Do social norms regarding carbon offsetting affect individual preferences towards this policy? Results from a stated choice experiment

Yashar Araghi [*], Maarten Kroesen, Eric Molin, Bert van Wee

Faculty of Technology Policy and Management, Delft University of Technology, Jaffalaan 5, 2628 BX, Delft, The Netherlands

ARTICLE INFO

ABSTRACT

This study investigates the idea that people's willingness to offset flight-related carbon emissions is a function of the collective participation rate, which can be regarded as a social norm, towards carbon offsetting. Additionally, we reveal people's preferences toward two other environmental policies; a baggage allowance and airline eco-efficiency index. A discrete choice experiment is designed and administrated among a sample of air travelers. The results indicate that carbon offsetting generates utility, with people gaining more utility when the collective participation rate is high. Additionally, it was found that the baggage allowance and the eco-efficiency index strongly influenced respondents' airline choices. People also became more sensitivity towards a baggage allowance and the eco-efficiency label, when the collective offsetting rate was high.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

Despite continuing improvements in aircraft technology the expected growth of air travel will likely lead to increasing emissions to the environment. To reduce emissions, various polices can be implemented, ranging from measures that focus on airlines – e.g. the European Emission Trading System (EU ETS), to individual-based measures that directly target air travelers, such as voluntary carbon offsetting (VCO) schemes. Since the success of the latter policies depend on the degree of voluntary participation or compliance of passengers, knowledge about people's preferences towards such policies is necessary.

Previous studies that have primarily focused on willingness to pay for carbon offsetting have found that generally people gain utility from offsetting. In practice, however, offsetting rates are generally only in the range of two to ten percent (Gössling et al., 2009; Mair, 2011). This difference may be because people are only willing to contribute if others do as well.[1] Here we test the idea that the collective participation rate in carbon offsetting positively influences passengers' willingness to participate in such schemes. We also look at people's stated preferences regarding baggage allowances and an airline eco-efficiency label.

To achieve this, a choice experiment (CE) is designed and administrated among a sample of air travelers at two Dutch airports. While CEs have advantages as well as disadvantages compared to other valuation methods such as contingent valuation, an important advantage here is that they allow a valuation of several attributes at the same time.

---

* Corresponding author. Tel.: +31 645388716.
 E-mail address: y.araghi@tudelft.nl (Y. Araghi).

[1] MacKerron et al. (2009) and Brouwer et al. (2008), for example, find that many people would only be willing to pay or participate if they knew that other fellow passengers would also participate.

2. Airline environmental policies

Three environmental policies are selected for inclusion in the choice experiment.

- *Voluntary carbon-offset*

By implementing a VCO policy, airlines provide an opportunity for passengers to voluntarily offset the carbon emissions associated with their flight. The offsetting costs are usually calculated by multiplying the estimated CO_2 emitted during the particular flight by a fixed price per ton of CO_2 emissions. The funds raised by offsetting can be used to finance initiatives that are known as 'sink' projects, such as afforestation and reforestation projects, or emissions-saving projects, such as fuel substitution and energy-efficiency projects.

While VCO schemes are increasingly popular by airlines, concerns have been expresses on limited potential and temporary nature of afforestation (i.e. considerable space would needed for an indefinite time to compensate for annual emissions) and the lack of transparency of offsetting schemes due to large differences in existing calculation and accreditation methods (Gössling et al., 2007; Mair, 2011). In addition, VCO schemes have been objected to on moral grounds. Offsetting can be seen as a simple solution to alleviate one's guilt and detract people from "real" solutions like flying less. Nevertheless, well-managed VCO schemes may reduce greenhouse gas emissions, raise public awareness about climate change, demonstrate people's support for environmental measures to policy makers, and (given the flexibility of the voluntary market) help channel investment into innovative and high-risk environmentally beneficial projects (MacKerron et al., 2009).

- *A baggage allowance*

A substantial amount of the payloads of airlines are in the form of passenger luggage. Fuel efficiency and consequently lower emission rates can be achieved by reducing the luggage carried by passengers (Lee et al., 2009). In this respect, Filippone (2008) has estimated that if the baggage allowance is reduced from 20 to 15 kg for a B737-500 flight over 1500 nautical miles, reduction in CO_2 emissions would be around 3.5 kg per person; 1.5% of total emissions for each passenger.

- *An airline eco-efficiency label*

Gössling et al. (2009) argue that if environmental efficiency of airlines is determined and communicated to air travelers in a transparent way, passengers may integrate this information in their choice for an airline. There have been some attempts to create a standard airline efficiency indexing system that could be used for the industry. For example, the Atmosfair Airline Index (Atmosfair, 2012) is a recognized labeling system that ranks airlines according to their efficiency using input on the types of aircraft used, seating capacities and load factors. Flybe is an example airline that has adopted eco-labels.

3. Methodology

3.1. Survey and experimental design

A choice experiment was introduced in which respondents were first asked to imagine taking a transatlantic flight from Amsterdam to New York. Next, the social norm towards carbon offsetting was introduced. Each respondent was randomly assigned to one experimental condition, i.e. one of three collective offsetting rates : 5%, 50% or 90%. Then the choice experiment was introduced with different unlabeled flight options that varied by ticket price and the three environmental policies. Ticket price was varied from €505 to €545 reflecting prevailing airline prices for economy class tickets on the Amsterdam–New York route. For the first policy attribute (i.e. individual carbon-offsetting), three levels were considered: no offsetting of the current flight (0%), partial offsetting (50%) and full offsetting (100%). Respondents were informed that the costs of carbon offsetting were included in the ticket price. For the baggage allowance policy, passengers were offered the chance to carry 10, 15 or 20 kg of luggage free. These weights were chosen based on typical weights provided by airlines for passengers to carry luggage without having to pay any extra charges. For the eco-efficiency index system, a simple labeling system is introduced, whereby airline efficiency varied over three levels: A (green airline), B (average airline) and C (grey airline).

Each respondent was presented with nine choices, and instructed to choose one flight option from each choice set. Ngene software (ChoiceMetrics Pty Ltd.) was used to construct the choice sets useing efficient designs.[2] To generate an efficient design, some preliminary, estimated values of coefficients are required, and these were taken from an earlier pilot study (Araghi, 2012) involving 80 respondents.

---

[2] Efficient experimental designs are preferred to the traditional orthogonal designs since they minimize the elements of asymptomatic variance–covariance (AVC) matrix resulting in smaller standard errors and increasing reliability of parameters estimated by the outcome of a choice experiment (Bliemer et al. 2009).

Table 1
Descriptive statistic.

Variable		%
Gender	Male	58.6
	Female	41.4
	<20	5.3
Age	20–40	49.0
	41–60	27.0
	>61	18.6
Education level	High school	14.5
	Professional training	11.2
	College or university	74.3
Number of return flights in the past year	3–5	26.7
	6–10	9.5
	>10	5.5
	Missing	12.0
Ever purchased a VCO in the past	No	89.3
	Yes	6.5
	Missing	4.2

Table 2
The effect coding scheme used for the context effect.

Contextual condition	Indicator 1	Indicator 2
Context 1 (collective offsetting rate = 5%)	1	0
Context 2 (collective offsetting rate = 50%)	0	1
Context 3 (collective offsetting rate = 90%)	−1	−1

3.2. Respondents

A survey conducted among people at Rotterdam and Schiphol airports[3] in the Netherlands in May 2013, which provided 261 useable responses. The survey was conducted at arrivals and departures and the respondents were chosen randomly at equal time intervals during the day. The final sample was slightly skewed towards younger age groups, with more than 49% of the respondents aged between 20 and 40. This, however, conforms with available population figures at these airports, which indicate that 46% of passengers fall within this range (Schiphol Group, 2012). Highly educated people were also strongly present in the sample; 74.3% either had a college or university degree. Again, this is in line with the general composition of passengers (Schiphol Media, 2011). Finally, the ratio of men and women was also in accordance with the population figures obtained from the airports; a 6:4 ratio.

Eighty-seven percent of respondents had undertaken at least one return flight in the past year and 2.7% were frequent flyers passengers, who flew more than 20 times in the preceding year. Six and a half percent of respondents indicated that they at some point offset their carbon emissions; a rate in line with Mair (2011). Table 1 summarizes the descriptive statistics.

3.3. Estimation procedure

To model the relationships between the attributes and people's choices a multi-nomial logit (MNL) model was estimated. The effects of the attributes were assumed to be linear. Two indicator variables were constructed using an effect-coding scheme (Table 2), to assess the influence of collective offsetting rates on respondents' choices. These indicators were interacted with each of the four attributes, leading to eight additional interaction effects. This means that the effect of each attribute on respondents' choices may differ for each contextual condition, representing the collective offsetting rates. In turn, such differences would imply varying passenger preferences towards the environmental policies across the social norms, indicated by different collective carbon offsetting rates.

4. Results

Before estimating the model with main and interaction effects, an initial model is estimated that includes only the main effects. Comparison of main effects model with the full model, using a likelihood-ratio test, indicates that the latter fits the data significantly better; i.e. generally the context indicators interact significantly with the four attributes.

---

[3] Rotterdam serves mainly to regional European destinations, whereas Schiphol Airport, located closely to Amsterdam, serves as hub for intercontinental flights as well as serving European destinations.

Table 3
The parameter estimates of the full MNL model.

Main effects	Estimate	t-Value
Ticket price	−0.0306	−18.83
CO_2 offset contribution	0.0055	11.35
Baggage allowance	0.1310	21.89
Eco-efficiency index of the airline	−0.1990	−7.75
Interaction effects		
Ticket price ∗ context 1 (5%)	0.0000	0.01
Ticket price ∗ context 2 (50%)	0.0092	4.09
Ticket price ∗ context 3 (90%)	−0.0092	
CO_2 offset contribution ∗ context 1 (5%)	0.0002	0.35
CO_2 offset contribution ∗ context 2 (50%)	−0.0011	−1.61
CO_2 offset contribution ∗ context 3 (90%)	0.0009	
Baggage allowance ∗ context 1 (5%)	0.0127	1.48
Baggage allowance ∗ context 2 (50%)	−0.0176	−2.10
Baggage allowance ∗ context 3 (90%)	0.0049	
Eco-efficiency label ∗ context 1 (5%)	−0.0077	−0.21
Eco-efficiency label ∗ context 2 (50%)	0.0775	2.12
Eco-efficiency label ∗ context 3 (90%)	−0.0698	
Model fit		
Initial log-likelihood	−2581.7	
Final log-likelihood	−2158.1	
Rho-square	0.164	

Table 3 shows the estimates of the full model. All four main effects are significant, with the baggage allowance having the strongest positive effect on people's utility. The ticket price is the next most important factor with an expected negative effect on utility, while the eco-efficiency index and passengers' carbon offsets, although having significant effects, are less strong. As expected, when the eco-efficiency of the airline decreases from A to C people, on average, lose utility. The effect of the CO_2 offset contribution is positive.

The interaction effects indicate that respondents' utility gain from individual offsetting is only marginally affected when the collective offsetting rate is 5% and positively affected when the collective offsetting rate is 90%. The utility gain of individual offsetting becomes lower when the collective offsetting rate is 50%. While it was expected that the preference towards offsetting would increase linearly with the collective offsetting rate, it seems that the actual relationship is curvilinear.[4]

The contexts do significantly interact with the baggage allowance and the airline eco-efficiency label. Similar to the interaction with the offsetting attribute, curvilinear relationships can be observed in the baggage attribute. Hence, with respect to the baggage allowance, the first context has a positive effect on the utility slope, the second context has a negative effect and the third, again, has a positive effect. It may be speculated that a collective offsetting rate of 50% positively triggers people's environmental consciousness, making them less sensitive towards restrictions on the amount of luggage one is allowed to carry. When the collective offsetting rate reaches 90%, however, people may be inclined to think that environmental concerns are sufficiently addressed by the fact that the majority of the passengers are offsetting their emissions, in effect, making them more sensitive towards a baggage allowance.

The interactions of the context indicators with the third policy, eco-efficiency labeling, are also somewhat surprising. The first context has no significant effect on the utility slope of the eco-efficiency label. For the second context, however, when the collective offsetting rate is 50%, the slope of the eco-efficiency label is positively, and significantly, affected, indicating that people in this context are less sensitive to an eco-labeling scheme. This may result, like the interaction with the carbon-offsetting attribute, from an ambivalence of the social norm causing people to attach less weight to environmental considerations. This is consistent with the finding that with an offsetting rate of 90%, an uncontroversial positive environmental norm, people attach more weight to the eco-efficiency label.

Finally, the slope of the price-attribute is significantly affected by the various contexts. Again, a curve-linear effect can be observed suggesting that, when the collective offsetting rate is 50%, people become less sensitive towards the ticket price and, when the collective offsetting rate is 90%, they become more sensitive. One possible explanation is that when the collective offsetting rate is 90%, people feel morally obliged to pay extra attention to environmental considerations, as reflected in the interactions with carbon offsetting and the eco-efficiency label, but, at the same time, try to compensate for this by being extra sensitive of the ticket price.

---

[4] It may be that the 50% offsetting rate in this context is indicative of controversy over offsetting, leading respondents to withdraw or attach less value to offsetting. However, the interactions between the context indicators and the offsetting attribute are not significant, and thus these results cannot be generalized.

5. Conclusions

On average, people gain utility from carbon offsetting. As expected, the utility slope of carbon offsetting also increases when the collective offsetting rate is high, and thus reflecting a strong social norm. However, this effect is not statistically significant. In addition, the results suggest that when the collective offsetting rate is 50% it has a negative effect on people's willingness to contribute to CO_2 compensation. This result contrasts with the predictions derived from Nyborg and Rege (2003) that suggested preference towards performing a socially desired behavior would be linearly affected by the degree of collective participation in that behavior.

Acknowledgement

References

Araghi, Y., 2012. Consumers Preferences on Airline Environmental Policies. Master's Thesis. Faculty of Technology, Policy and Management, Delft University of Technology.
Atmosfair, 2012. Atmosfair Airline Index 2012. <http://www.atmosfair.de/fileadmin/user_upload/Airline_Index/Airline_Index_2012_EN.pdf> (accessed 08.13).
Bliemer, M., Rose, J., Hensher, D., 2009. Efficient stated choice experiments for estimating nested logit models. Transportation Research Part B 43, 19–35.
Brouwer, R., Brander, L., Van Beukering, P., 2008. A convenient truth: air travel passengers' willingness to pay to offset their CO_2 emissions. Climatic Change 90, 299–313.
Filippone, A., 2008. Analysis of carbon-dioxide emissions from transport aircraft. Journal of Aircraft 45, 185–197.
Gössling, S., Broderick, J., Upham, P., Ceron, J., Dubois, G., Peeters, P., Strasdas, W., 2007. Voluntary carbon offsetting schemes for aviation: efficiency, credibility and sustainable tourism. Journal of Sustainable Tourism 15, 223–248.
Gössling, S., Haglund, L., Kallgren, H., Revahl, M., Hultman, J., 2009. Swedish air travellers and voluntary carbon offsets: towards the co-creation of environmental value? Current Issues in Tourism 12, 1–19.
Lee, D., Fahey, D., Forster, P., Newton, P., Wit, R., Lim, L., Owen, B., Sausen, R., 2009. Aviation and global climate change in the 21st century. Atmospheric Environment 43, 3520–3537.
MacKerron, G., Egerton, C., Gaskell, C., Parpia, A., Mourato, S., 2009. Willingness to pay for carbon offset certification and co-benefits among (high-) flying young adults in the UK. Energy Policy 37, 1372–1381.
Mair, J., 2011. Exploring air travellers voluntary carbon-offsetting behaviour. Journal of Sustainable Tourism 19, 215–230.
Nyborg, K., Rege, M., 2003. On social norms: the evolution of considerate smoking behavior. Journal of Economic Behavior and Organization 52, 323–340.
Schiphol Media, 2011. In Facts and Figures. <http://www.schiphol.nl/SchipholGroup/Company1/Statistics/FactsFigures.htm> (accessed 09.13).
Schiphol Group, 2012. In Facts and Figures. <http://www.schiphol.nl/SchipholGroup/Company1/Statistics/FactsFigures.htm> (accessed 09.13).