESULTS

Table 4 presents the results of the estimated panel mixed logit model as described in the above sections. We use Biogeme 1.8 to estimate the models (Bierlaire 2003). In the final estimation we applied 2250 Halton draws. In our estimation we distinguish between alternative specific variables (e.g. "Fare") and variables that do not change over the alternatives (e.g. "Days booked in advance"). For every alternative specific variable we estimate one related parameter which is valid for each of the alternatives. In case the variables do not differ over alternatives, we estimate a separate parameter for each of the five alternatives. Since only differences in utility are of importance, one of the five parameters is normalized in order to identify the model. For all these latter variables, we normalize the parameter of the first alternative to zero. The parameters of the remaining four alternatives are therefore interpreted as relative effects compared to the first alternative. In addition, each dummy variable needs a reference category (e.g. Bronze for tier membership), which we also normalize to zero, so the parameter estimates are interpreted relative to this reference category.

Insert Table 4 about here

As discussed in Section 3 we test the hypothesis that correlation between error terms of adjacent alternatives is present. Our results show that all four specified variance error components are significant at the 5% level. Hence, correlation between error terms of adjacent alternatives is present and the simple MNL model assumptions are violated. Another concern is the correlation between multiple observations per FFP member. Using results not reported we conclude that the panel mixed logit model specification of this model outperforms the non-panel mixed logit model. Below we discuss in detail the obtained effects of fare, fare conditions and FFP to fare type choice. Note that we cannot assess the magnitude of the separate effects directly from Table 4. Given our model specification, i.e. the discrete choice model, we can only assess significance levels and signs. The magnitude of the effects can be assessed via analysis of marginal effects and/or elasticities of choice probability. Since we use our preceding empirical results in the next section to derive the expected price premium per trip and the implied value of a FFP point, we do not report the marginal effect and elasticities of choice probability here but in the next section.

Before discussing the results in detail, we address the issue of the potential omitted variable bias in our estimation caused by not including the trip purpose. Since we do not observe the trip purpose, we cannot distinguish between business or leisure trips and cannot indicate whether or not the trip is paid for by the employer. One could argue that the trip purpose has an effect both on the fare choice and the elite status of a passenger.[8] Therefore, our estimates could be biased and inconsistent. The potential omitted variable bias can occur at the trip and individual (sequence of trips) level. In general, airlines try to discriminate between business and leisure passengers based upon characteristics such as days of booking in advance and the origin destination. In order to diminish the potential omitted variable bias, we include these type of variables airlines use themselves. At the individual level we try to capture the difference between general business and leisure passengers by including "Job", "FFP member other airline" and "FFP tier status other airline". One could argue that the status of the individual within the FFP program of the competing airline combined with the status at airline X is a good signal for the distinction between business and leisure passengers.

Finally as a robustness check against this potential bias at the individual level, we also estimate the model without the individuals who have a Gold or Platinum status at the competing airline. The results turn out to be robust against this potential omitted variable bias.

The effects of fare and fare conditions to fare type choice - The fare parameter is included as a random parameter with a normal distribution. We observe that the mean effect of the fare is negative and significant. As expected and predicted by economic theory, the probability of choosing a particular alternative declines if the price of that alternative increases. By specifying individual specific fare parameters we capture the effect of differences amongst airline X's FFP members in opportunities to spend the awarded FFP mileage. In the literature these opportunities are often attributed as network or hub effects (see e.g. Nako 1992, Morrison and Winston 1995 and Lederman 2007). The estimated standard deviation of the fare parameter is significant and in absolute terms larger compared to the mean effect. This indicates that for several FFP members an increase in price results in an increase in the choice probability of that particular alternative. Possible explanations are that higher prices signal higher quality or that frequent fliers are insensitive to prices but sensitive to the extra accrual of FFP points, particularly if opportunities to spend awarded mileage are ample, induced by higher prices. We allow for different price effects per FFP status by including the interaction effects "Fare*Tier". Both effects are in absolute terms smaller than the average mean fare effect. Compared to Bronze tier members, the average price effect of silver tier members is 0.0034 smaller whereas the difference in the average price effect between the silver and gold members is just 0.0001. Hence, our results show that members in higher tiers are less sensitive to prices. As expected, the mean of the effect of the quality, i.e. "Fare conditions", variable is positive implying that increasing our proxy of quality of an alternative increases the probability that the alternative will be chosen.

The effects of FFP to fare type choice - The results with respect to tier membership indicate that silver and gold tier members are more willing to buy more expensive tickets compared to bronze tier members. All tier membership effects, except the "Silver tier level alt. 5" are significant. In particular, the effect of gold tier membership on choosing the most expensive fare type seems to be large. Furthermore if tier members are within 10% of moving to the next tier level, the probability that these members choose a more expensive fare type increases. This finding is in line with Morrison and Winston (1995) who argue that travellers who have accumulated almost enough points for a reward (i.e. a free trip, an upgrade) place a very high value on additional accrual of points. Our results show that being a member of another FFP enhances the probability of choosing more expensive fare types. Furthermore, the probability of choosing more expensive fare types is increasing in the tier status in the competing FFP program. Note that e.g. the total effect of choosing fare type 5 of a FFP member of airline X who holds a Gold tier status in the competing FFP program equals 1.1671 + 2.0286 compared to a FFP member of airline X who is not a member of the competing FFP program and 2.2086 compared to a FFP member of airline X who holds a Bronze status at the competing FFP program. These finding suggest that for the FFP members in our data the effect of being a frequent flier overpowers the incentive to buy less expensive fare types.

To summarize, our results show that fare, taking into account differences in quality, and the probability of choosing a particular alternative have, as expected, a positive relation. However, the fare effect differs over individuals and over groups of individuals. Furthermore, tier membership plays a significant role in explaining the choices of FFP members. Members in higher tier classes are more willing to purchase expensive fare types. In the next section we apply our results to calculate the expected revenues derived from FFP members' willingness to pay price premiums and subsequently the monetary value of a FFP (status) point.

FFP INDUCED PRICE PREMIUMS AND VALUES OF FFP POINTS

We have shown in the preceding sections that the members of airline X's FFP are to varying degrees influenced by virtue of their FFP membership to buy more costly fare types. Although this finding in itself contributes in no small terms to the empirical literature investigating FFPs it raises two further questions, which prior empirical research has tried to address with recourse to competitive effects between carriers. The first question addresses the magnitude of the FFP price premium whereas the second question addresses the monetary value of one FFP point. In this section we address both questions. What sets our results apart from prior empirical results (e.g. Lederman 2008) is that we exploit variations in the structure of airline X's FFP itself (i.e. status tier levels) to both derive the FFP induced price premiums and values of FFP points. We derive the FFP price premiums based on the marginal effect of a hypothetical change of tier status (Bronze to Silver and Silver to Gold).[9] Subsequently, we calculate the monetary value of a FFP point in airline X's FFP. Our findings are not only of major relevance to airline X and the FFP structure, but can play a significant role in future policy making with respect to regulation of FFPs and possible taxation of FFP benefits to FFP members. Below we formulate the price premium in terms of expected revenue per trip on airline X and the monetary value of a FFP point.

Expected revenue - We determine the expected revenue to airline X per trip per FFP member, which equals the expected price a FFP member is willing to pay for that trip:

(6) $$\textit{Expected revenue per trip}_n = \sum_j \mathrm{P}_{nj} p_j .$$

where P_{nj} is the probability that person n chooses alternative j and p_j is the average fare for alternative j. FFP members buy a composite product; the airfare is due to the structure of airline X's FFP intrinsically linked to the number of FFP points the member receives. Using scenario analysis, we calculate the implicit willingness-to-pay per trip according to FFP tier membership. The difference between the expected revenues (price) at status quo (base case) and the counterfactual scenario determines the implicit willingness-to-pay.

We look at two scenarios in which we forecast the change in behaviour of airline X's tier member based on an exogenous change in their elite tier status. As discussed in the previous section, the estimation results suggest that a higher tier level increases the expected revenue since the probability of buying more expensive fare types increases with tier membership and fare tier membership interaction effects. Stated differently, the forecasted revenues are assumed to be different due to the marginal effect of a change in tier level. In the first scenario the elite tier status of each Bronze FFP member changes to Silver, while in the second scenario the elite tier status of each Silver FFP member changes to Gold all else being equal. The implied price and points premium per trip in each scenario is defined as:

$$\text{(7)} \qquad \textit{Price Premium} = \sum_j \mathrm{P}^1_{nj} p_j - \sum_j \mathrm{P}^0_{nj} p_j ,$$

$$\text{(8)} \qquad \textit{Points Premium} = \lambda^1 \sum_j \mathrm{P}^0_{nj} p_j - \lambda^0 \sum_j \mathrm{P}^0_{nj} p_j .$$

where 0 and 1 represent the base case and counterfactual scenario respectively. Furthermore, λ represents the points per 2008 US$. All remaining variables are defined as above. The price premium reflects the forecasted increase in revenues per trip, whereas the forecasted increase in acquired FFP points per trip is reflected by the points premium. By dividing the price premium by the points premium we obtain the forecasted implied value of a FFP point induced due to an exogenous change in tier level. The value of a point is evaluated at the (average) price the FFP member would pay in the base scenario. The value of a point at the new price can also be derived by multiplying λ^1 by $\sum_j P^1_{nj} p_j$. In the latter case, both an increase in (average) fare and the difference in points awarded per dollar spent determine the value of a FFP point. In order to avoid an arbitrarily disentanglement of effects we evaluate the value of a point at (average) prices paid in the base scenario.

Results - The average FFP induced price premium in the first scenario equals US$ 8.67 (std. dev. US$ 6.32) per trip or six percent of the average fare paid. In the second scenario, the FFP induced price premium equals US$ 8.15 (std. dev. US$ 8.97), or six percent of the average fare paid. The average value of a FFP point in the first scenario ranges from US$ 4c to US$ 6c (std. dev. US$ 2c) respectively. In the second scenario, the average value of a FFP point ranges from US$ 4c to US$ 6c (std. dev. US$ Xc). These results are based on the assumption that the extra FFP points earned per dollar spent on a fare type are the only benefit a loyal customer derives from a higher tier level. Therefore our reported values of a FFP point are the upper limits of the true values. Although these findings are somewhat lower compared to reported figures in earlier studies they are consistent. One possible explanation for our slightly lower values is that we restricted our data to domestic flights, which by definition are shorter and cheaper than international flights.

General Discussion **-** We show that airline X derives direct and measurable benefits from the existence of its FFP. It can hence be argued based upon these results that FFP members are willing to pay a higher airfare in order to ‘buy’ FFP points. Our findings furthermore suggest an explicit monetary value of a FFP point. The implications of such a value for the airline are twofold. Firstly, many airlines sell points to other firms (e.g. banks, credit card companies) for the exclusive use of these other firm’s customers. The sale price per point depends on the outcome of the negotiation between the airline and the buyer. Anecdotally this value ranges between US$ 1.5c and US$ 2c. Our results of US$ 4c to US$ 6c per FFP point can serve airline X as a benchmark price when entering into negotiations and when reviewing current sales agreements. In fact, airline X should have a range of different prices at which it sells its points. In other words, points that the bank or credit card company intends to allocate to its highly valued customers should be sold by airline X at a higher price per point than those points intended for allocation to low value customers. In theory this price discrimination is straightforward. In practice however points are seen as homogenous goods. One point is exactly equal to the next point, hence asking different prices for essentially the same good appears at first glance difficult to implement. However the sales negotiation for points, which are generally sold in large ‘blocks’ (e.g. 100,000 points per block), take place between two very informed parties, the airline and the bank/credit card company etc. There is little information asymmetry prevalent about the market and customer behaviour. Both the airlines and the banks/credit card companies know that different customers value points at different prices, which in fact makes a point not equal a point. It will hence come down to the bargaining power held by either side, whether a menu of prices reflecting different customer valuations will be have to be paid by the banks/credit card companies for the FFP points.

Secondly, with the introduction of the international accounting standards IFRIC 13 in 2008 it has become mandatory for airlines to estimate the value of the FFP points to customers and to defer this amount of revenue as a liability until the FFP member has redeemed their points. IFIRC 13 is based on the view that FFP members implicitly pay for the FFP points and hence that airlines need to measure the amount that the FFP member has paid for the points. Errors in estimation of this liability lead invariably to large profitability issues for airlines. Our research measures what FFP member of airline X have paid for the points on average, hence it allows airline X to allocate an appropriate monetary amount as a liability. Furthermore our empirical approach to estimate the value of FFP points can be applied to any FFP data of any airline and in fact any loyalty program provided that the program has a status membership structure in place.

Our research has shown that airline X's FFP with its hierarchical three status tier levels has a mechanism at its disposition that changes the behaviour of FFP members in favour of airline X. FFP members across all tiers are paying tangible price premiums according to their status in the FFP. A direct implication of this finding for airline X is that it should raise variation within the FFP by e.g. increasing the number of status tier levels to further exploit the willingness-to-pay of its FFP members. In fact a number of FFPs, most notably Lufthansa's Miles and More with its Honors Circle and United Airlines with Platinum Elite have recently departed from the traditional three tier pyramid membership structure to a four and even five tier structure. However a structural change that introduces a super elite tier over the current elite tier is not costless. Irrespective of the potentially large financial costs of undertaking this change, it seems that the real trade-off facing airline X is between how many FFP members it elevates into a super elite tier and the changes all remaining FFP members in the program will experience. It might lead to a loss of engaged FFP members who feel disenfranchised by such changes to status tiers. Dreze and Nunes (2009) have recently addressed exactly this trade-off from a psychological point of view. They present evidence that the addition of a fourth tier to a traditional three tier loyalty program actually benefits the perceptions of status for members in the second tier. On the other hand Dreze and Nunes (2009) find no evidence that members in the top tier are being negatively impacted.

Combining these insights with our findings we hence recommend to airline X take a bottom-up approach when introducing a third elite tier. Airline X's FFP, just like any other large FFP or loyalty program with elite tier levels, has a very large base level membership. This large bottom or base membership naturally lends itself by the virtue of its size and heterogeneity of membership (i.e. large number of members across a wide range of accrued status points) to be subdivided into two or more independent status levels (see Figure 3). This recommendation can in fact easily be generalised to any large FFPs and loyalty programs with elite tier level.

Insert Figure 3 about here

A change in airline X’s or any other large FFP structure as depicted above would effectively introduce a Super Elite membership tier, without actually changing the top tier of the FFP. On the other hand the current second tier (Silver) would become more valuable. Furthermore, achieving tier status for those members in the bottom tier would become more attainable.

CONCLUSION

FFPs have gained much popularity since American Airlines first introduced its program almost thirty years ago. In spite of their vast application throughout the airline industry and many other industries little is known about whether FFPs truly change consumer behaviour, introduce price premiums and what the magnitude of such a premium might be. Prior literature relies on publicly available data and the assumptions of exogenous factors (e.g. network effects) and specific market structures (competition/monopolistic) in order to show the existence of a FFP price premiums. Due to the detailed nature of our data we can show that no recourse to competition is necessary in order to have FFP fare premiums, but that the mere existence of an FFP leads to higher prices paid by FFP members. Although we have derived the expected FFP price premiums and FFP points values by having recourse to simulations of hypothetical changes from one membership status to the next higher status, we nevertheless believe that our FFP price premium effect exists next to effects based on airline competition and other exogenous factors indicated in prior literature. The notable FFP price premium of 5-6% on an average airfare that we find is based on the intrinsic characteristic of the FFP structure itself, i.e. the variation in status tier levels. Hence our research indicates that it would make sense for airline X to introduce another tier level into its current FFP in order to further exploit the willingness-to-pay a fare premium by FFP members. We further derive the explicit monetary value per FFP point that FFP members are willing to pay. This value ranges between US$ 4c and US$ 6c, depending on the tier status of an FFP member. Our methodology can be used by airlines and loyalty programs with elite tier structures to estimate the average value of their points in accordance with IFRIC 13 regulation, enter into price negotiations with banks/credit card companies or as a blue print for the re-structure of their FFP to take better advantage of the behaviour changing incentives that FFPs provide them with.

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Table 1 FFP empirical literature: reported findings (in 2008 US$)

Author (Year)	Data †	Method*	Explanatory variable capturing FFP effect	Findings – average fare premiums and value of FFP point
Morrison et al. (1989)	RP	MNL	Frequent flier mileage awarded times number of cities served by carrier	30.15 i.e. 5.1 cents per FFP point
Nako (1992)	RP	MNL	FFP membership and hub effect	30.05 i.e. 7.46% of average fare
Morrison and Winston (1995)	RP	MNL	Frequent flier mileage awarded times number of cities served by carrier	12.3 cents per FFP point
Proussaloglou and Koppelman (1999)	SP	MNL	Participation and active participation in FFP	39–54 i.e. 8-11% of average fare
Hess, Adler, and Polak (2007)	SP	MNL	None, standard or elite-plus FFP member	29.5-75 i.e. 9-25% of average fare
Lederman (2007)	RP	2SLS FE	Increase in the number of eligible partner flights by 1000 flights	1.91 i.e. 0.32% of average fare
Lederman (2008)	RP	FE	Extension of dominant airline's FFP to include its partner's flights	10 i.e. 3.8% of average fare

†RP = Revealed Preference, SP=Stated Preference; *MNL = Multinomial Logit, 2SLS = Two-Stage Least Squares, FE = Fixed Effects

Table 2 Summary of categorical variables

	Category	N	Percentage
Flight variables			
Departure time	05:00 – 9:59	19834	32.6
	10:00 – 13.59	10325	17.0
	14:00 – 16.59	12296	20.2
	17:00 – 20:59	17708	29.1
	21:00 – 4:49	619	1.0
Fare conditions	1	11439	18.8
	2	40725	67.0
	3	7129	11.7
	4	1489	2.4
Within 10% of next tier level	No	59475	97.8
	Yes	1307	2.2
Tier variables			
FFP member other airline	No	6557	49.9
	Yes	6591	50.1
FFP tier status other airline	Bronze	4141	31.5
	Silver	1339	10.2
	Gold	675	5.1
	Platinum	436	3.3
Tier	Bronze	11900	90.5
	Silver	961	7.3
	Gold	287	2.2
Socio-economic variables			
Gender	male	7335	55.8
	female	5813	44.2
Job	Managers, administrators	3955	30.1
	Professionals, associate professionals	2847	21.7
	Tradespersons	945	7.2
	Clerical, service workers	808	6.1
	Self employed	754	5.7
	Retiree, student, unemployed	1046	8.0
	Other	2793	21.2

Table 3 Summary statistics

	N	Mean	Standard Deviation
Flight variables			
Days booked in advance	60782	12.11	16.43
Distance alt. 1	11439	516.84	204.69
Distance alt. 2	40725	547.10	252.37
Distance alt. 3	7129	514.18	226.41
Distance alt. 4	1005	568.23	283.32
Distance alt. 5	484	683.96	441.25
Fare alt. 1	11439	68.21	13.96
Fare alt. 2	40725	122.54	25.42
Fare alt. 3	7129	227.48	41.71
Fare alt. 4	1005	285.48	65.32
Fare alt. 5	484	366.28	109.83
Socio-economic variables			
Age	13148	42.22	13.34

Table 4 Estimation results, robust standard errors are given in brackets, bold are significant at the 5% level

Variable	**Panel Mixed Logit**	
Alternative specific variables		
(Mean of) Fare	**-0.0062**	(0.0008)
Std. dev. of Fare	**0.0114**	(0.0003)
Fare*Silver	**0.0034**	(0.0013)
Fare*Gold	0.0033	(0.0024)
Fare conditions	**1.8429**	(0.0885)
Alternative specific constants		
Constant alt. 1	0	n/a
Constant alt. 2	0	n/a
Constant alt. 3	0	n/a
Constant alt. 4	**-5.2075**	(0.3109)
Constant alt. 5	**-8.5882**	(0.5665)
Tier airline X		
Silver tier level alt. 2	**0.3815**	(0.1076)
Silver tier level alt. 3	**0.9567**	(0.3070
Silver tier level alt. 4	**0.8018**	(0.4098)
Silver tier level alt. 5	0.7731	(0.5349)
Gold tier level alt. 2	**0.4591**	(0.1634)
Gold tier level alt. 3	**1.6781**	(0.4288)
Gold tier level alt. 4	**1.6322**	(0.5220)
Gold tier level alt. 5	**2.0856**	(0.6977)
Within 10% of next tier level, alt2	0.2385	(0.1136)
Within 10% of next tier level, alt3	**0.3921**	(0.1489)
Within 10% of next tier level, alt4	**0.7495**	(0.2213)
Within 10% of next tier level, alt5	**0.5390**	(0.2622)
Tier other airline		
FFP member other airline alt. 2	**0.1882**	(0.0376)
FFP member other airline alt. 3	**0.3627**	(0.1070)
FFP member other airline alt. 4	**0.7532**	(0.1754)
FFP member other airline alt. 5	**1.1671**	(0.3065)
Silver tier level other airline alt. 2	**0.1989**	(0.0628)
Silver tier level other airline alt. 3	**0.7609**	(0.1708)
Silver tier level other airline alt. 4	**0.9898**	(0.2787)
Silver tier level other airline alt. 5	**1.3433**	(0.3543)
Gold tier level other airline alt. 2	**0.3464**	(0.0922)
Gold tier level other airline alt. 3	**1.3221**	(0.2509)
Gold tier level other airline alt. 4	**1.5147**	(0.3149)
Gold tier level other airline alt. 5	**2.0286**	(0.4374)
Platinum tier level other airline alt. 2	**0.4466**	(0.1097)
Platinum tier level other airline alt. 3	**2.2038**	(0.2533)
Platinum tier level other airline alt. 4	**2.3571**	(0.3431)
Platinum tier level other airline alt. 5	**3.8232**	(0.4501)
Trip specific variables		
Days booked in advance alt. 2	**-0.0330**	(0.0013)
Days booked in advance alt. 3	**-0.0819**	(0.0038)
Days booked in advance alt. 4	**-0.1037**	(0.0087)
Days booked in advance alt. 5	**-0.0564**	(0.0103)
Job		
Managers, administrators alt. 2	0.0040	(0.0429)
Managers, administrators alt. 3	**-0.5544**	(0.1153)
Managers, administrators alt. 4	**-0.5359**	(0.1966)
Managers, administrators alt. 5	**-1.1348**	(0.3055)
(Associate) professionals alt. 2	**0.3914**	(0.0750)
(Associate) professionals alt. 3	0.2471	(0.1846)
(Associate) professionals alt. 4	0.3601	(0.2784)
(Associate) professionals alt. 5	-0.2405	(0.3951)
Tradepersons, related workers alt. 2	0.0993	(0.1156)
Tradepersons, related workers alt. 3	-0.7530	(0.4201)
Tradepersons, related workers alt. 4	-0.5151	(0.5671)
Tradepersons, related workers alt. 5	**-6.9820**	(0.6572)
Clerical, sales workers alt. 2	-0.1716	(0.0922)
Clerical, sales workers alt. 3	**-1.0920**	(0.2624)

Clerical, sales workers alt. 4	**0.9457**	(0.4577)
Clerical, sales workers alt. 5	-1.4963	(0.8798)
Self employed alt. 2	-0.0323	(0.0737)
Self employed alt. 3	**-1.1815**	(0.2347)
Self employed alt. 4	0.0072	(0.5137)
Self employed alt. 5	0.5695	(0.5067)
Retiree, student, unemployed alt. 2	**-0.4409**	(0.0688)
Retiree, student, unemployed alt. 3	**-3.4918**	(0.3437)
Retiree, student, unemployed alt. 4	**-2.1986**	(0.4982)
Retiree, student, unemployed alt. 5	**-1.9261**	(0.6355)
Other alt. 2	0	n/a
Other alt. 3	0	n/a
Other alt. 4	0	n/a
Other alt. 5	0	n/a
Variance error component		
Alt1 and Alt2	0.0245	(0.2734)
Alt2 and Alt3	**0.2157**	(0.0844)
Alt3 and Alt4	**1.4680**	(0.0602)
Alt4 and Alt5	**0.8653**	(0.1839)
Observations	60 782	
Initial Log Likelihood	-79 324	
Final Log Likelihood	-48 992	
Adjusted Rho-square	0.498	

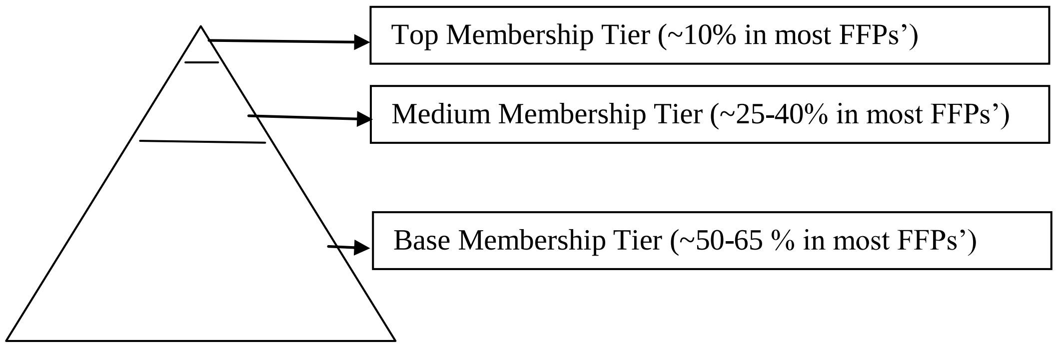

Figure 1: FFP tier membership pyramid

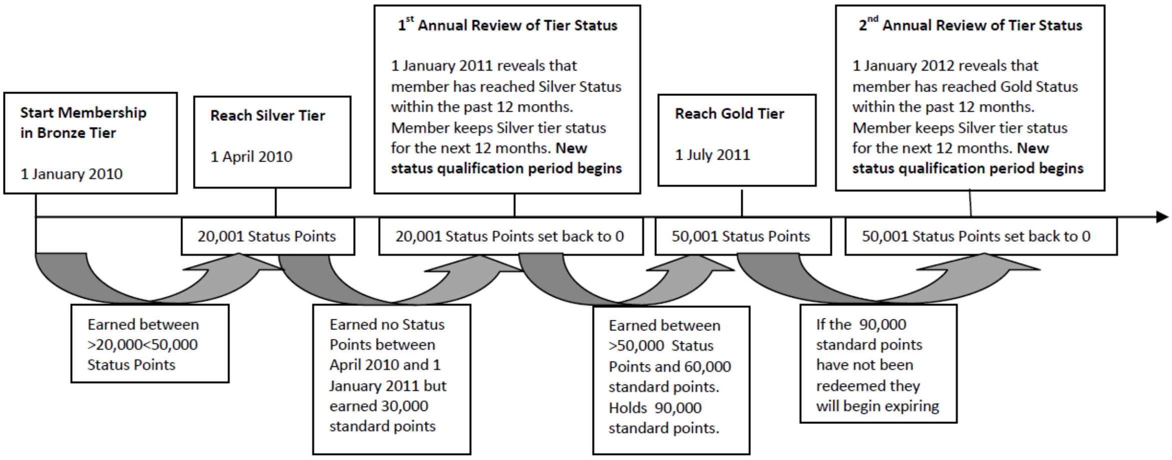

Figure 2: The process of moving across FFP membership tier

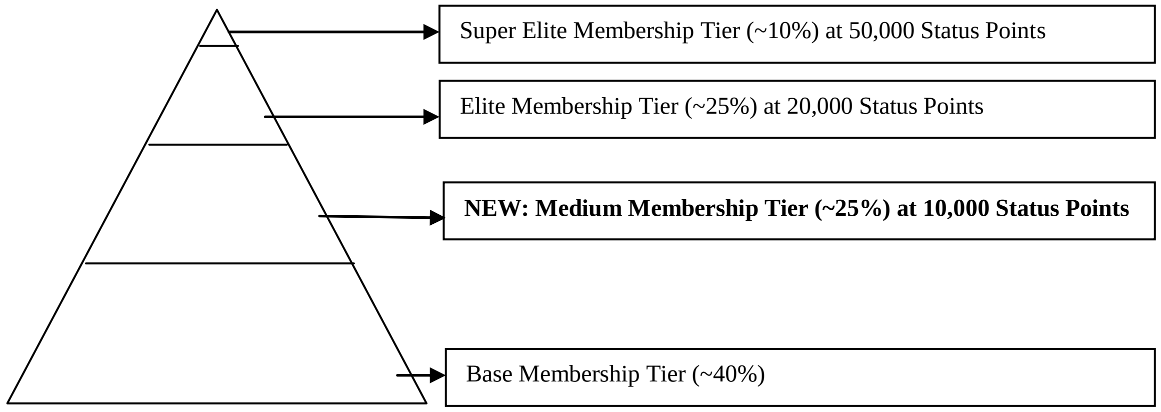

Figure 3: Proposed structural change to airline X's FFP

[1] The FFP listing is published and regularly updated by Global Flight, a company focusing on the needs of frequent business travellers. For more information on Global Flight, see www.globalflight.net.

[2] The following quote represents generally held views amongst airline executives: "(…) there is a massive behavioural reaction around status miles and thresholds. Often accentuated by the airline actively raising the awareness for expiring miles or proximity of higher level." (P. Baumgartner, CCO Etihad Airlines by email, April 8, 2010).

[3] "We didn't want a FFP. But it came to my attention that FFPs were siphoning business travel away (…) I think if we had not done that we would have been terribly disadvantaged."- H. Kelleher, Former President Southwest Airlines. See www.frequentflier.com/ffp-005.htm.

[4] Marketing research investigates how FFPs contribute to financial and market performance (e.g. Sharp and Sharp , 1997) and whether FFPs create customer loyalty, e.g. Dowling and Uncles (1997) state: "it is probably a mistake for a company to introduce a frequent-buyer program if it is selling a parity brand in a competitive market".

[5] Assuming that each error term is independent with identically distributed extreme value (Gumbel and type I extreme value distributed), the standard logit probability that person *n* chooses alternative *j* is defined as: $\mathrm{P}_{nj} = \frac{\exp\left(\beta' x_{nj} + \gamma' z_n\right)}{\sum_i \exp\left(\beta' x_{ni} + \gamma' z_n\right)}$.

[6] Data details are available upon request on a confidential basis upon signing a NDA.

[7] We distinguish between booking 0–7, 8–20, 20–60 and >60 days in advance, and flying within the following time slots: 05:00–09:59, 10:00–13.59, 14:00–16:59, 17:00–20:59 and 21:00–04:59.

[8] Reversed causality between the fare type choice and status level is not an issue here since the status level is based upon the aggregated past behaviour of the consumer and does not depend on the current fare type choice.

[9] The probabilities in both the base and scenario case(s) are simulated using hundred Halton draws, only taking into account the individuals who are facing a change of tier membership in the scenario.