Are Malaysian airline passengers willing to pay to offset carbon emissions?

Article *in* Environmental Science and Pollution Research · July 2020

DOI: 10.1007/s11356-020-08662-y

CITATIONS
14

READS
1,042

3 authors:

Nur Fatihah Shaari
Universiti Teknologi MARA
26 PUBLICATIONS **30** CITATIONS
SEE PROFILE

Abdul Rahim A.S.
Universiti Putra Malaysia
130 PUBLICATIONS **1,831** CITATIONS
SEE PROFILE

Syamsul Herman Mohammad Afandi
Universiti Putra Malaysia
70 PUBLICATIONS **390** CITATIONS
SEE PROFILE

Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-020-08662-y

RESEARCH ARTICLE

Are Malaysian airline passengers willing to pay to offset carbon emissions?

Nur Fatihah Shaari[1] · Abdul Samad Abdul-Rahim[1] · Syamsul Herman Mohammad Afandi[1]

Received: 14 November 2019 / Accepted: 30 March 2020

Abstract
Recently, greenhouse gas (GHG) emissions become the hottest issue in the transportation sector. The air transport sector contributes approximately 2% of global greenhouse gas emissions. Reducing greenhouse gas emissions from aircraft is one of the issues taken seriously by the transportation sector. However, air transportation has implemented several ways to reduce carbon emissions, and one of them is by launching a carbon offset program. This study estimates the willingness among Malaysian airline passengers to pay for a carbon offset program to have a better environmental performance. Using a double-bounded dichotomous choice of contingent valuation method (CVM) estimates how much air passengers would be willing to pay to offset carbon emissions generated by their travel. The results obtained from this study suggest that the additional fee for airline tickets will be RM86.00 can be charged to have a better environmental performance.

Keywords Contingent valuation method · Willingness to pay · Carbon offsets · Greenhouse gas emissions · Airline industries

Introduction

In the new global economy, air transportation is one of the growing transport demands. Cheaper and more abundant flights can make travel easier, for both local and abroad trip (Chapman 2007). However, this sector has an impact on the environment, as it increased greenhouse gas (GHG) emissions (Somerville 2003; Chapman 2007). Aviation is thus a significant and increasingly important contributor to global warming, as carbon emissions from air travel are released in the upper troposphere and lower stratosphere, where they have a larger impact on ozone generation (Gössling et al. 2007). Among all transportation, air transportation accounted for about 2% of total emissions. It is not significantly high but still considerable. Chang et al. (2010) mentioned that the incentive and any policies made to reduce GHG emissions of surface transportation are most likely not suitable for the air transportation sector.

Thus, there are several ways that Malaysian airlines have implemented to reduce greenhouse gas problem such as the limit number of luggage for each passenger and the use of an environmental engine, and another initiative is by implementing carbon offsets. Becken and Hay (2012) explained that carbon offsetting is a form to neutralize emissions released by investing in schemes that reduce greenhouse gases through some projects offered such as reforestation or renewable energy. The carbon offset program is currently popular throughout the world; however, it still applied as a volunteer program (Chang et al. 2010). Except for Malaysia, airlines around the world use a variety of ways to become involved with offsetting, included in their ticket prices, and some provide an option for customers to purchase offset at the market (Mair 2011).

Malaysia is a rapidly developing country with a vision of achieving a developed country status by 2020. However, to become a developed nation by its target date, the rapid growth necessary could gift severe consequences about the climate change burden (Masud et al. 2015). Recently, the Malaysian government has declared, by the year 2020, to reduce greenhouse gases (GHG) by 40% compared with the 2005 emission level.

Responsible editor: Baojing Gu

✉ Abdul Samad Abdul-Rahim
abrahimabsamad@gmail.com

Nur Fatihah Shaari
fatihah3388@gmail.com

[1] Department of Economics, Faculty of Economics and Management, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor, Malaysia

Published online: 18 April 2020

Back in 2008, MAS has launched the voluntary carbon offset program for their flight, called "towards a greener future." It became the first airline in South-East Asia to offer passengers the option of paying voluntarily to reduce their carbon footprint. However, this program is considered failed and has been discontinued. It also does not receive any support from passengers because the program is not generally advance to the public. No advertisement to announce at the airline website and not commercially advertised through mass media is the reason why it is not happening until today. MacKerron et al. (2009) stated that respondents are willing to pay more for carbon offset only if they have information, which is education and awareness about the offset program schemes. Thus, this study aims to estimate the appropriate price level to implement a carbon offset program in the airline industry, in concerned to improve and re-launch again voluntary carbon offset in Malaysian airlines.

Although there are several numbers of studies had done in Malaysia using contingent valuation method (CVM) and choice experiment (CE), but yet to our knowledge, there is none study done about willingness to pay for aviation carbon offsets using these two methods. However, research by Afroz et al. (2005) is the only known study using CVM in the case of air pollution in Malaysia. To our knowledge, this is considered the first study in Malaysia using a stated preference approach, CVM. This study was done to estimate the value of willingness to pay for air quality improvement in the Klang Valley, Malaysia, using three different question formats which are open-ended, dichotomous choice, and payment card. The results of this study show that the value of the mean willingness to pay is higher when using the dichotomous choice format than using open-ended and payment card format. The amount of mean willingness to pay (WTP) of the respondents to improve the air quality in Klang Valley is RM0.91 billion.

Besides, a study by Bazrbachi et al. (2017) is the latest study using the CVM method in assessing the current value that a private vehicle is willing to pay to continue using their private vehicle instead of using a public vehicle such as commuters. A number of 534 respondents were used for this study, and the survey was conducted in seven different locations in Shah Alam, Gombak, Pekeliling, Cheras, Bandar Tasik Selatan, Kajang, and Bukit Nanas. Using a single-bounded format, his study has come out with RM4.99 as a maximum value that a private vehicle is willing to take part per trip, to avoid from using public transportation. However, the results also show that the respondents with health problems related to air pollution are more willing to shift to public transportation.

Apart from studies related to aviation carbon offsets and air pollution, some studies have been conducted in Malaysia using the contingent valuation method. The implication of using the CVM method in Malaysia to study aviation carbon offsets is still not done by any scholar, but there are some studies about air pollution which have been performed using this method (Bazrbachi et al. 2017; Afroz et al. 2005). Besides, there are also some studies about households' willingness to pay using the CVM method for a carbon reduction program in Kuala Lumpur (Masud et al. 2015).

This paper is separated into five sections, where the first section is the "Introduction," which introduces the study, followed by the next sections "Literature review" and "Methodology" two which explained the methodology and source of data used. Empirical results are presented in the "Results and discussion" section, and the last section, "Conclusions," is the conclusion of the study.

Literature review

Economic valuation of aviation carbon offsets

Some studies have been done in quantifying the economic value of aviation carbon offset throughout the world. Some researchers employed the contingent valuation method (CVM) to estimate the value that passengers are willing to pay (WTP) in reducing the emissions from their travel (Brouwer et al. 2008; Lu and Shon 2012; Fatihah and Rahim 2017). Lu and Shon (2012) used the CVM to examine airline passenger WTP for carbon offset among 1000 Taiwanese passengers flying to countries in Asia, Europe, North America, and Oceania. This study used a double-bounded dichotomous choice question format to obtain WTP from passengers. Taiwanese air travellers were willing to pay for the carbon offsets. Flight distance and passenger travel characteristics were the main variables assessed in Lu and Shon (2012).

Brouwer et al. (2008) showed that a significant result between travellers from certain countries exists in a substantial demand for climate change mitigation action. However, their study wanted to find out whether the estimated cost of climate change is accurate. A second researcher wanted to observe whether air travel passengers, as a polluter, are willing to accept or willing to pay for some increases in the cost of their travel and offset the environmental damage caused by the flight. Using the CVM, they found that the willingness of the general public to invest in climate change mitigation may be much higher than was generally assumed.

In a CVM study, a respondent is asked about something (e.g. emissions from air transportation) and elaborate on how critical they think that the emissions will affect people and the environment. Respondents must decide as to how much they are willing to pay in reducing CO_2 emissions by implementing the carbon offset program. A single-bounded CVM will only illustrate a scenario before a respondent starts to answer the questions on whether they are willing to pay for some amount or not. In finding the determinants of WTP for the carbon

offset program, several amounts of money about an effort to reduce CO_2 emissions are being asked, where the respondents have to answer "yes" or "no" to the WTP questions.

According to Chang et al. (2010), less than 10% of the respondents from the East Asian region are willing to pay for the offset even if the price offered for the carbon offset program is dropped to a low level. Choi (2015) estimates about AU$13.94 (RM46.42) and AU$11.04 (RM36.76) are the values that passengers are willing to pay for aviation carbon offsets. However, this amount is considered lower compared with those in other literature, as others estimate the value of WTP as $12.68 or RM55.73 (Cheung et al. 2015); 21 Fr (Swiss Franc) or RM91.80 (Blasch and Farsi 2014); €23.10 or RM107.77 (Brouwer et al. 2008); $29 or RM127.47 (Lu and Shon 2012), and the highest payment noted with regard to the study of WTP for air travel passengers is £24 or RM132.10 (MacKerron et al. 2009).

Besides, there is also some research trying to investigate whether respondents are willing to pay, not only for now but also in the future. Based on the study by Cliffe (2014), about 82% of passengers consider that there will be an offset for their flight in the future, and this result is higher compared with the finding by Gössling et al. (2009), which discovered only 64% of passengers are willing to pay in the future. Hinnen et al. (2017) found that 20% of air travellers in Switzerland have the interest to pay and are willing to pay at a higher price for green products and a subset of the passengers are willing to pay for green air travel.

Methodology

The contingent valuation method (CVM) is widely used in areas of economics such as in health economics, cultural economics, transportation economics, and environmental economics. Recently, this method has been commonly used in environmental economics. There are four types of eliciting technique used in contingent valuation methods, namely the bidding game, payment card, open-ended, and dichotomous choice. As noted by Arrow et al. (1993), the dichotomous question is the most recommended eliciting technique in a contingent valuation study. This method is the most suitable survey instrument to obtain a monetary value in a non-market good (Bateman et al. 2002).

This study applied the double-bounded dichotomous choice approaches. In this approach, respondents were presented with a first bid, whether they are willing to pay or not. If "yes", the higher level of the bid will be presented. If "no", the lower level of the bid will be presented, followed by the open-ended question, which respondents need to fill the maximum value they are willing to pay (Brouwer et al. 2008). The double-bounded logit model is more efficient compared with the single-bounded in terms of the information obtained about the respondent's willingness to pay (Hanemann et al. 1991; Bateman et al. 2002). Thus, it makes the point estimates from the double-bounded less biased than produced by the single-bounded. Another risk found in single-bounded is the question that will only derive the maximum willingness to pay value and not the actual value of willingness to pay because respondents can only choose one value instead of answering with lower and upper value in double-bounded. Yet, the double-bounded is now preferred by CV analysts than the single-bounded method (Calia and Strazzera 2000).

Survey design

This study used the primary data, and it was collected through interviews in the form of questionnaires. A total of 823 Malaysian airline passengers were interviewed. Information on demographic characteristics of respondents obtained enclosed gender, race, marital status, age, education level, occupation, and monthly income (Table 1). The questionnaire was divided into three parts: Part 1 contained a question to elicit the respondent's knowledge concerning carbon offset. Part 2 captured the respondent's willingness to pay for a carbon offset program, which is the CVM question. In the CVM part, the respondent was given a scenario based on the current situation and how air transportation can harm the environment. Afterwards, the respondent needs to answer the question based on the scenario given. Part 3 aims to capture the demographic profile of the respondent. The questionnaire has five different sets, which differ in terms of starting bid price for CVM question: set A (RM10), set B (RM25), set C (RM50), set D (RM75), and set E (RM100).

Before the actual survey was conducted, a pre-test was carried out to test the questionnaire. This is to ensure the respondents' understanding of the questions. Respondents were interviewed for the pre-test. Pre-test questionnaire does not have any bid price, only the open-ended question. From the open-ended question, it is then transformed into bid price, which ranged from minimum to maximum price obtained from an open-ended pre-test question.

Sampling technique and size

The target population for this study is Malaysians, who fly using the MAS and AirAsia flights only. This study is conducted at the Kuala Lumpur International Airport (KLIA) and Kuala Lumpur International Airport 2 (KLIA2). Respondents will be airline passengers at the airport, no matter whether they are on domestic or international flights. The main criterion of the respondents is that they must be an adult who is flying either with MAS or AirAsia. All respondents need to fill up the questionnaire according to their experiences when travelling with these two airlines.

Table 1 Socio-economics characteristics of the passengers

Variable	Respondents' profile	Frequency	Percent (%)
Gender	Male	281	34.14
	Female	542	65.86
Race	Malay	722	87.73
	Indian	21	2.55
	Chinese	65	7.90
	Others	15	1.82
Marital status	Single	495	60.15
	Married	319	38.76
	Others	9	1.09
Age	15–24 years	89	10.81
	25–54 years	696	84.57
	55–64 years	37	4.50
	65 years and over	1	0.12
Education level	Primary school	56	6.80
	Secondary school	101	12.27
	Professional certificate/diploma	96	11.66
	Bachelor degree	440	53.46
	Master / PhD	130	15.80
Occupation	Government	203	24.67
	Private sector	273	33.17
	Own business	120	14.58
	Self-employed	84	10.21
	Retiree	11	1.34
	Student	104	12.64
	Housewife	28	3.40
Income	Below RM1000	73	8.91
	RM1001 – RM2000	130	15.87
	RM2001 – RM3000	145	17.70
	RM3001 – RM4000	181	22.10
	RM4001 – RM5000	116	14.16
	RM5001 – RM6000	19	2.32
	RM6001 – RM7000	41	5.01
	Above RM7001	114	13.92

Personal interviews have been conducted among passengers of Malaysia Airline (MAS) and Air Asia flight, by filling the questionnaires at the Kuala Lumpur International Airport (KLIA) and Kuala Lumpur International Airport 2 (KLIA2) departure and arrival hall. For this research, intercept sampling was used as a sampling strategy to select potential respondents from KLIA and KLIA2. Intercept survey is a research method used to gather on-site feedback from a respondent. The main reason why this sampling was chosen is because of the small population but important sub-group which is important to the study. Respondents comprise passengers who are flying only with Malaysia Airlines (MAS) and AirAsia. To make a survey more arranged, the sample size used data obtained from MAHB's annual report (2016 MAHB's annual report) and the sample size attained from the table for determining sample size from a given population (Krejcie and Morgan 1970). The total number of passengers in 2015 is 48.94 million (MAHB 2015). According to Krejcie and Morgan (1970), a population exceeding 100,000 results in a target sample size of 384. Thus, the number of respondents for this study is 900, which is 450 from KLIA and 450 from KLIA2. The authors decided to increase the number of respondents to ensure a sufficient number of respondents for data analysis are obtained (after removing incomplete surveys).

The questionnaire design

The questionnaire consisted of three parts. The first part consists of questions related to the respondent's general knowledge about carbon offset and a CVM questionnaire. The second part was a respondent's general flying information, including a frequent destination flying and trip purposes. The third part contained information on the respondent's demographic profile. Each of the respondents was briefed on the details of the purpose of preservation of area, facilities available, and format used in contingent value technique. Respondents required to answer "yes" or "no" on the following question, upon the bid value. Respondents then were questioned for their WTP for a second follow-up bid, considering which they can again reply either "yes" or "no". If respondents reply "no" (yes) to the initial bid, the follow-up bid is a lower (higher) amount (Brouwer et al. 2008). RM X ranged from RM5 until RM100 will be a reasonable price for voluntary carbon offsets. Those who were not willing to pay were asked a follow-up question to seek out their reasons for not willing to pay.

Flying like many others forms of transport impacts the environment because the fuel used by airlines results in the release of carbon dioxide (CO_2) and other emissions into the upper atmosphere. As flying becomes cheaper and accessible, the problem is heading towards the sky. Carbon offsets are one of the ways for airline passengers to 'neutralize' their amount of an aircraft's emissions by investing in carbon offsets project. If you were to buy a voluntary carbon offsets, the carbon emissions from your consumption were compensate somewhere else, by investing in some program such as renewable energy or by investing in energy efficiency. An additional charge RM X for carbon offset will be imposed on your plane ticket to reduce and minimise emission by investing this voluntary carbon offset in an offset project.

Specification of the model

In order to fulfil the study goals, two approaches were adopted to spot outcomes. First, a multiple regression analysis was employed to analyse the socioeconomic factors which influence an individual's WTP to reduce carbon emissions and second, the CVM was used to determine the value of environmental goods to measure a monetary valuation of carbon offsets. A specific econometric model is presented based on the hypothetical scenario presented to the respondents. By referring to the study done by Hanemann (1984), an individual's utility depends on income (y), access to improve a good (j), and demographic characteristics(s).

If the accessibility to (j)is expressed by "yes" = 1 and "no" = 0 and follows random variables with zero means (ε), the equation can be specified as:

$$u_1 = v(1, y; s) + \varepsilon_1 \tag{1}$$

Equation 1 refers to those who have access to the improved good or service(j). For those who have no access to (j), their utility function will be:

$$u_0 = v(1, y; s) + \varepsilon_0 \tag{2}$$

Next, the respondent was asked to pay for an amount of money, $A, for access to an improved good or service (j). The respondent will accept the offer if:

$$v(1, y{-}A; s) + \varepsilon_1 > v(0, y; s) + \varepsilon_0 \tag{3}$$

If the respondent refuses access, then the equation will not be Eq. (3). Hence, this equation can be transformed into a probability equation form:

$$\begin{aligned} P_1 \equiv & P_r\{\text{individual willing to pay}\} \\ & = P_r\{v(1, y{-}A; s) + \varepsilon_1 > v(0, y; s) + \varepsilon_0\} \\ P_0 \equiv & P_r\{\text{individual unwilling to pay}\} = 1{-}P_1 \end{aligned} \tag{4}$$

The above equation can be changed into the statistical model functional form:

$$v(j, y; s) = \propto_j + \beta_j, \beta > 0; j = 0, 1 \tag{5}$$

However, to get the value of mean WTP, the estimation model is (Cameron 1988):

$$WTP_i = -\left(\frac{\propto_0}{\beta_1} + \frac{\beta_2}{\beta_1}(X_{2i}) + \ldots + \frac{\beta_n}{\beta_1}(X_{ni})\right) \tag{6}$$

where

wtp = willingness to pay
$\propto_0$ = intercept associated with the model
β_1 = parameter of the bid vector amounts
$\beta_2 to\ \beta_n$ = coefficients of the parameters X_2 *to* X_n.

WTP_i as a dependent variable is passenger's willingness to pay for voluntary carbon offset program and it can be expressed in a linear regression model.

$$WTP_i = x_i\beta + e_i \tag{7}$$

where x_i stands for independent variables which indicate passenger income, age, gender, education, and many more which are observable. β is a parameter to be estimated with numerical values. In this study, i represents a passenger of Malaysia Airlines (MAS) and Air Asia. The independent variables in

this study are selected based on the previous studies in voluntary carbon offset.

Variables	Description of the variable	Expected sign
Dependent variable		
Willingness to pay	Dummy of saying "yes" 1 and "no" 0 to price offered	
Independent variables		
The bid price for carbon offset	The proposed price for carbon offset (expressed in Ringgit Malaysia (RM) currency)	–
Income	Respondent's monthly income (expressed in Ringgit Malaysia (RM) currency)	+
Education	Level of education will be measured based on the higher level of education that passengers' have	+
Occupation	1 = housewife; 2 = student; 3 = retiree; 4 = self-employed; 5 = own business; 6 = private sector; 7 = government	+
Age	Respondent's age (in years)	–
Gender	1 = Male; 0 = female	+
Offset info	Knowledge of carbon offsetting	+

The WTP study can be stated functionally as:

$$WTP = \beta_0 + \beta_1 \text{gend} - \beta_2 \text{age} + \beta_3 \text{work} + \beta_4 \text{edu} + \beta_5 \text{inc} + \beta_6 \text{off} + \varepsilon \quad (8)$$

where WTP = willingness to pay (dependent variable), gend = gender, age = age, work = occupation, edu = education, inc = income, and off = offset info (independent variables). The independent variables and the expected signs for each variable of this study were selected based on a literature review, which found essential determinants of valuing environmental services. However, only those significant variables from pretest regression model are included in the final regression model. In contrast, to worth the voluntary payment for carbon offset program to have a better environment, the CVM was used as a mechanism to decide a monetary valuation for carbon offset.

At the socio-demographic profile, gender is a generally discussed demographic variable. Many trusts that women are more sensitive and concerned about the health and environmental problems (e.g. climate change and global warming). The nature of women being compassionate makes them tend to choose and be willing to pay more for carbon offsetting, compared with men. Women are more responsible and willing to pay any amount for a carbon offset because having children might cause respondents to be more concerned about the impact of climate change on future generations (MacKerron et al. 2009). Thus, the study can show how gender will influence in contributing to their willingness to pay for carbon offset.

Passengers' income has a positive relationship with the willingness to pay for carbon offset (Brouwer et al. 2008; Masud et al. 2015). A passenger with a higher income is willing to pay more for carbon offset since they manage the cost for the airfare at any price. Thus, a passenger is believed to be willing to pay an additional for their present airfare to reduce the emissions. As indicated by Masud et al. (2015) and Lu and Shon (2012), age has a negative relationship in the model for carbon offset. This demonstrates that younger respondents are more responsible towards carbon offset (they are more mindful of the environmental issues). Therefore, age is an essential variable that influences someone's willingness to pay for carbon offset.

The level of education is measured based on the highest formal education of respondents such as post-graduate, undergraduate, diploma, high school, primary school, and no formal education. The more educated the respondents, the higher their willingness to pay for carbon offset. Masud et al. (2015) found that education level is significant with the willingness to pay. Besides, educated people are more aware of the environmental problems, and they feel responsible for taking care of the environment.

Payment vehicle

The payment vehicle for this study will be an additional payment on top of the airfare per person, every time passengers purchase their airline ticket online. Whenever a passenger makes a payment for airline tickets, the option for voluntary carbon offset will appear. It depends on the passenger to either buy or not because the payment is voluntary. The airlines will not keep the money, but give out the money to the parties involved to implement carbon offset programs such as reforestation and the implementation of using renewable energy.

Results and discussion

The socioeconomic characteristic of passengers

Table 1 reports the descriptive statistics for the main socioeconomic characteristics of the respondents. The gender distribution of the samples was 34.14% male and 65.86% female. The majority of respondents were aged between 25 and 54 years (84.57%). In this study, 87.73% of the respondents were Malay, 7.90% Chinese, 2.55% Indian, and 1.82% other. Most of the passengers interviewed are not yet married (60.15%), 38.76% are married, and only 1.09% had other marital status. The highest percentage of the passengers (53.46%) had a bachelor's degree, 15.80% had reached a

Table 2 Knowledge and experience towards carbon offset

Variables	Frequency	Percent (%)
Knowledge of carbon offset		
I do not know what carbon offsets are	436	52.98
I slightly know what carbon offsets are	94	11.42
I know what carbon offsets are	293	35.60
Experience buying carbon offsets		
Yes	8	0.97
No	553	82.26
I am not sure	138	16.77

postgraduate level, 12.27% had a secondary level, 11.66% had a diploma or professional certificate, and 6.80% had a primary level. Only 8.91% of passengers had an income below RM1000 per month. A total of 15.87% earned RM1001–RM2000, 17.70% earned RM2001–RM3000, 22.01% had an income range of RM3001–RM4000 per month, and 14.16% had an income range of RM4001–RM5000. A total of 2.32% received a salary of RM5001–RM6000, 5.01% received RM6001–RM7000, and 13.92% had an income of above RM7001 per month.

General knowledge of carbon offset

In an attempt to examine the general knowledge about carbon offset program, respondents were asked a number of questions as shown in Table 2. The results revealed that half the number of the respondents (52.98%) did not have any ideas about carbon offset program, and only 0.97% among respondents had experience buying carbon offset. In total, 16.77% are not sure whether they had experienced or not about buying carbon offset program, while 82.26% never experienced buying carbon offset.

Reasons for not being willing to pay

In indicating the results for willingness to pay, almost half of the respondents are willing to pay for carbon offset program, and over a quarter of respondents (35.48%) were not willing to pay (Table 3). This study asked passengers why they were not willing to pay for offsetting carbon emissions for their flight (Table 4). A total of 53.67% of passengers specified that they were not willing to pay because the airfare is already expensive or costly, which makes them not favourable with an extra payment. In total, 27.67% think that the government and airline companies should cover the cost for emission reduction because passengers believe the burden should not be transferred to the passengers. Airline companies and the government should cooperate with each other to overcome this problem.

Table 3 Respondents' response to the probability of WTP

Response	Frequency	Percent (%)
Yes	531	64.52
No	292	35.48
Total	823	100

Figure 1 shows the perception among air travellers about the distribution of responsibility for emissions. Air travellers put their responsibility last, after the government, aircraft producers, and airline company. Some of the respondents think it is entirely not their responsibility to reduce the emissions released, but it goes to the aircraft producers and airline company, as they need to control it from the base, and not transfer the burden to the travellers (Gössling et al. 2009; Lu and Shon 2012; Blasch and Farsi 2014). Besides, some also think that the government needs to play a role in a way to reduce the emissions by charging a green tax to the airline companies or subsidies for the carbon offset program.

Estimation of willingness to pay

Table 5 indicates the frequency analysis of each bidding price for the double-bounded dichotomous choice. The price for an additional charge of airfare ranged between RM10.00 and RM100.00 per person. The higher the bid price offered, the smaller the number of respondents that say "yes". Previous research also found that as the bid price increases, the willingness to pay among passengers decreases (Mitchell and Carson 1989; Brouwer et al. 2008; Lopez-Feldman 2012).

An initial estimation of the model using all the demographic characteristics as independent variables reveals that all variables come out with different results in the double-bounded model. WTP was the dependent variable in this study. The maximum likelihood estimates of the specification for the double-bounded logit model are estimated using STATA, version 11. The logit model for double-bounded is as in Eq. (1), and the results are as shown in Table 5. Passengers' income is significant at 5% and shows a positive sign, which means it gives a positive impact on the willingness to pay. The determinant is consistent with the economic theory, as the good increases with income. It denotes that as passengers' income increases, respondents' probability of saying "yes" increases too. A respondent with a high income is willing to pay for the additional cost of carbon offset, as they are willing to sacrifice some value of money to have a better environmental performance. These results are consistent with those of Masud et al. (2015) and Brouwer et al. (2008).

The McFadden pseudo R^2 is usually computed to assess the fitness of the logit model. It is exactly not the same as the R^2 statistic obtained from linear regression models. Usually, the value of Pseudo R^2 is smaller than the conventional R^2 (Hensher et al. 2005). According to Louviere (2001), a pseudo

Table 4 Respondents' reason for not willing to pay for the carbon offset program

Reason	Percentage (%)
Airfare already expensive (costly)	53.67
Government and airlines company should cover the cost	27.67
Other reason	18.66

R^2 shows a good model fit when the value is ranged between 0.2 and 0.4. The McFadden Pseudo R^2 value for the logit model is 0.1022.

Occupation is one of the variables that have a positive relationship with WTP and significant at 1% level for double-bounded. It demonstrates that as respondent's occupations become more professional or working as full-time employee, they are willing to pay more for their airfare for a carbon offset program. The relationship between occupation and WTP is as expected in this study. As people working in a good position, they willing to pay more to have a better environment. Working people travel more using air transportation for their business matters. Thus, they are more aware of the problem arise and willing to contribute to tackling that problem.

Variable education in Table 6 is significant at 1% with a positive sign in the double-bounded model, shows that the more educated respondent is willing to pay extra for their airfare to take care of the environment. This result follows as previous research finding (Lim and Yoo 2014). Variable age is significant at 5% for double-bounded with the correct expected sign, which is a positive sign. These show that as the respondent's age increase or as they are getting older, they are willing to pay more to save the environment. The reason is that they want to take care of the environment for the future generation and also because of the issues of global warming is critical. The old respondent is more consent about the environment compared to young respondents. This result is different from the result attained by Lu and Shon (2012), and age has a negative relationship with willingness to pay as it describes that younger respondents are more likely than older respondents to pay a higher rate of WTP.

However, gender and offset information are not significant and offset information has a negative sign. This can relate to Table 2, where 52.98% do not know what carbon offset is. Thus, this can be concluded that most passengers did not have any idea or knowledge of carbon offset program, because only 0.97% of passengers have experienced buying a carbon offset.

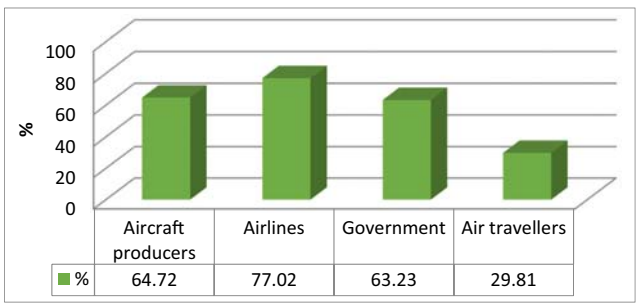

Fig. 1 Air travellers' perception of responsibility for emissions

Based on the estimation results, the mean WTP can be calculated manually using the estimation model by Cameron (1988). However, for this study, it is estimated using the STATA software. Mean WTP was presented in Malaysian Ringgit (MYR).[1] The calculated mean WTP ranged from RM73.74 to RM98.28 based on 95% confidence interval (Table 7). Thus, the mean value of WTP of this study is RM86.00, in which the calculation for mean WTP only included the variable that is significant in the model to have a better environmental performance. The mean WTP is still in the range of bidding price (minimum bidding price at RM5.00 and maximum bidding price at RM100.00). Furthermore, it finds that the amount of WTP calculated is higher than the stated as the first bid towards the end and gives a result that airlines fare for travel can be set at a higher price, as the mean value calculated. If the airlines (MAS and Air Asia) would like to implement the carbon offset program in reducing the emissions from their flight, RM86.00 can be a base value for them to set for a price. The price can be lower than RM86.00 or the maximum is RM86.00, because this value is the mean value that Malaysian airline passengers are willing to pay for carbon offset program.

$$\text{Mean WTP} = \frac{\beta_0 + (\sum \beta_2 x_2 + \ldots + \beta_k x_k)}{-\beta_1} \tag{9}$$

where β_0 is the estimated constant, β_2, …, β_k is the estimated parameters of the coefficients, x_k is the mean value of explanatory variables, and β_1 is the estimated coefficient on the BID (Cameron 1988).

Conclusions

The objective of this study is to estimate the appropriate price level for the willingness to pay for carbon offsets, to have a better environmental performance. The CVM method was used to evaluate the value of people willing to pay for carbon offsets. The study has shown that Malaysian airline passengers are willing to pay about RM86.00 for carbon offset program. Passengers believed that reducing the emissions from their travel is their responsibility, and some of them are aware

[1] As the rates from the Interbank Foreign Exchange Market in Kuala Lumpur (Bank Negara Malaysia) on the 1st of June 2018: RM1.00 = $3.9835

Table 5 Respondents' response to the offered price

WTP					
Price bid	No (0)		Yes (1)		Total
	Frequency	Percent (%)	Frequency	Percent (%)	
RM10.00	23	13.94	142	86.06	165
RM25.00	39	24.38	121	75.63	160
RM50.00	72	43.90	92	56.10	164
RM75.00	68	42.24	93	57.76	161
RM100.00	90	52.02	83	47.98	173
					823

of the environmental problem which is a climate change problem. Thus, they decide to contribute and are willing to pay for some amount as an additional price for their airline ticket. This study is a way to addressing alternatives to reducing environmental impact, in terms of carbon emission for Malaysia as it is approaching as the second largest carbon emitter in South-East Asia. Other than giving such alternatives, this study is hoping to influence people's attitudes, raising awareness, and encouraging people to change in behaviour to promote WTP.

The government should support airline companies in realizing carbon offset program in air transportation as one of the ways to reduce carbon emissions from this sector. Education regarding environmental problems, such as climate change, greenhouse gases (GHG), and global warming, must be implemented starting from primary school. The policymakers should provide early exposure to children about the importance of the environment, and this education must continue until at the university level. These can help in developing an environmental attitude and awareness among them. As it is hard to fix any rules in reducing emissions in air transportation, thus, a voluntary carbon offset program will be the best way of reducing emissions in air transportation. Make it as voluntary before changing it to mandatory. In the early stage, voluntary will be the best choice.

Besides, the government should play a role in monitoring and auditing the program regularly. These are to ensure that the program can run smoothly. The government should provide some incentives to encourage airlines to integrate with carbon offset, such as giving a subsidized project, to support carbon offset program, and finance-related companies or parties that are involved in the success of carbon offset program. Furthermore, it is feasible for policymakers to expose Malaysian to the importance of the environment, to maintain its sustainability, and to the problem of climate change that is happening, thereby potentially increasing the participation levels of carbon offset program and to change the mentality of Malaysian towards nature.

Another suggestion to make carbon offset program can be achieved include making a purchase of carbon offset mandatory, in which the cost for carbon offset is incurred automatically in the ticket price along with other additional costs, such as airport taxes and fuel surcharges. A carbon tax is one of the examples if the government wants to implement it as a mandatory payment, where the carbon tax is a fee imposed on the burning of carbon-based fuels such as oil. It can be implemented in mandatorily not only for airlines but also for road transportation. Another thing that the policy-makers can make to promote carbon offset is by offering carbon offset not only while purchasing a ticket but also making it outside or after buying a ticket. The government should set up or create one application that allows passengers to calculate and offset their carbon after travel individually or by group, for example, like investing in carbon offset program, through offset's website (Carbon Footprint TM, Climatecare website, Terrapass.com, Carbonfund.org, etc.). Even though carbon offset is still new in Malaysia, the government can adopt and implement it.

Taken together, these results suggest that airlines should be carried out to assess ways to improve, review, modify, and relaunch carbon offset program from the past. Carbon offset program can be realized in air transportation. The payment options for carbon offset in air transportation can be an offer by opt-in and opt-out: the passengers pay for the offset, for example by ticking a box at the time of the ticket purchase. If the passengers wish not to offset, they can untick the box for compensating. The airline needs to find partner organizations to find and vet high-quality projects to reduce emissions.

The airline interface, which airline's staff (those dealing directly with the public, media, and decision-makers) should be well informed about the offset program. They should be

Table 6 Results of double-bounded regression model

Variable	Coeff.	Std. error
Constant	3.2278	15.1758
Income	0.0019**	0.0009
Education	2.0612***	0.5604
Occupation	5.2302***	1.3513
Gender	4.0923	4.6812
Age	0.6186**	0.2613
Offset info	− 5.2422	3.2612
Number of respondents	823	
Log-likelihood function	− 1019.8978	
Pseudo R^2	0.1022	

***, **, and * denote levels of significance at 1%, 5%, and 10%, respectively

Table 7 Estimated of WTP

	Lower value	Mean	Upper value
Double bounded	RM73.74	RM86.00	RM98.28

included in the preparations for the launch of the program and should be briefed on the general information about carbon offset. Passengers and the public should be informed, and the carbon offset program must be officially advertised. Thus, the information about carbon offset can be clearly explained. Easy access: passengers should be able easily to access information on the nature of the program including what emissions are being offset and how they are calculated, where the money goes, location of the project, and the project development organization.

Taken together, these findings suggest that airlines could give certain sorts of offset project to air travellers in achieving an efficient carbon offset program. Firstly, this study demonstrated that respondents esteem forest management projects the most (generate the highest utility). Airlines could consequently choose to offer this type of project to their customers to get a higher uptake of the offset program. Although renewable energy and energy efficiency projects give a relatively low WTP, the overall WTP for an offset that includes forest management will be much higher. Airlines should, therefore, promote forest management when supporting another project, linking all the project together. Besides, since respondents were willing to pay generously more for offset project happening abroad, which is in another nation, thus, airlines could put resources in projects that are located elsewhere yet give a higher utility to respondents. Airlines could consider disguising the offset cost into their ticket cost (with appropriate marketing and communication). Airlines may likewise look for a government subsidy to promote carbon offset program to increase air travellers' awareness.

In conclusion, the findings of this research provide insights for airline companies to impose an additional fee on top of the ticket price to have a better environmental performance. Besides, this study can encourage Malaysian airlines to implement the carbon offset program as a new way to reduce CO_2 emission in Malaysia. Overall, this study strengthens the idea that carbon offset can be done in airline transportation as one of the alternatives in reducing the emission from travel.

Acknowledgements The authors are grateful to the anonymous reviewers for the valuable comments that helped to considerably improve the manuscript.

Funding information This study is financially supported by the research grants from the Fundamental Research Grant Scheme (FRGS) under the Ministry of Education, Malaysia (Project Code: FRGS/1/2016/SS08/UPM/02/4).

References

Afroz R, Hassan MN, Awang M, Ibrahim NA (2005) Willingness to pay for air quality improvements in Klang Valley Malaysia. Am J Environ Sci 1(3):194–201

Arrow K, Solow R, Portney PR, Leamer EE, Radner R, Schuman H (1993) Report of the NOAA panel on contingent valuation. Fed Regist 58(10):4601–4614

Bazrbachi A, Sidique SF, Shamsudin MN, Radam A, Kaffashi S, Adam SU (2017) Willingness to pay to improve air quality: a study of private vehicle owners in Klang Valley, Malaysia. J Clean Prod 148:73–83

Bateman IJ, Carson RT, Day B, Hanemann M, Hanley N, Hett T, ... Sugden R (2002). Economic valuation with stated preference techniques: a manual.

Becken S, Hay J (2012) Climate change and tourism: from policy to practice. Routledge

Blasch J, Farsi M (2014) Context effects and heterogeneity in voluntary carbon offsetting–a choice experiment in Switzerland. J Environ Econ Policy 3(1):1–24

Brouwer R, Brander L, Van Beukering P (2008) "A convenient truth": air travel passengers' willingness to pay to offset their CO 2 emissions. Clim Chang 90(3):299–313

Calia P, Strazzera E (2000) Bias and efficiency of single versus double bound models for contingent valuation studies: a Monte Carlo analysis. Appl Econ 32(10):1329–1336

Cameron TA (1988) A new paradigm for valuing non-market goods using referendum data: maximum likelihood estimation by censored logistic regression. J Environ Econ Manag 15(3):355–379

Chang JS, Shon JZ, Lin TD (2010) Airline carbon offset: passengers' willingness to pay and reasons to buy. In: 12th World Conference on Transport Research (WCTR), Lisbon, pp 11–15

Chapman L (2007) Transport and climate change: a review. J Transp Geogr 15(5):354–367

Cheung J, Kragt M, Burton M (2015). The awareness and willingness of air travelers to pay for voluntary carbon offsets and their co-benefits. Working Paper, School of Agricultural and Resource Economics, University of Western Australia, (1505)

Choi AS (2015) An experimental study to explore WTP for aviation carbon offsets: the impact of a carbon tax on the voluntary action. J Environ Plan Manag 58(9):1617–1634

Cliffe AD (2014) An investigation of UK passenger attitudes towards the carbon offsetting of both flight and airport emissions, *Unpublished master's thesis*. University of Chester, Chester

Fatihah SN, Rahim AA (2017) The willingness to pay of air travel passengers to offset their carbon dioxide (co2) emissions: a Putrajaya resident case study. J Tour I(5):18–32

Gössling S, Broderick J, Upham P, Ceron JP, Dubois G, Peeters P, Strasdas W (2007) Voluntary carbon offsetting schemes for aviation: efficiency, credibility and sustainable tourism. J Sustain Tour 15(3): 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? Curr Issue Tour 12(1):1–19

Hanemann WM (1984) Welfare evaluations in contingent valuation experiment with discrete responses. Am J Agric Econ 66(3):332–341

Hanemann M, Loomis J, Kanninen B (1991) Statistical efficiency of double-bounded dichotomous choice contingent valuation. Am J Agric Econ 73(4):1255–1263

Hensher DA, Rose JM, Greene WH (2005) Applied choice analysis: a primer. Cambridge University Press

Hinnen G, Hille SL, Wittmer A (2017) Willingness to pay for green products in air travel: ready for take-off? Bus Strateg Environ 26(2):197–208

Krejcie RV, Morgan DW (1970) Determining sample size for research activities. Educ Psychol Meas 30(3):607–610

Lim HJ, Yoo SH (2014) Train travel passengers' willingness to pay to offset their CO2 emissions in Korea. Renew Sust Energ Rev 32: 526–531

Lopez-Feldman A (2012). Introduction to contingent valuation using Stata (MPRA paper no. 41018). *Toluca, Mexico: Centro de Investigacion y Docencia Economicas (CIDE)*

Louviere JJ (2001). Choice experiments: an overview of concepts and issues. The choice modelling approach to environmental valuation, 13

Lu JL, Shon ZY (2012) Exploring airline passengers' willingness to pay for carbon offsets. Transp Res Part D: Transp Environ 17(2):124–128

MacKerron GJ, 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(4):1372–1381

Mair J (2011) Exploring air travellers' voluntary carbon-offsetting behaviour. J Sustain Tour 19(2):215–230

Malaysia Airports Holdings Berhad (2015) 2015 annual report of the Malaysia Airports. Retrieved from https://www.klsescreener.com/v2/announcements/view/643000

Masud MM, Al-Amin AQ, Akhtar R, Kari F, Afroz R, Rahman MS, Rahman M (2015) Valuing climate protection by offsetting carbon emissions: rethinking environmental governance. J Clean Prod 89: 41–49

Mitchell RC, Carson RT (1989) Using surveys to value public goods: the contingent valuation method. Resources for the Future, Washington, DC

Somerville H (2003) Transport energy and emissions: aviation. In: *Handbook of Transport and the Environment*. Emerald Group Publishing Limited, pp 263–278