Do default frames significantly alter individuals’ willingness to pay to offset carbon emissions? Evidence from a controlled experiment

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In the first of a number of papers which deal with the application of economic theory and econometrics to the issue of climate change, Liam Brown, Rowan Hamilton, Yannik Obelöer and Charlie Walsh conduct a controlled experiment to evaluate the impact of default frames in determining willingness to pay to offset carbon emissions. Employing a linear probability model analysis, the authors find that using a presumed consent frame, whereby the consumer is opted into offsetting their carbon emissions by default, significantly increases the probability of paying to offset carbon emissions as compared to when an explicit consent frame is used. As the authors note, at a time when the need to reduce carbon emissions is paramount, the use of default frames in the process of purchasing air travel tickets amounts to a simple and cheap solution to nudge people towards behaving in a more environmentally conscious manner. They also note, however, that this is only one small

step towards a carbon neutral future, and that small-scale nudges must be complemented by demand modelling and a radical change in behaviour in order to achieve net neutrality.

I. Introduction

This study analyses the impact of default effects on the uptake rate of carbon emission offsetting in air travel. A default is a condition which is externally preassigned in a choice scenario resulting in a default effect occurring as individuals fail to make a decision which differs from the default on a consistent basis (Pichert & Katsikopoulos, 2008). Default effects have been established as one of a number of robust findings in human deviations from rational decision making (Arana & León, 2013). The industry of interest in the study – the travel industry – currently accounts for 28% of US carbon emissions with 10% being sourced from air travel alone (US EPA, 2018). The industry primarily makes use of command-control methods to address emissions, facilitating economy-wide reduction targets via projects such as the Emissions Trading Scheme (European Union Aviation Safety Agency, 2019). However, carbon offsetting has become a popular option across airlines, with 30 International Aviation Transport Association (IATA) airlines adopting a strategy which allows customers to allocate some funds to the neutralization of their environmental impact via additional carbon neutral investments. This study aims to investigate the hypothesis that when set as the default choice, more people will pay to offset their carbon emissions than if it is set as an optional extra.

II. Literature Review

The air travel industry is one of the most polluting industries in the world, globally contributing to the spread of short- and long-term pollutants (European Union Aviation Safety Agency, 2019). The cost of air travel emissions are measured across three metrics: social costs; the cost of abatement; and the market control penalties on carbon enforced by bodies such as the EU (Jardine, 2005). With little voluntary uptake of bio-based and electro fuels, neoclassical market models have driven the adoption of measures such as tradable permits (European Union Aviation Safety Agency, 2019). Recognition is growing for individualised treatments for pollution (Urmetzer et al., 1999) and in 2018 76 International Civil Association Organisation (ICAO) countries agreed to the Carbon

Offsetting and Reduction Scheme for International Aviation (CORSIA) programme which will require all aircraft operators to offset excess emissions, spreading to all ICAO members by 2024 (European Union Aviation Safety Agency, 2019). Approximately 11% of airlines have adopted offsetting programmes for customers to reduce carbon emissions driven by increasing pressure from bodies such as the EU (Pavlovich & Corner, 2014).

Insights from behavioural economics can potentially be used to increase the effectiveness of carbon offsetting programmes. Behavioural economics has grown in popularity over recent decades with growing evidence for predictable deviations from rationality in consumers (Avineri, 2012). Behavioural programmes have, despite protests over paternalism, been widely adopted in order to achieve large-scale socially desirable outcomes on a consistent basis (Thaler & Sunstein, 2009). These programmes regularly take the form of "nudges", with the prominent use of framing to manipulate cognitive biases and produce socially optimal outcomes (Tversky & Kahneman, 1974). This manipulation takes many forms with one of the most prominent being defaults (Johnson & Goldstein, 2004). Applying these methods to travel is suggested by Avineri (2012) suggesting the adoption of various "soft interventions" such as framing to complement command-control system's "hard interventions". One such framing model suggested by numerous researchers (ibid.) as demonstrating sufficient reliability and predictability is the application of defaults, i.e. making environmentally beneficial options the default rather than an additional option. Johnston and Goldstein (2004) note that defaults are often considered the recommended action as well as the optimal and most efficient decision. Therefore default effects can be applied in air travel to maximise carbon offsetting donations. While this is not a solution to the climate crisis, it represents a cost effective policy that can be used alongside more standard command and control policies.

The structure of default studies typically contains two experimental conditions. The first condition is a presumed-consent frame, whereby the choice maker is opted in as a default. The second is an explicit-consent frame, whereby the choice maker is opted out of the target action (Araña & León, 2013). Johnston and Goldstein (2004) argue that default effects stem from three sources: firstly, defaults are regularly viewed as a recommended option, influencing ill-informed consumers; secondly, sticking with the default reduces the effort required in making a decision, meaning consumers prioritising efficiency will be subject to default effects due to inertia (Goswami & Urminsky, 2016). The final effect is an anchoring effect as defaults serve as a reference point causing deviations from defaults to be more similar to the default than had it not been present (ibid.).

The use of defaults in offsetting carbon emissions is a sparsely researched field (Araña & León, 2013) with the studies completed demonstrating the opt-in/opt-out structure provides the opportunity to address climate change in areas previously accepted as having inevitable negative externalities.

Offsetting carbon emissions is an extra charge voluntarily levied on the consumer to invest in "sink" projects such as fuel and energy efficiency or nature-based work such as reforestation (Araghi et al., 2014). Engagement rates in this initiative are closely linked to perceptions of collective participation (ibid.) and knowledge of environmental change (Löfgren et al., 2012). In a key study on air travel and default effects, Arana and León (2013) studied the impact of defaults on offsetting carbon emissions via online retailers. The study randomly assigned consumers to offset emissions via either a Presumed-Consent or Explicit-Consent Frame. LPM regression and chi-squared tests demonstrated that the Presumed-Consent Frame produced significantly higher levels of emission offsets than the explicit-consent frame. The study is a key finding in research across both the air transport and default effect fields, demonstrating that framing effects occur in the real marketplace (Samuelson & Zeckhauser, 1988). These findings also demonstrate that individuals, assumed to maximise personal welfare independent of social gains, are willing to adopt individualised actions which serve a collectively beneficial role (Araña & León, 2013).

The research conducted by this study aims to add to the body of literature on the impact of default effects on carbon emission offsetting strategies and thus test the hypothesis that a presumed-consent frame will result in higher levels of offsetting then an identical transaction with an explicit-consent frame.

III. Experimental Design

The experiment, conducted from the 18th to 25th of February 2019, aimed to explore the effect of default options on willingness to pay a carbon emission offset charge in the context of purchasing flights. Two surveys were created, each identical bar one question. This question referred to the carbon emission offset and was framed in different ways across the surveys. In the first survey, an opt-in option was given to paying the charge ('explicit consent'). In the second, an opt-out option was given ('presumed consent'). The framing of the question was as follows:

Survey 1, Opt-in:
"You have purchased return flights to London for a long weekend break. You will leave on Friday the 24th of May and return on the 27th of May.

The base cost of the flight is **€50.**Please select the additional services you would usually select on a flight"

Check-in Bag Charge (+€10)
Select Seats Charge (+€4)
Carbon Emission Offset Charge (**+€4**)
Travel Insurance Charge (€10)
Transfer from Airport Charge (€9)

Survey 2, Opt-out:
"You have purchased return flights to London for a long weekend break. You will leave on Friday the 24th of May and return on the 27th of May.

The base cost of the flight is €**54.** Please select/deselect the additional services you would usually select on a flight."

Check-in Bag Charge (+€10)
Select Seats Charge (+€4)
Remove Carbon Emission Offset Charge (**-€4**[1])
Travel Insurance Charge (€10)
Transfer from Airport Charge (€9)

1 Emphasis added to the changes across surveys was not present during the control experiment.

The default option for Survey 1 was to be opted-out of the climate emission offset charge ("explicit consent" frame). Subjects in the presumed consent default frame had the default option of being opted-in to the climate neutral charge ("presumed consent" frame). The following control variables were added to the survey:

Gender (Male, Female, Other)[2] .
Age Bracket (Below 35, Above 35).
Additional Services (Check-in Bag Charge, Select Seats Charge, Travel Insurance Charge, Transfer from Airport Charge).
Ranking of Important Factors in Purchasing Flights (Cost,Airline, Time of Flight).
Whether the subject flies alone or with a group most of ten.

Two hundred subjects' responses were recorded across the two surveys.

IV. Data Summary

In order to conduct our statistical analysis, dummy variables were implemented mirroring each of the survey questions (see table A1 in Appendix). Before testing the actual effects of the default option, randomization of the data has to be inspected. Illustration 1 shows graphically what a Pearson's chi-squared test (Table 1) proves quantitatively. Apart from age, none of the differences between the two surveys are significantly different. Thus, there is little observable evidence that the sample of either survey is significantly different to the other. Due to the potential bias from the difference in the age variable, this variable is not considered for separate analysis.

V. Chi-Squared difference testing

As already demonstrated with the other independent variables, chi-squared tests are used for finding differences in a two-sample investigation. Table 2 visualises the different outcomes. A simple Pearson's chi-squared test (see Table 3) reaffirms the obvious difference between the two surveys at all reasonable confidence levels with the opt-in

2 For the control variable 'Gender', no subject selected 'Other'. Therefore, it was omitted during statistical analysis.

survey having a far larger number of participants offsetting their climate cost.

Illustration 1 Distribution of responses across the two surveys, series 1 = opt-in

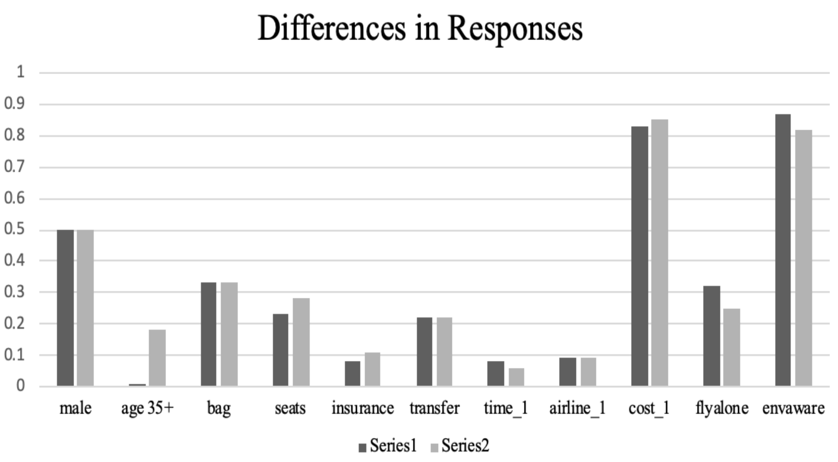

Table 1 Statistical difference between two surveys from contingency tables

Variable	Opt-Out Survey	Opt-In Survey	Chi-Square (p-value)
Male	0.50	0.50	1.000
Age35+	0.18	0.1	0.000 (***)
bag	0.33	0.33	1.000
seats	0.28	0.23	0.417
insurance	0.11	0.08	0.469
transfer	0.22	0.22	1.000
flyalone	0.25	0.32	0.273
envaware	0.82	0.87	0.329
time_1	0.06	0.08	0.372
airline_1	0.09	0.09	1.000
cost_1	0.85	0.83	0.700

Table 2 Contingency table opt_out and offset

Individual faced an opt-out option, 1 = yes	Climate cost was offset, 1 = yes 0	1	Total
0	82	18	100
1	25	75	100
Total	107	93	200

Table 3 Statistical difference on offset between two surveys

Variable	Opt-Out Survey	Opt-In Survey	Chi-Square (p-value)
Climate cost offset	75	25	0.000 (***)

VI. Results

Linear Probability Model (LPM)

$$offset_i = \beta_1 opt\_out_i + \beta_2 male_i + \beta_3 bag_i + \beta_4 insurance_i + \beta_5 transfer_i + \beta_6 seats_i + \beta_7 flyalone_i + \beta_8 envaware_i + \beta_9 time\_1_i + \beta_{10} airline\_1_i$$

Overall our preferred specification has significant explanatory power with an R^2 of 0.3855. Facing a presumed consent frame increases the probability of offsetting the carbon emissions by approximately 57%. This coefficient is significant at the 99% confidence level. While also significant, the increase of 13.6% in the probability of offsetting emissions when the individual surveyed is male contradicts the standard view in the literature, which generally finds greater environmental concern among women (Mohai, 1992)[3]. Another striking observation is that other add-ons to the price do not have significant effects on whether the carbon emissions are offset. While flying behaviour does not seem to have a large impact, environmentally aware individuals surprisingly are less likely to offset climate costs. This could simply be a result of misstated preferences, a common issue in state-preference

3 This effect might be due to a non-fulfilment of a randomised trial in a sense that the sample population had an unrepresentative group of environmentally aware male participants.

surveys such as this. Whether time or airline was ranked as most important compared to ranking cost as most important had some effect on the likelihood of offsetting emissions. While time was not significantly different to cost, airline as the highest ranking seems to increase the probability of choosing to offset emissions compared to ranking cost at number 1 by about 19.5%. This is in line with the expected results that individuals mostly focusing on low price flights might be less likely to choose an offsetting option than those more interested in the time of the flight or the quality of the airline.

While yielding satisfactory results, there are also some statistical shortcoming of the Linear Probability Model used in this study. LPMs are often criticised in a more general sense for potential non-normality of the disturbance, heteroscedastic variances of the disturbance and the absence of probability boundaries. However, non-normality does not pose a major problem to the statistical results as with n =200 and 190 degrees of freedom, a close to normal distribution may be assumed. Heteroscedasticity is also corrected for by using robust coefficient estimators with a feasible generalised least squares model. Probability boundaries may have led to problems but as no absolute value of the coefficient estimates is outside [0,1], using an LPM seems appropriate in the case of this study.

Table 5 Results different specifications of LPM

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	Opt_out	+male	+bag	+insurance	+transfer	+seats	+flyalone	+envaware	+time_1	+airline_1
opt_out	0.570***	0.570***	0.570***	0.565***	0.566***	0.563***	0.571***	0.567***	0.568***	0.568***
	(0.0582)	(0.0576)	(0.0577)	(0.0580)	(0.0580)	(0.0583)	(0.0572)	(0.0576)	(0.0576)	(0.0573)
male		0.130**	0.128**	0.130**	0.129**	0.132**	0.123**	0.126**	0.131**	0.138**
		(0.0576)	(0.0595)	(0.0594)	(0.0593)	(0.0598)	(0.0596)	(0.0595)	(0.0600)	(0.0604)
bag			-0.0151	-0.0275	-0.0249	-0.0325	-0.0394	-0.0451	-0.0444	-0.0573
			(0.0604)	(0.0615)	(0.0618)	(0.0606)	(0.0599)	(0.0595)	(0.0596)	(0.0594)
insurance				0.152	0.142	0.117	0.118	0.114	0.117	0.107
				(0.115)	(0.115)	(0.120)	(0.122)	(0.122)	(0.122)	(0.120)
transfer					0.0575	0.0596	0.0477	0.0492	0.0500	0.0382
					(0.0706)	(0.0720)	(0.0722)	(0.0724)	(0.0724)	(0.0725)
seats						0.0746	0.0665	0.0619	0.0595	0.0601
						(0.0702)	(0.0703)	(0.0705)	(0.0712)	(0.0715)
flyalone							0.117*	0.127*	0.118*	0.123*
							(0.0649)	(0.0651)	(0.0680)	(0.0675)
envaware								-0.110*	-0.113*	-0.122*
								(0.0612)	(0.0613)	(0.0637)
time_1									0.0744	0.0938
									(0.116)	(0.118)
airline_1										0.195*
										(0.101)
Constant	0.180***	0.115***	0.121**	0.112**	0.0996*	0.0849	0.0591	0.153**	0.149**	0.141*
	(0.0386)	(0.0399)	(0.0511)	(0.0495)	(0.0523)	(0.0567)	(0.0564)	(0.0740)	(0.0737)	(0.0767)
Observations	200	200	200	200	200	200	200	200	200	200
R-squared	0.326	0.343	0.344	0.351	0.354	0.358	0.368	0.375	0.376	0.388

Robust standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

VII. Discussion

The results above confirm our initial hypothesis that, when set as a default, more people will pay to offset their carbon emissions than if it were set as an optional extra. Respondents in our survey were 57.07% more likely to pay the carbon offsetting charge if it was already included in the price of the plane ticket, than if it were an optional extra, all else equal. Our chi-squared test rejected the hypothesis that the proportion of "presumed consent" and "explicit consent" respondents who paid the carbon offset charge was selected from the same binomial distribution. This is in line with other research which has shown the effect of default options on organ donations (Johnson & Goldstein, 2004), green energy uptake (Pichert & Katsikopoulos, 2008) and choice of health insurance plans and pension schemes (Samuelson & Zeckhauser, 1988). Furthermore, it supports the findings of Araña and León (2013) who concluded that the default option had a larger effect on the acceptance of the carbon offsetting charge when framed as an opt-out alternative, than when framed as an opt in alternative.

The authors believe there are two main explanations for our results. The first is loss aversion. In the "explicit consent frame" an individual was comparing the loss of €4 to the gain of offsetting their carbon footprint. In the 'presumed consent frame' the individual compared the gain of €4 to the loss of no longer carbon offsetting. This explains the higher proportion of people paying the carbon offset charge in the "presumed consent" frame since, according to loss aversion, losses are weighted more highly than equal gains (Kahneman & Tversky, 1979). Our second explanation revolves around social norms. Araghi et al. (2014) showed that individuals are more likely to offset their emissions if they feel it is a social norm. By setting payment as the default option, individuals may view it as the recommended course of action and feel that payment is a social norm.

Our results are of great significance to policymakers as they attempt to reach the targets set out in the 2016 Paris Climate Agreement. Policymakers typically rely on demand modelling policies to change consumer behaviour by providing more information and altering incentives (Avineri, 2012). These policies are expensive, time consuming and have been shown to be ineffective in areas such as organ donations (Kherani et al., 2003). Our analysis has shown that manipulating the choice architecture by introducing a presumed consent frame is a near costless way of nudging individuals to behave in a more environmentally responsible manner. At a time when the need to reduce carbon emissions is paramount, this amounts to a simple and cheap solution to influence behaviour for the better.

Despite the strength of our results, there are a number of important caveats and criticisms that can be pointed at the use of defaults for carbon offsetting programmes. Firstly, they are not a substitute for demand modelling policies aimed directly at curbing the harmful behaviour. Utilising defaults takes advantage of behavioural biases to nudge individuals in a desired direction, however, by definition they do not limit the consumers' freedom of choice. As such, the environmentally harmful option remains a possibility likely to be chosen by a proportion of the population. Defaults are simply one tool to be used alongside a package of methods to ensure a sustainable environment into the future. The use of defaults has also been criticised on ethical grounds. If the default effect is occurring due to inertia, where consumers are simply failing to make a decision, then it could be argued that "presumed consent" frames are taking advantage of individuals who are not paying enough attention. While this may not be a big ethical issue for a €4 payment, as the sum increases this becomes a bigger concern.

Further criticisms have been directed at carbon offsetting policies more generally for failing to address the behaviour that has the damaging effect in the first place – flying. Paying to offset carbon emissions has no actual effect on the emission level of a flight. Instead they are used to fund initiatives known as "sink" projects such as afforestation or reforestation (Araghi et al., 2014). However, afforestation is not an effective means of carbon reduction as the scale of land required to compensate for carbon emission is largely unfeasible (Gössling et al., 2007). As such, carbon offsetting can be seen as simply alleviating one's guilt, detaching them from the long-term solution of flying less (Araghi et al., 2014). The researchers recognise these criticisms, and while they acknowledge that utilising default effects and carbon offsetting charges are not a long term solution to climate change, they are cheap and easy to implement and as such can be used alongside demand modelling policies aimed at addressing the damaging behaviour.

There are a number of possible extensions to this experiment that further research can explore. First of all, this experiment could be recreated in the field, partnering with airlines to introduce the two default conditions and measure their impact on willingness to pay. Secondly, it would be informative to observe how the scale of the default effect changes as flight prices and the carbon emission offset charges change. This would allow us to investigate absolute and relative price effects on the default bias and the decision making in this context. This research would aid in identifying the optimal default carbon offset charge to maximise donation revenue.

VIII. Conclusion

This paper aimed to investigate the impact of a default frame on individuals' willingness to pay to offset the carbon emissions of their flights. The results returned from a controlled experiment showed that the default frame did have a significant effect on their willingness to pay. It contributes to the growing literature on the applications of default framing and, more importantly, on adapting the world economy to the realities of climate change. The recent IPCC report stated that "far reaching, multi-level and cross-sectoral climate mitigation by both incremental and transformational adaptation" are needed to combat future climate related risks (IPCC, 2018). As such, default framing, such as that outlined in this paper, can form a cost-effective part of a larger, overarching strategy to tackle climate change. As a result of the affirmation of this paper's hypothesis, it would be worthwhile to replicate and extend the experiment to shed more light on the possible limitations and benefits of default frames.

IX. References

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X. Appendix

Table A1 Description of the variables

Variable	Description
offset	Dummy variable that is used as the independent variable in the later model, describes whether money was paid to offset carbon emissions of a flight; if offset = 1
opt_out	Dummy variable for distinguishing the two surveys; if individuals faced a default option of the inclusion of the donation (opt-out / presumed consent), the variable = 1
age35+	Dummy variable for age bracket of 18-34 and 35+; if in bracket 35+ = 1 (age was translated into a single dummy due to very small number of observations in different brackets, later dropped)
male	Dummy variable for sexes; if male = 1
bag	Dummy variable for option to pay an extra fee of €10 to take an extra bag onto the flight; if willing to pay = 1
seats	Dummy variable for option to pay an extra fee of €4 to be able to select the seat; if willing to pay = 1
insurance	Dummy variable for option to pay an extra fee of €10 for travel insurance; if willing to pay = 1
transfer	Dummy variable for option to pay an extra fee of €9 for transfer to the airport; if willing to pay = 1
flyalone	Dummy variable for flight behaviour; if mostly fly alone = 1
envaware	Dummy variable for environmental awareness; if individual considers itself environmentally aware = 1
time_1	Dummy variable for ranking of key aspect when flying; if first rank is "Time of flight" = 1
airline_1	Dummy variable for ranking of key aspect when flying; if first rank is "Airline" = 1
cost_1	Dummy variable for ranking of key aspect when flying; if first rank is "Cost" = 1 (dropped in model to avoid dummy variable trap)