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Assessing air traveler preferences for pay-per-weight pricing

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ABSTRACT

In efforts to reduce fuel consumption of air travel, the inclusion of passenger body weight in airline pricing is a relevant but contested opportunity. This study aims to investigate this issue from the economic perspective; by implementing a stated choice experiment to assess the stated preferences of consumers toward a set of predefined air passenger weight policies. Three policies are tested: "standard", where price is defined irrespective of weight; "threshold body weight", where an additional fee is required when exceeding a certain weight; and "unit body weight", where passengers pay according to their body weight and receive a discount for reduced luggage size. In terms of respondents' preferences for policies, service and price attributes were found to have significant importance, while environmental concerns related to pay-per-weight pricing received only marginal consideration. The results provide practical implications to airline companies regarding pricing policies and airline choice behavior.

1. Introduction

The aviation industry is undergoing rapid transformation across all business aspects including customer, ground and in-flight services, as well as cabin configuration, crew and network management, and carbon offsetting (Heiets, et al., 2022). These transformations are reflected in the practices and policies of airlines, most notably in the changes made to pricing and distribution systems. Aviation has become very competitive due to the emergence of low-cost carriers and liberalization of the sector (Ferrer-Rosell, Coenders & Martínez-Garcia, 2015). At the same time, airlines are increasingly pressured by consumers and governments (Scott & Gössling, 2022) towards more sustainable solutions in an industry that is increasingly viewed as a "carbon sinner" (Rosenthal, 2013), since airlines are the biggest emitters of CO_2 related to the tourism industry (Jalalian, et al., 2019). As such, airlines need to achieve a wide number of, at times, conflicting objectives, as they seek to be competitive, profitable, sustainable and deliver good customer service. In achieving this, airlines have to consider various trade-offs.

There are numerous initiatives to change the fuel types or heighten fuel efficiency for airlines (Baroutaji, et al., 2019). Significant reduction on fuel consumption has already been achieved thanks to innovation in airplane design, which led to lighter airframes,

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improved aerodynamics, and engines (Zhu, et al., 2019). The cost of fuel can take around 50% of the flight expense (National Academies of Sciences, Engineering, and Medicine, 2013) depending on fluctuating fuel prices. The smaller the airplane, the higher the share of the fuel cost. Further reductions could be reached with reduced weight on the aircrafts. Less weight on the aircraft equals less fuel used. Less fuel used equals less carbon emissions and potentially also cheaper flights for the consumer.

One of the important areas that touches on many of the dimensions listed above is the pay-load related passenger mass—that is the weight of passengers and their baggage. Traditionally, a certain size and weight of baggage is included in the standard price. However, most low-cost carriers do not include any checked-in baggage in the price of a ticket, rather extra fees need to be paid. More recently, legacy airlines have also begun to experiment with alternative baggage policies, and implement base fares with no baggage allowance.

An interesting proposition is to charge not only for the weight of the baggage, but also for the body weight of the passenger. This would potentially incentivize people to bring less weight onto the plane and thus lower emissions. In addition, knowing the exact weight of passengers and baggage would allow airlines to load the plane with less fuel, which also lowers emissions (Melis et al., 2019). Therefore, measuring passengers can correct for overestimation of the load, creating a positive economic and environmental impact. It could also ensure that weight is not underestimated and it is well-balanced on board, which is an important safety issue for smaller aircrafts. As Melis et al. (2019) demonstrated, the majority of airlines, especially in the African and Asian continents with lower obesity rates, actually overestimate the weight carried on the airplane due to the discrepancy between average weight of the population and weight standards used by airlines. Among their suggestions, Melis et al. (2019) propose direct measuring of body weight before boarding to reduce uncertainty and fuel waste. In line with Steinegger (2017), 1 kg decrease in payload translates to 0.02–0.03 kg of less fuel needed for a distance of 1000 km of an Airbus airplane. Moreover, 1 kg of fuel contributes 3.16 kg of CO2 emissions (IATA, 2022). While the savings looks negligible, they can add up when counted in totals annually, as for example in the US airspace more than 10 million scheduled passenger flights are yearly (FAA, 2023). According to Calder (2023), airlines spend over 200 billion US dollars yearly on fuel, and only by measuring passenger weight and consequently not carrying 1% more fuel than necessary, they could save 1 billion in total annually.

Indeed, the measurement of passenger weight has recently generated a lot of media interest (BBC, 2023; Calder, 2023, Ji-Eun, 2023), focusing on implications relating to economic, ethical, environmental and operational issues. It is clear from media articles that this policy is already highly debated among passengers. The main reasoning of the articles is about safety and fuel efficiency, whereas sustainability concerns are not explicitly mentioned. Yet, speculations about future implementation of pricing according to weight are present in the media. A key issue being that weighting passengers is a sensitive issue since many people do not like to disclose their weight. Incorporating this information in the ticket price is often seen as discriminatory (Marcus, 2020) as body weight also depends on human characteristics, such as height, gender, race, health conditions, and pregnancy status. Yet, additional weight means additional costs and emissions, therefore, the pay-per-weight pricing can be argued to be the fairest approach, as suggested by Bhatta (2013).

Samoa Air was one of the first airlines of the world to have introduced such a policy (The Guardian, 2013). However, in this case, the decision on the pricing policy was supported by the importance of weight distribution on the small aircrafts. Weight-based pricing policies could lead to reduced cost thanks to fuel saving and increased revenues stemming from heavier passengers. Ideally, the potential increase in airlines' profits should be used for carbon offsets. This way, it would encourage customer involvement in the CO_2 reduction, and eventually could be an incentive for healthier lifestyles in the long run. Despite these benefits, the acceptance of these policies remained questionable. Indeed, Bhatta (2013) called for further investigation of the pay-per-weight pricing model regarding passengers' perception and attitudes in relation to their socioeconomic characteristics. Although he considered charging per kilogram of weight as the fairest way to price flights, the preferences of air passengers toward different pricing policies lack investigation.

This study aims to address this gap. By performing a stated choice experiment in the US market, the analysis investigates their preferences for alternative international flight options that differ in terms of service, price of airplane ticket and weight pricing policy. Theoretical contributions lay in the investigation of individual preferences regarding conflicting concepts of self-interest, ethical concern and sustainability in the airline context. Analyzing a controversial policy option from the consumers' perspective is of significant theoretical and practical importance. Moreover, the study enriches the research stream on airline selection attributes with alternative pricing policies related to weight-based pricing. In particular, three weight-pricing policies are compared: "standard", where price is defined irrespective of weight; "threshold body weight", where an additional fee is required when exceeding a certain weight; and "unit body weight", where passengers pay according to their body weight. In order to better understand underlying preferences, respondents were asked to state their weight in the survey which was then applied to customize the price in each scenario's pay-per-weight alternatives.

The paper is organized as follows. The next section reviews the literature concerning airline choice, green preferences and the factors of passenger mass in the airline industry. The research design is then outlined through the description of the survey and method used, whereas sample statistics and model estimates are proposed in the Results section. Finally, the last section presents the implications and conclusions of the research. The results provide practical implications to airline companies regarding pricing policies and airline choice behavior.

2. Literature review

2.1. Airline choice

The advancement of pricing policies in the airline sector is triggered by deregulation, competition and the financial characteristics of the industry (Abate, et al., 2020; Gupta, 2018). Ticket pricing needs to reflect the trade-offs customers face regarding the selection of comfort, service quality, travel time and brand. In the airline choice literature, the decision-making process of travelers is most commonly captured by choice modelling and attribute rankings methods. In line with Kim and Park (2017), studies on airline choice focus on airline factors and passenger factors. Indeed, personal variables, such as socio-economic, psychographic and trip characteristic variables can affect the choice of airline. For example, there are differences related to country of origin of passengers; airfares are found to be more important in Europe, while service quality is rated higher in East Asia (O'Connell & Williams, 2005). Age, gender and education are found to be differentiating factors in the willingness to pay for in-flight services (Balcombe, et al., 2009). In a study on segmentation, Zhou et al. (2020) found young female leisure travelers more sensitive to air fares, while older male passengers, especially travelling for business, belong to the price-insensitive segment.

In most research, ticket price is the main determinant attribute of flight selection (Collins, et al., 2012), in line with the law of demand. Eventually, many other attributes are somewhat related to price (provision of meals, entertainment, quality, luggage fees, and loyalty programs). Travel time is the second most considered element of airline selection. Time can be measured as a whole a journey, trip to airport, flight time, connecting time in transit, waiting time, punctuality or delay. Kurtulmuşoğlu, et al. (2016) found punctuality and on-time performance to be the most important variables after price. On-time performance is a good indication of punctuality, and found to be significant determinant of choice especially in the case of longer flights (Hess, et al., 2007).

Cho and Dresner (2018) found that baggage fees influence flight selection, especially for long distance leisure travel. Chiambaretto (2021) found that the willingness to pay for luggage is much lower than the actual price airlines ask to pay. He reasoned the findings by speculating that airlines might want to discourage passengers to bring extra weight on the plane. In-flight entertainment is generally considered less influential on airline choice (Fourie & Lubbe, 2006), although its importance rises with the duration of the flight, as well as with rise in ticket price (Milioti, et al., 2015). Similarly, providing meals onboard is more relevant for longer flights. This may explain why airlines are exceedingly removing these options from short haul flights. The willingness to pay and to accept the (non) provision of food and drink were also investigated in the context of airline choice. Balcombe, et al., (2009) examined the willingness to accept having no meals on flights, in exchange for a price reduction and found the tipping point to be 31 Euros. This reduction was significantly higher for females than males. Martín, et al. (2008) found the willingness to pay for a lower category of in-flight catering was only 5 euros and 11 euros for a higher category, which are lower than the actual price that passengers usually pay for the value-added service sold separately. Yet, the same research found business class passengers have a higher willingness to pay for meals and drinks options. Furthermore, business travelers and passengers with higher income are more likely to consider airline selection based on frequent flyer programs (Milioti et al., 2015) as they are more likely to participate in these.

2.2. *Green preferences in the airline industry*

The topic of green choice is increasingly important in the tourism industry. Especially in the hotel sector, customers' preferences and willingness to pay for green initiatives is receiving growing attention (Galati et al., 2021). In comparison to green influence in regard to hotel selection, the effect on airline booking behavior is an under-researched topic. Hagmann, et al. (2015) investigated the effect of green image on airline choice, and found eco-friendliness has little influence on booking a flight. Instead, their research showed that passengers are willing to pay more for comfort (namely greater legroom), than for eco-friendliness. Their study also found that passengers differentiated airlines according to their perception on environmental friendliness, and perceived low-cost airlines inferior in that aspect. This is interesting because low-cost carriers in fact emit less CO_2 per passenger, due to reduced seat size, and optimized load factors (Hagmann et al., 2015; CBC, 2016). Although it can be argued that low-cost carriers expand the total supply of airline seats on the lower end of the fare spectrum, which increases air travel and total industry emissions.

Voluntary carbon offsetting is an option for travelers to reduce their CO_2 emissions by financially helping environmental projects elsewhere. Passengers prefer offset programs that are accredited, local and effective in reducing emissions (Ritchie, et al., 2021). Yet, offset contributions are often lack transparency, and their impact is questionable. Liu, et al. (2021) investigated the carbon offset contribution among Chinese travelers. In their online experimental setting, passengers were more willing to pay an offset when they could choose among different offset options and received concrete messages, rather than abstract ones. Hinnen, et al. (2017) stated that 20% of Swiss travelers belong to a 'green segment', who are willing to pay a substantial amount for carbon offsets and other additional pro-environmental services of airlines. Becken (2013) highlighted the moral dimensions of tourism and climate change and argued that flying is a crucial issue. Indeed, 'flight shame' became a highly debated issue regarding the environmental ethics of air travel, especially in North European countries (Mkono, 2022). Juvan and Dolnicar (2014) found earlier that even the most environmentally conscious members of environmental organizations are less rigorous when it comes to their own vacation behavior, and attribute their behavior to external issues and limitations. Regarding US air travelers, 96% of them did not purchase offset with their airplane tickets or made any donation to support sustainable aviation fuel in 2023 (Airlines for America, 2024). The same survey reveals that 47% of the interviewed population is not willing to pay for airlines' sustainability at all, and only 6% would pay extra $50 per ticket for helping pro-environmental initiatives of airlines. This value cannot be explained by the lack of awareness of airline emissions, as 74% of respondents overestimate the GHG emissions of US air travel.

2.3. *The factor of passenger mass in the airline industry*

Several issues for the airlines arise from the increased body weight of passengers and the negative effect on neighboring passengers because of the reduction of their seat space (Evans, et al., 2021). Indeed, the airline sector has received the most attention within the tourism industry regarding the issue of obesity (Small and Harris, 2012). In Canada, as a result of a court ruling, all airlines must adopt a one-person-one-fare policy (1P1F) as long as obese passengers can demonstrate objective evidence of their weight and obtain a doctor's approval as being "disabled-by-obesity" (Rinaldi, et al., 2021). In other jurisdictions, some airlines implement the 'customer of size' policy which states that if passengers cannot fold down the armrest, they need to buy a second seat. In fact, the model of Melis, et al. (2018) reflects the central importance of passengers' biometrics in the considerations of safety, performance and design with regulation and standards. Poria and Beal (2017) highlighted some of the practical issues that make flying a challenge for obese people. For example, some obese passengers opt not to take the food and drinks provided on the airplane but prefer to take their own sandwich or ask for finger food without the use of tray. This is due to the discomfort caused by the limited space for the tray and to refrain from using the small airplane toilet. However, Evans et al. (2021) found the main concerns of obese people are being assigned to a middle seat on the aircraft and having negative interactions with other passengers. This is in line with Poria and Beal's (2017) findings that the experience of obese travelers is more affected by the social encounters with other passengers and cabin crew than by the physical barriers; and also, in line with Small and Harris (2012) who documented that obese travelers feel condemned and stigmatized by other passengers. Based on this, Poria and Beal (2017) called for future research to investigate business related approaches regarding obese travelers and their willingness to pay.

3. Research design

3.1. Survey

This empirical research relies on data collected through an online survey among residents of the United States. The focus on the United States market has been motivated by the fact that the country is responsible for 25% of global emissions originated from commercial aviation (Gössling & Humpe,2020). Besides standard questions related to travel habits before the COVID-19 pandemic, the first section of the questionnaire aimed at gathering air passengers' perceptions about a set of three predefined pricing policies (Table 1): i) "standard" policy (status quo), whereby passengers pay a standard price, irrespective of their weight; ii) "threshold body weight" policy (hypothetical), whereby passengers pay a personalized additional fee if their body weight exceeds 160 lb (or 72.6 kg); and iii) "unit body weight" policy (hypothetical), whereby passengers pay a personalized price based on their own body weight and receive a discount if the weight of the check-in luggage is lower than 50 lb (or 22.7 kg). For the first hypothetical airline passenger mass policy – the "threshold body weight" policy – the threshold was set at 160 lb, after assessing international standard weight calculations of airlines (FAA, 2023), academic research related to passenger weight (Bhatta, 2012; Melis et al., 2019), and the average of healthy body weight of the population under investigation (CDC, 2021). In particular, while the average weight among adults in the US is 181 lb (Gallup, 2021), this study considered the average height in the US (5'4'', or 162.6 cm, for women and 5'9'', or 175.3 cm, for men) and calculated the threshold as the average of the lower weight limit for overweight people (145 lb for women and 175 lb for men). Hence, the threshold body weight proposed in the study aims at promoting good health among air travelers, in line with the measures indicated by the US Centers for Disease Control and Prevention (CDC, 2021). In terms of luggage weight, this study adopts the international standard regulation of 50 lb for checked-in luggage (IATA, 2023).

As emerged from previous research, there is a lack of knowledge regarding airline emissions and airlines' efforts to them (Chiambaretto et al., 2021). Therefore, it cannot be assumed that respondents are aware of the emissions caused by body and luggage weight on a flight. Similar to Liu, et al. (2021), the following sentence was included in the description of weight policies, in order to ensure passengers awareness about the carbon emissions: *"These policies reflect on the fact that less weight on the aircraft, equals less fuel used for the flight. And less fuel used leads to less carbon emitted to the environment by the airplane."*.

The second section of the survey included a stated choice experiment aimed to assess the preferences of respondents for different international flight options. In particular, respondents were asked to imagine a situation in which they were about to book a flight of at least five hours for their next international leisure trip. Under this scenario, respondents would be more likely to consider the different aspects—comfort, service, convenience and amenities—of the air travel experience, as opposed to short-haul flights where most of these are considered unimportant (Hunt & Truong, 2019). Hence, the experiment was contextualized by assuming a longer, international flight setting to give more relevance to varying attributes of flight selection. Respondents were offered three airline alternatives, each applying one of the three pricing policies discussed above – "standard", "threshold body weight", and "unit body weight". The alternatives further differed in terms of service (such as in-flight meal and entertainment, on-time performance), sustainability practice, and price. Table 2 reports the attributes and attribute levels considered for the three pricing policies included in the stated choice experiment. The selection of the attributes "share of extra profit devoted to CO_2 reduction" and "discount light luggage" was motivated by the focus of the research, whereas the current literature informed the identification of the attributes related to price, in-flight entertainment, in-flight meal, and on-time punctuality. The price range was decided to reflect the average range of prices for medium-haul flights departing from the major international airports in the US. Information about the actual weight of the respondents was collected in the survey and used for the calculation of weight-based ticket pricing in the choice experiment. In this context, the

Table 1
Air passenger mass policies tested in the study.

"Standard" policy	Price includes 50 lb. of checked-in luggage and a carry-on.
"Threshold body weight" policy	Price includes 50 lb. of checked-in luggage and a carry-on. Passengers exceeding 160 lb. of body weight are subject to an extra charge per every additional lb.
"Unit body weight" policy	Price includes 50 lb. of check-in luggage and a carry-on. An individual price is calculated per lb. of body weight. A discount is applied for lower weight luggage.

Note: 1 lb (lb) = 0.45 kg (kg).

online setting reduced the possibility to understate own weight due to social desirability (Burke & Carman, 2017).

The formation of the hypothetical alternatives involved a two-step procedure. First, a pilot survey was conducted among 50 people applying fractional factorial experimental design. The pilot survey allowed the researchers to validate the questionnaire and acquire preliminary information on travel preferences. Second, a D-efficient experimental design (Rose & Bliemer, 2009) was generated for the main survey by using the estimates from the pilot survey data. Both experiments used in the pilot and main survey were generated through the software Ngene. The final experimental design comprised 18 choice tasks, which were randomly divided into three blocks of six choice tasks each. For each choice task, respondents needed to choose their preferred option, which belonged to one of the three policies described in Table 1. The unit-based pricing was presented with the option of reducing the luggage weight to save on the ticket price. Fig. 1 illustrates an example of a choice card, where the displayed prices refer to a person with body weight equal to 170 lb. Additionally, to profile the respondents, the survey collected personal information, such as gender, education, and income. Respondents' age was registered before the start of the survey to limit the compilation to adult population.

Human research ethics approval was gained from the Institutional Review Board of the University of Central Florida, under the approval ID: STUDY00005769. The data were collected among adult residents in the United States who have taken at least one flight in past years. The data collection for both the pilot (conducted in the first week of July 2021) and the main studies (conducted in the last week of July 2021) was administered by Qualtrics through online panels. The sampling platform of this professional survey company ensures an adequate representativeness of the U.S. population's demographics (Heen et al., 2014; Boas et al., 2020). Additionally, the application of selection screeners at the beginning of the survey further ensured that the collected sample reflects the intended target population (Arndt et al., 2022). To minimize satisficing behavior, the survey company discarded responses from individuals who completed the questionnaire in an unreasonable amount of time. In particular, the survey for the main study was distributed to 1050 respondents, which resulted in 1012 complete responses. Respondents took, on average, 13 min (median equal to 9 min) to complete the survey.

3.2. Method

Given that weight-based pricing is not currently practiced in the real market, the study adopted the stated preferences method. Indeed, the application of stated choice experiments allow the investigation of potential market for new products (Kemperman, 2021) and inexperienced product characteristics that are currently not available to respondents (Vedel, Jacobsen, & Skov-Petersen, 2017). Hence, the experiment was purposely designed to enable respondents to identify weight-based pricing schemes and compare them with the standard pricing.

The modeling of stated preference data relies on the random utility model framework (McFadden, 1973), which assumes that individual *n* chooses the alternative *j* that provides the greatest utility. The utility function for alternative *j* is specified as follows:

$$U_{nj} = V_{nj} + \varepsilon_{nj} = \sum\nolimits_k \beta_k x_k + \varepsilon_{nj} \tag{1}$$

where V_{nj} is the observable part (i.e., systematic utility), and ε_{nj} is the unobservable part (i.e., error term). Systematic utility is typically defined as a linear-in-parameters (β_k) function of the alternative's attributes (x_k). Each coefficient β_k represents the marginal utility associated with the alternative attribute x_k, that is the change in total utility given a unit increase in the attribute. Therefore, the systematic utility associated with the four alternatives presented in the stated choice experiment proposed in the current study is specified as follows:

$$V_{nj} = \beta_{ASCj} + \beta_{IE_l} IE_l + \beta_{IM_l} IM_l + \beta_{OP} OP + \beta_{CO_2} CO_2 + \beta_{D_{UW}} D_{UW} + \beta_{P_j} P_j \tag{2}$$

where, β_{ASC_j} is the alternative-specific constant introduced in *j-1* alternatives. Only differences matter in a discrete choice model (Train, 2009); thus, the constant term and any alternative invariant attributes can be introduced in *j-1* alternatives only. The coefficients associated with the alternative attributes, β_{IE_l} and β_{IM_l} refer to the marginal utility of the level *l* of the categorical attributes "in-flight

Table 2

Attributes and levels for the stated choice experiment.

Attribute	Attribute levels			
In-flight entertainment	Not provided; Standard quality; Premium quality			
In-flight meal	For purchase only; Food and soft drinks; Food, soft drinks and alcoholic drinks			
On-time performance	65% punctual; 80% punctual; 95% punctual			
Pricing	*Standard*	*Threshold*		*Unit body*
		wt < 160 lb	*wt > 160 lb*	
Level 1	\$680	\$680	680 + (wt – 160) × 5	wt × 4.25
Level 2	\$800	\$800	800 + (wt – 160) × 7	wt × 5.00
Level 3	\$920	\$920	920 + (wt – 160) × 9	wt × 5.75
Share of extra profit devoted to CO2 reduction (1)	None; 40%; 80%			
Discount light luggage (2)	\$40; \$60			

(1) Applies to "threshold" and "unit weight" pricing options only.

(2) Applies to "unit weight" pricing option only.

	Airline A: Standard pricing	Airline B: Threshold pricing	Airline C: Unit weight pricing	
Check-in luggage	Regular size (50 lb.)	Regular size (50 lb.)	Regular size (50 lb.)	Small size (25 lb.)
Threshold / Unit price		USD 680	USD 4.25 per pound	
In-flight entertainment	Standard quality	Standard quality	Not provided	
In-flight meal	Food and soft drinks	Food, soft drinks and alcoholic drinks	Food and soft drinks	
On-time performance	65% punctual	95% punctual	80% punctual	
Share of extra profit devoted to carbon offset		None	80%	
Price	USD 920	USD 870	USD 850	USD 920
Preferred option:	□	□	□	□

Fig. 1. Choice card example.

entertainment" (IE) and "in-flight meal" (IM), respectively. The coefficient β_{OP} reflects the marginal utility of the attribute "on-time punctuality" (OP), whereas β_{CO_2} is the marginal utility of the attribute "share of extra profit devoted to carbon offset" (CO_2), which is introduced in the systematic utility for threshold pricing and unit weight pricing alternatives only. The attribute "discount for light baggage" (D_{UW}) is only introduced in the systematic utility for unit weight pricing (luggage 25 lb.) alternative and the marginal utility is captured by the coefficient $\beta_{D_{UW}}$. It is assumed that individuals have different sensitivity to the price (P_j) of the alternative pricing policies. Hence, the alternative-specific price coefficient β_{P_j} captures the marginal utility associated with the price of the three pricing schemes, namely, standard pricing, threshold pricing, and unit weight pricing.

The following empirical application relies on the estimation of random parameter logit models, which allow for the identification of both random and systematic preference heterogeneity across the sample (Hensher & Greene, 2003). In particular, each coefficient β in Equation (2) is individual specific (β_n) and specified as follows:

$$\beta_n = \overline{\beta} + \delta_p w_{pn} + \sigma \eta_n \tag{3}$$

where, $\overline{\beta}$ refers to the mean of the coefficient. Systematic heterogeneity is captured by the coefficient δ_p associated with the *p-th* observed individual variable (w_{pn}), whereas random heterogeneity is captured by the coefficient σ which is associated with a random term (η_n), here assumed normally distributed, with mean zero and standard deviation equal to one.

Taking into consideration the specification of random parameters and the multiple choice tasks collected for each respondent, the choice probability associated with respondent n for alternative i in choice task s is defined as follows:

$$P_{nis} = \int_{\beta} \prod_s \frac{exp(V_{nis})}{\sum_j exp(V_{nis})} f(\beta) d_{\beta} \tag{4}$$

The integral in equation (4) does not have a closed form and the estimation of the model coefficients relies on the maximization of the following simulated likelihood function (LL_n):

$$LL_n = \sum_n ln \frac{1}{R} \sum_r \prod_s \frac{exp(V_{nis})}{\sum_j exp(V_{nis})} \tag{5}$$

where r = 1, …, R denotes the number of draws used in the simulation, s = 1, …, 6 denotes the number of choice tasks, and V_{nis} refers to the systematic utility function specified in Eq. (2) with each coefficient β defined as in Eq. (3).

Given that the model estimate associated with a given attribute x (β_x) represents the marginal utility ($MU_x = \beta_x = \partial U/\partial x$), the ratio between two coefficients reflects the marginal rate of substitution. Therefore, the presence of the coefficient associated with the price attribute allows the derivation of willingness to pay $\left(WTP_{x,price} = \frac{\partial U/\partial x}{\partial U/\partial price} = \frac{\beta_x}{\beta_{price}} \right)$ measures.

4. Results

4.1. Sample statistics

The sample was initially analyzed through descriptive statistics of respondents' characteristics and choice statistics associated with the alternative pricing policies proposed in the stated choice experiment (Table 3). Respondents are mostly males (60.2%) and above 36 years of age (70.5%). A considerable share of the sample holds a postgraduate degree (31.3%) and revealed an annual household income greater than US$90,000 (37.8%). A consistent number of respondents (41.7%) took, on average, more than three flights a year before the COVID-19 pandemic, whereas 11.4% travelled frequently (more than eight flights a year) by air. Overall, in our sample 21% of respondents stated that they flew mainly business, 63% mainly leisure, and 15% of respondents flew equal amount for leisure and business purposes. This result is in line with the report of Airlines for America (2023), which registered a 24% business and 76% leisure flight ratio in the U.S. population. Moreover, 74,4% of the sample reported to have experienced 5–8 h and/or more than 8 h long flights for leisure purposes. While technically these lengths of flights could be domestic in the US context, the long flight experience of respondents should contribute to their understanding and assessments of the choice scenarios applied for the minimum 5-hours long international flights.

The average body weight in the sample is equal to 176.9 lb with a moderate variation (standard deviation equal to 51.6 lb) across respondents. These data reflect the average weight of 181 lb registered among all U.S. adults (Gallup, 2021). In line with the statistics on the average height among the U.S. population (5′4′' for women and 5′9′' for men; CDC (2021)), the sample statistics indicate an average height in the range 5′4′' to 5′5′' for women and 5′8′' to 5′9′' for men. Overall, 18.7% of the respondents reported a height above 6′0′', and, as expected, weight increases as height increases. Differences in body weight are also observed across gender and age groups, whereas similar values are registered among respondent education, income and air travel experience. This is confirmed by the correlation statistics reported at the bottom of Table 3. The highest correlations are observed between height and gender (0.594) and between weight and height (0.422). Relatively moderate correlations are registered between weight and gender (0.297) and between weight and age (−0.164).

Regarding respondents' perceptions on the three pricing policies tested in the study, fairness was measured on a 7-point Likert scale. Aggregating the answers from 4 (neutral) to 7 (fair), the three pricing policies were not perceived unfair by most of the respondents. The standard policy was not evaluated unfair by 81% of respondents, followed by unit-weight policy (62%) and the

Table 3
Sample statistics.

	Freq.	Weight	Choice statistics			
			Standard	Threshold	Unit	Unit light
All sample (n = 1012)			40.5%	26.2%	21.4%	11.9%
Weight (m = 176.9, s = 51.6)						
Up to 160 lb.	44.4%		28.3%	29.6%	26.7%	15.4%
Above 160 lb.	55.6%		50.2%	23.5%	17.2%	9.1%
Up to 130 lb.	22.0%		25.0%	27.4%	30.2%	17.5%
130 lb. to 160 lb.	22.3%		31.6%	31.9%	23.3%	13.3%
160 lb. to 190 lb.	25.0%		42.6%	26.8%	19.7%	10.9%
190 lb. to 220 lb.	15.8%		59.5%	19.6%	14.7%	6.3%
Above 220 lb.	14.8%		53.3%	22.1%	15.6%	9.0%
Height						
5′0′' to 5′4′'	21.6%	147.7	34.3%	26.2%	24.7%	14.8%
5′4′' to 5′8′'	31.9%	167.4	34.6%	28.7%	22.8%	13.9%
5′8′' to 6′0′'	27.8%	189.9	47.1%	23.7%	19.5%	9.7%
6′0′' to 6′4′'	15.3%	205.9	51.1%	25.7%	16.1%	7.1%
6′4′' to 6′8′'	3.4%	216.2	33.8%	25.5%	27.0%	13.7%
Gender						
Female	39.8%	158.1	35.8%	28.2%	22.3%	13.7%
Male	60.2%	189.4	43.6%	24.9%	20.8%	10.7%
Age						
Under 36 years	29.5%	163.9	25.8%	32.3%	27.8%	14.1%
36 years or more	70.5%	182.4	46.7%	23.7%	18.7%	10.9%
Education						
Up to Undergrad	68.7%	175.2	39.5%	27.0%	21.5%	12.0%
Postgraduate	31.3%	180.7	42.6%	24.6%	21.2%	11.7%
Income						
Below $90,000	62.2%	176.2	38.2%	26.5%	22.6%	12.7%
$90,000 or more	37.8%	178.1	44.3%	25.7%	19.5%	10.6%
Flights per year						
Up to 8 flights	88.6%	176.8	40.6%	26.3%	21.3%	11.8%
8 flights or more	11.4%	178.4	40.0%	25.4%	22.5%	12.2%
Correlations	2.	3.	4.	5.	6.	7.
1. Weight	0.422	0.297	–0.164	0.049	0.067	0.010
2. Height		0.594	–0.066	0.143	0.142	0.059
3. Gender (Male)			–0.168	0.201	0.224	0.056
4. Age (Under 36)				–0.134	–0.315	–0.020
5. Education (Postg.)					0.376	0.080
6. Income						0.148
7. Flights/year (≥ 8)						

Note: 1 feet (ft) = 30.48 cm (cm); 1 in. (in) = 2.5 cm (cm).

threshold policy (55%). Comparing this data to previous literature, Bhatta (2013) reported different survey results in which pay-per-weight pricing policy was supported by 40% to 80% of the respondents.

Furthermore, the choice statistics for the four alternatives (three pricing policies and the discounted unit-based option) proposed in the choice experiment provide preliminary insights into the respondents' preferences for weight-based pricing policies. In general, the standard pricing policy was selected in 40.5% of the 6,072 choice tasks, whereas the weight-based pricing options were selected in the remaining choice tasks (26.2% for threshold pricing, and 33.3% collectively for unit weight pricing). This suggests that both standard and weight-based pricing alternatives were considered by respondents. However, respondents weighing above 160 lb selected the standard policy 77 percent more frequently (50.2%) than respondents weighing up to 160 lb (28.3%). A more granular categorization of the body weight confirms that as the body weight increases the selection of the standard pricing policy increases, whereas the shares of the weight-based pricing policies decrease. Nevertheless, the share of the threshold pricing policy, which explicitly penalizes heavier people, does not drop drastically among the heaviest segments (i.e., 190 lb to 220 lb, and above 220 lb) as this policy was selected in 19.6% and 22.1% of the choice tasks, compared to an average of 29.6% for respondents with body weight under the threshold of 160 lb.

Similarly, the classification of choice statistics according to individual characteristics depicts high shares of standard pricing policy for tall respondents (51.1% for the height range 6′0’ to 6′4’’), male respondents (43.6%), and middle age/senior respondents (46.7%), with the latter experiencing the highest variability. In fact, while the difference in weight between female and male is larger than that between young and middle age/senior respondents, the share of standard pricing policy is considerably lower among young respondents (25.8%) than among female respondents (35.8%). Instead, the classification of the sample according to variables such as education, income and air travel experience indicates similar shares of the four alternative pricing policies within variable groups.

4.2. Model estimates

The modeling approach involved the estimation of a random parameter logit model allowing for random preference heterogeneity and further explaining sources of heterogeneity with observed individual characteristics (reported in Table 3). In particular, following the descriptive analysis provided in the previous section, several variables were tested to explain the heterogeneity in the model attributes and alternative specific constants, previously described in Table 2. The constant term for the Standard pricing alternative is

Table 4
Model results.

	Model coefficients			
	β	**(t-ratio)**	**σ**	**(t-ratio)**
Constant (Ref: Standard)				
Threshold	–1.404	(7.07)		
Under 36 y.o.	0.842	(9.58)		
Unit weight	–2.479	(–5.21)	1.468	(18.69)
Under 36 y.o.	1.030	(7.04)		
Unit weight light	–4.009	(–7.10)	2.062	(17.53)
Under 36 y.o.	0.905	(4.40)		
In-flight entertainment (Ref: NA)				
Standard	0.228	(4.36)		
Under 36 y.o.	–0.287	(–3.19)		
Premium	0.305	(5.57)		
Under 36 y.o.	–0.268	(–2.85)		
In-flight meal (Ref: Purchase only)				
Meal and drinks	0.232	(5.34)	0.211	(1.64)
On-time punctuality	0.021	(10.77)	0.020	(6.94)
Under 36 y.o.	–0.011	(–3.11)		
Share of extra profit to CO2 offset	0.005	(1.73)	0.015	(15.17)
Body weight [(1)]	–0.0047	(–2.89)		
Frequent traveler	0.004	(1.67)		
Discount unit weight light luggage	0.004	(0.68)		
Price (Standard policy)	–0.0060	(–10.38)		
Body weight [(1)]	0.0015	(7.07)		
Price (Threshold policy)	–0.0044	(–10.21)		
Body weight [(1)]	0.0013	(9.37)		
Price (Unit policy)	–0.0039	(–6.68)		
Body weight [(1)]	0.0011	(6.03)		
Log-likelihood (model)	–6898.2			
Log-likelihood (constants)	–8417.6			
McFadden Pseudo R^2	0.181			
Individuals	1012			
n	6072			
Number of parameters (k)	28			

Notes:
[(1)] pounds / 100.

normalized to zero, whereas the constant term for the other three alternatives, namely Threshold, Unit weight, Unit weight light, are estimated. Only statistically significant random preference heterogeneity and statistically significant interaction terms were included in the selected model. Table 4 reports the model results estimated in Nlogit 6.0 using 1,500 draws from the Halton sequence (Train, 2009).

Preliminary analysis indicated the indifference between the coefficients associated with the two levels of in-flight meal "Food and soft drinks" and "Food, soft drinks and alcoholic drinks". Therefore, the two levels are combined into a unique attribute (i.e., "Food and drinks"). The McFadden pseudo R^2, defined as $1 - \frac{LL_{Model}}{LL_{Constants}}$, is used to compare the overall performance of the models as it relates the log-likelihood for the full model to the log-likelihood for the model with only the alternative specific constants. The model estimates confirm the significance of the mean (β) coefficients for most of the attributes considered in the choice experiment and indicate the presence of random preference heterogeneity (σ) in the sample for the alternative specific constant associated with the unit body weight pricing and for the attributes "in-flight meal", "on-time punctuality" and "share of extra profit to CO2 offset".

Deterministic preference heterogeneity across the sample is significantly explained by the respondents' body weight (metric variable expressed as pounds divided by 100), age (binary variable distinguishing respondents under 36 years of age, or otherwise), and air travel experience (binary variable distinguishing respondents who traveled by air more than 8 times per year).

The negative sign of the constant terms associated with pricing options based on passenger body weight indicates a general preference for the standard pricing. This result reflects the tendency to choose the alternative framed as the status quo (Samuelson & Zeckhauser, 1988). A significant random preference heterogeneity is registered for the unit weight pricing alternatives, which is partly explained by the age of the passengers. Participants' general aversion to the unit weight pricing policy increases, as their body weight increases. Similarly, the preference for the standard pricing policy over the weight-based pricing policies is significantly lower among young (under 36 years of age) participants.

The alternative-specific price coefficients reveal that the standard pricing policy is, on average, associated with a higher price sensitivity than the body weight pricing options. Results further indicate that the body weight of the respondents negatively affects the price sensitivity and its effect is different across the pricing policies. In particular, for an average person weighing 160 lb, the price responsiveness on the threshold pricing and unit weight pricing policies is respectively, -0.0024 ($-0.0044 + 0.0013 \times 1.60$) and -0.0021 ($-0.0039 + 0.0011 \times 1.60$), that is 36% and 44% lower than the price responsiveness on the standard pricing policy, which is equal to -0.0037 ($-0.0060 + 0.0015 \times 1.60$). Furthermore, a person weighing 190 lb is 14% less sensitive to the price of the standard policy than a person weighing 160 lb, and 19% less sensitive to the price of the threshold pricing and unit weight pricing.

Regarding the in-flight services and flight performance, the model estimates indicate a pattern in line with expectations, that is, a preference for the availability of in-flight entertainment and meals as well as for on-time performance. Interestingly, the preferences for in-flight entertainment and on-time performance attributes are significantly different across young and middle age/senior respondents. Young respondents are somewhat adversely affected to standard quality in-flight entertainment ($0.228 - 0.287 = -0.058$) and express only a slight preference for premium quality in-flight entertainment ($0.305 - 0.268 = 0.037$) as compared to the absence of any in-flight entertainment. Similarly, young respondents demonstrate a lower preference toward on-time flight performance (marginal utility equal to 0.010) than middle age/senior respondent (0.021). Instead, the attribute related to in-flight meal does not exhibit any deterministic heterogeneity, but only random heterogeneity. The lower sensitivity of young respondents toward service quality attributes indicates that this market segment has a lower willingness to pay compared with the middle age/senior market segment. Furthermore, due to the differences in the price responsiveness across pricing policies, the pricing based on body weight is associated with a higher willingness to pay than the standard pricing. In particular, considering a person weighing 160 lb, the willingness to pay for premium in-flight entertainment on a standard pricing policy flight is, on average, $82 for the middle age/senior segment and $10 for the young segment. The willingness to pay for a threshold (unit) pricing policy flight increases to about $129 ($146) and $15 ($18) for the middle age/senior and young segments, respectively. Given that body weight significantly mitigates the price coefficients, the willingness to pay increases as the weight increases. That is, for a middle age/senior person weighing 190 lb, the willingness to pay for premium in-flight entertainment is, on average, $11 to $28 more than for a person weighing 160 lb. Similarly, under a standard pricing policy, the availability of in-flight meal items is valued about $63 by people weighing 160 lb as opposed to $71 for people weighing 190 lb. Regarding the on-time performance, a middle age/senior person weighing 160 lb. (190 lb.) would, on average, be willing to pay $5.6 ($6.3) on standard pricing policy, and $8.7 ($10.4) and $9.9 ($11.8) on the threshold pricing and unit weight pricing policy, respectively, for a one-percent increase in the punctuality of the flight. These values approximately halve for young people.

With regards to the private benefits derived from the passenger weight-based pricing policies, the results indicate high heterogeneity in the preference for the allocation of extra profit to CO_2 offsetting initiatives. Moreover, the valuation of this feature significantly depends on the body weight and air travel experience of the respondents. In particular, the implementation of green initiatives by an airline positively affects the preferences of people, of any size, that travel frequently by air (i.e., more than 8 flights per year), though the effect is relatively small and diminishes as passenger weight increases. For example, a person with high air travel experience weighing 160 lb is willing to pay about $30 for an increase of 50% in the share of airline's extra profit dedicated to carbon offsetting, which decreases to about $1.5 for a person weighing 190 lb. This result suggests that, despite the significant divergence across the sample, the concept of social preferences has a marginal role in directing traveler choices towards pricing policies that account for environmental concerns. Regarding the prospect of a discount on light baggage for the unit weight pricing policy, the increase of up to $60 in the ticket price in exchange for a 50% reduction in the weight of the checked-in luggage does not attract significant interest as indicated by the mean coefficient.

To gain further insights from the model results, a what-if analysis was conducted by considering three pricing interventions. In particular, the analysis aims at assessing the change in the choice probabilities resulting from either (1) a 20% increase in the price of the standard pricing policy, (2) a 20% decrease in the price of the threshold body weight pricing policy, and (3) a 20% decrease in the price of the unit body weight pricing policy. The first intervention simulates an increase in the taxation associated with the standard pricing, whereas the second and third interventions simulate an incentive toward the use of pricing schemes that improve the fuel consumption efficiency of airlines.

Table 5 reports the results for the what-if analysis. A 20% increase in the price of the standard pricing policy would decrease the respective alternative share by 16.2% (from 40.5% to 24.3%) and lead to an increase of 8.5% and 7.7% in the shares of the threshold body weight and unit body weight pricing policies, respectively. Instead, a 20% decrease in the price of the threshold body weight pricing policy would increase its share by 15.2%. However, the increase in the market share is partially offset by the unit body weight pricing policy which decrease its share by 5.5% overall, whereas the standard pricing policy would decrease by 9.7%. Similarly, a 20% decrease in the price of the unit body weight pricing policy would increase its share by only 10.7%, of which 4.0% to the expense of the threshold body weight pricing policy.

5. Implications and conclusion

The aim of this study was to investigate passenger preferences towards airlines adopting different pricing based on passenger body weight. In particular, two variations of weight-based pricing were tested with the standard pricing policy. While previous research of Bhatta (2013) described the underlying principles of these policies, according to authors' knowledge, this study represents the first attempt to test individual preferences related to weight-based airline pricing policies. In particular, a random parameter logit model was estimated aimed at explaining the heterogeneity in passengers' choices through individual characteristics such as body weight, age, and air travel experience. Therefore, it contributes to current literature on airfare selection by assessing passengers' preferences for alternative pricing policies. The results imply that the US sample prefers the status quo of current practices with standard pricing. Not surprisingly, the preference for body weight pricing is negatively affected by weight; the heavier participants are, the less they select body weight pricing. Yet, the fact that the model estimates are significant and in line with the expectation (e.g., positive sign for quality attributes and negative sign for price) indicates that respondents considered every attribute proposed in the experiment when making trade-offs among alternatives and provides evidence about the rationality of the interviewees' responses. Indeed, looking at the alternative pricing policies collectively (threshold, unit-based and discounted unit-based), they have been selected in 60% of choice tasks. In case of respondents weighting above 160 lb, any alternative policy was selected in 49% of the choice tasks. Therefore, while heavier respondents selected alternative polices less frequently than lighter ones, this result explains the importance of other attributes in comparison to weight-based pricing policies.

Results related to the price sensitivity of different policies provided interesting insights. Alternative pricing schemes based on body weight were associated with lower price sensitivity. In terms of heterogeneity in the sample, the price sensitivity was even lower for heavier participants throughout all three pricing policies, meaning that they preferred the standard pricing option even if it was less convenient. Therefore, the selection of alternative pricing policies was not supported by economic reasoning. The assumption is that heavier people rejected the principle of being measured and prefer to pay the cost of avoiding it.

To further examine this result, a what-if analysis was conducted on the model estimates. In order to incentivize weight-based pricing policies, effects of three interventions were simulated. The first one looked at a 20% increase in the standard price, while the second and third simulations applied a 20% decrease in the weight-based pricing schemes separately. The biggest influence was provided by the 20% increase in the price of the standard pricing policy, which would lead to a 16% decrease in the share of people selecting such an alternative. The 20% price increase could be associated with an environmental tax to airlines that do not further optimize their fuel consumption.

Regarding the share of extra profit related to CO_2 reduction of weight-based policies, respondents' preferences were assessed within the choice experiment, providing a further extension to literature on environmental attitude and air travel behavior. In line with previous research, the environmental initiative investigated in this study had marginal effect on airline selection (Hagmann et al., 2015). The concern with sustainability was even less relevant for heavier participants. Therefore, pro-environmental concern does not explain the higher price sensitivity of heavier participants for alternative policies. In reality, airlines apply an average weight per passenger, therefore, the true cost of flying is compensated by passengers below this average weight for heavier fellow passengers. And interestingly, in this study the lighter participants are those passengers, who value carbon offsetting more than their heavier peers. Furthermore, frequent travelers (8 flights per year or more) give more importance to this aspect than the rest of the sample. This could be explained by feelings of guilt due to their above-average consumption and emission. Despite this, still only a few passengers carbon

Table 5
Choice probabilities for pricing interventions.

	Alternatives			
	Standard Share (%)	**Threshold** Share (%)	**Unit** Share (%)	**Unit (small)** Share (%)
Baseline	40.5%	26.2%	21.4%	11.9%
Scenario				
1. Standard: Price + 20%	24.3%	34.7%	26.4%	14.6%
2.Threshold: Price – 20%	30.8%	41.4%	17.7%	10.1%
3. Unit: Price – 20%	33.8%	22.2%	28.7%	15.3%

offset their flights according to both the media (CNN, 2022), literature (Hinnen, et al., 2017; Ritchie et al., 2021) and industry survey results (Airlines for America, 2024). Similarly, the willingness to pay for sustainable initiatives of airlines expressed by a low portion of respondents both in this study and in the results of the above-mentioned industry survey. Overall, the social benefits of pay-per-weight pricing seemed to receive less importance in passengers' preferences. While the introduction of this policy was based on the issue of sustainability, the actual preferences are motivated by individual gains. However, with the increasing number of policies to mitigate the effects of climate change, passengers will need to further contribute to carbon offsetting caused by their air travel.

Regarding the in-flight product, the option to add alcoholic drinks to in-flight meal showed little interest. A possible explanation could be the social desirability bias, meaning that respondents would understate their preference for alcohol due to the social undesirability of alcohol consumption. In line with Poria and Beal's (2017) research, some obese passengers prefer not to eat and drink on the airplane to avoid further discomfort. Indeed, body weight was not associated with a significant increase in the preferences for in-flight meals. Regarding in-flight entertainment, younger passengers showed lower interest. Access to online entertainment is part of daily life of younger generations, which explains the lower need and willingness to pay in the airline context.

This study also provides practical contributions to the well-debated topic on introducing weight-based pricing by airlines. The analysis reveals the acceptance and preferences related to airline selection within this topic by the US population. If the unit weight pricing policy is taken up by some airlines, the implications are straightforward. Lighter, younger, more environmentally conscious passengers who give higher consideration to carbon offsets and are less sensitive to price, would more likely select these airlines. The fact that these are preferences among younger consumers may be a sign of future demand in the airline industry, and may thus be useful to airlines looking to better attract and cater to potential future consumer groups. The willingness to pay of passengers for different attributes can guide possible policy implementation on various issues including taxation, forced carbon offsets or other legislation.

While for some the pay-per-weight scheme can be perceived as incentive-based pricing, in this study it is reflects the polluter pays principle. Passengers should pay according to their pollution to the environment. The idea of paying according to an individual's weight is in line with what implicitly occurs in the use of private automobiles. As Jacobson and Mclay (2006) calculated, 39 million gallons of fuel are estimated to be used annually for each additional pound of average passenger weight in automobiles. The heavier the driver, the more petrol the car consumes, therefore heavier people pay more for car travel. In the airline industry, the confidential reporting of passengers' weight can generate environmental savings. As introduced in the choice experiment, the additional economic benefits could be used for carbon offsetting.

The paper touches upon critical issues for society; transport emissions and obesity rates in the population. The economic impact of obesity on fuel consumption has been demonstrated in the automobile (Jacobson & McLay, 2006) and airline (Melis et al., 2019) industry in the literature. Notably, in comparison to ground-level emissions, the impact per kilogram of airplanes' high-altitude emissions on climate change is about twice as much (Lee et al., 2004). By applying pay-per-weight pricing, emission reduction should happen in three ways: (1) by knowing the exact weight on board, planes would need to carry less fuel, (2) passengers would aim to bring less weight on board, and (3) airlines could spend a share of additional profit on decarbonization. Regarding the first point there are industry estimates on the effects of measuring passengers. The second point would encourage a behavioural change of passengers, while the third would demonstrate further commitment of airlines towards sustainability. Therefore, this paper aids the discussion on this sensitive topic among airlines and policy makers.

5.1. Limitations and further research

While the implementation of these pricing polices was not the scope of this study, its importance calls for further research. As Bhatta (2013) explains, the high transaction costs and practical issues related to implementation are crucial limitations of weight-based pricing policies. Measuring people and adjusting price at the moment of check-in or embarking would require additional time and resources at the airport. However, with technological development, passenger mass calculations could be delivered automatically with pressure pads (Calder, 2023). Furthermore, the facilitation of fee adjustment to actual weight versus self-reported weight could be handled with tolerance thresholds. Although Bhatta (2013) suggests the fairest treatment would be to apply pay-per-weight policies with seat adjustments, this experiment did not explore the compensation of more seat space for a higher airline fare, which would be possible with a flexible airplane seat design. Within the policy formulation of body weight pricing, a framework based on incentives instead of penalties could be explored and compared in future research, and could further advance the understanding of psychological approaches in pro-environmental decisions. This study did not include carry-on luggage as part of the experimental design. Thus, future studies may include modelling where passenger weight, carry-on luggage weight and checked-in luggage weight are introduced as separate variables. Moreover, estimating of carbon dioxide reductions as a result of different passenger policy alternatives is a valuable consideration for future research. This should consider potential changes in the average payload as well as changes in terms of contributions to carbon offsetting projects. While the sample explored the preferences of US citizens, future research could extend to other aviation markets, comparing the results across different countries and economies. More than half of the participants were overweight or obese in the sample. While this percentage is in line or even slightly better than official public health statistics in the US, studies in economies with different public health characteristics (lower average weight) may lead to different results, caused by financial advantages or more pro-environmental attitudes. Finally, the data were collected during the summer of 2021, when Covid-19 was present for more than a year. As the pandemic had a strong influence on travel behavior, it might have affected the responses collected for this study.

CRediT authorship contribution statement

Lorenzo Masiero: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Judit Zoltan:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Denis Tolkach:** Writing – review & editing, Conceptualization. **Stephen Pratt:** Writing – review & editing, Conceptualization. **Matias Thuen Jørgensen:** Writing – review & editing, Conceptualization. **Markus Schuckert:** Writing – review & editing, Conceptualization. **Kaye Chon:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

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