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Sustainability or Bust: Malaysian Home Buyers' Stated Preferences for Sus-Tainable Housing

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Abstract. The lack of data on sustainable home buying behaviour in developing countries such as Malaysia is due to the absence of sustainable housing itself. However, it is still possible to solicit home buyers for their stated preferences and quantify its effects on housing demand. In this study, a sample of 300 responses to a Discrete Choice Experiment (DCE) on sustainable housing features was analysed using the "support.CEs" program. This study found that the addition of sustainable features; renewable energy generation, enhanced soundproofing and ventilation, energy saving features, and higher green area ratios significantly increase home buyer's willingness to pay (WTP) for sustainable housing.

1 Submitting the manuscript

The notion of sustainable housing, previously absent from public consciousness, is slowly coming to the fore in de-veloping countries such as Malaysia [1]-[4]. However, de-velopers are yet to catch up to this sentiment change [5], resulting in the unavailability of sustainable housing to match these changing attitudes.

Under-development in the past has blessed Malaysia with potential sustainability gains in energy efficiency and greenhouse gas emissions [6]. However, these gains have not realised because it is more effective to build sustain-ability into new projects [1], including sustainable housing, rather than retrofitting existing buildings. Because of this, it is important to get developers into building sustain-ably sooner rather than later, from the get-go instead of than as a bolt-on to previously less sustainable plans.

A major reason cited by developers for not building sustainable housing is the perceived lack of demand [5], which leads to the current catch-22 on Malaysian sustain-able housing: developers won't build without knowing if home buyers will buy and it is impossible to know if home buyers will buy unless developers build.

However, by adapting Discrete Choice Experiments (DCE), a technique used in non-market valuation [7], to evaluate Malaysian sustainable housing demand it is possible to know the Willingness to Pay (WTP) for the incorporation of sustainable features in homes amongst Malaysian home buyers.

2 Research methodology

2.1 Experimental design

As with all attribute-based methods for eliciting stated preferences, the one first steps in eliciting home buyer preferences for sustainable features in homes is to identify and describe the attributes that define the choices given to respondents [8]. For this purpose, the authors have resorted to the definitions for sustainable housing used in sustain-able building standards, namely the Green Building Index (GBI) [9] to suit the Malaysian home buying public. The authors reasoned that using established standards provides a ready baseline to define "sustainability" in real estate and enhance the applicability of this study's results.

The experimental design of the overall survey is based on the L^{MA} design[1] generated internally from the support.CEs program [11], where the experimental design is directly from the orthogonal main effects plan [12]. This experimental design is generally larger than most orthogonal main effects plan for DCEs [13], which the authors mitigate through effective separation of the choice sets into multiple blocks; subsets of choice sets.

Based on previous evidence, the authors have decided to construct the survey based on six choice sets of two options each containing six attributes of three or two levels, separated into six blocks. Figure 1 is a sample of a question in the survey, where respondents choose options 1, 2, or neither options to indicate their preference in sustain-able housing.

The authors have decided to incorporate pictorials and colour coding to allow the survey's attribute and attribute levels to be more easily understood. This follows the effects of "traffic light" system which enhances the

[1] The L^{MA} design is defined in Viney *et al.* as an experimental design, where L is the number of levels, M is the number of alternatives in each choice set, and A is the number of attributes for each alternative [10].

visibility of pertinent information [14]. Also, having a more "game-like" survey technique, which include more visual rather than textual information, leads to a more enjoyable experience for respondents [15].

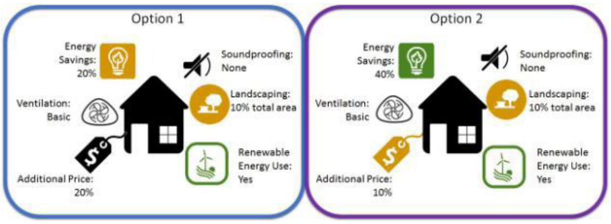

Figure 1. Question 1, block 1.

2.2 Theoretical background

The basis of many attribute-based methods such as DCEs is the assumption that agents would choose alternatives yielding the highest utility, also known as the Random Utility Theory [2] [17]. Assuming respondent i selects alternative j to maximise his or her utility. The utility from making the choice, U_{ij} can be decomposed into:

$$U_{ij}=V_{ij}+e_{ij} \tag{1}$$

where V_{ij} is the systematic component of the utility of respondent i from selecting alternative j, and e_{ij} is the stochastic component of the utility [18]. The systematic component of the utility is assumed to be as follows:

$$V_{ij} = ASC+b_1 EN_{ij}+b_2 SD_{ij}+b_3 VN_{ij}+b_4 LD_{ij}+b_5 R_{ij}+b_6 PR_{ij} \tag{2}$$

where ASC denotes an alternative specific constant for housing choices relative to the 'neither' option, where the systematic component of the utility for the option is normalised to zero. The definitions for other variables are tabulated in Table 1:

Table 1. Variable definition.

Coef.	IV	Type	Definition
b_1	EN_{ij}	Continuous	Percentage of energy saved from the respondent's energy consumption
b_2	SD_{ij}	Dummy	Enhancement of interior soundproofing
b_3	VN_{ij}	Dummy	Enhancement of indoor ventilation
b_4	LD_{ij}	Continuous	Percentage of development area set aside for landscaping and recreational uses
b_5	R_{ij}	Dummy	Production of renewable energy within the development area and usage of renewable energy in common areas
b_6	PR_{ij}	Continuous	Increase in price as a function of the respondent's perception of house price

[2] A further exposition of this theory and its applications to DCEs can be found in Alberini *et al.* [16]

2.3 Survey methodology

This survey was carried out online using Google Forms as its basis, which allowed for branching questionnaires that enabled effective separation of the choice sets into blocks that reduce the number of choice sets faced by respondents, which significantly reduce complexity [19] and lessens respondents' cognitive burden [20].

The preliminary sections of the survey include basic demographic information; age, income, education, and employment which allows the authors to separate the WTP for sustainable features against different demographic groups. Previous studies have shown that demographics affect WTP for sustainable housing features [21], [22], which the authors believe is also the case amongst Malaysian homebuyers.

The following section looks at the respondents' current housing situation, including home ownership, current type of house, and future housing purchase decisions. The most pertinent of these questions is whether future house purchases is for investment or own use, which has been shown to affect WTP for sustainable housing [23].

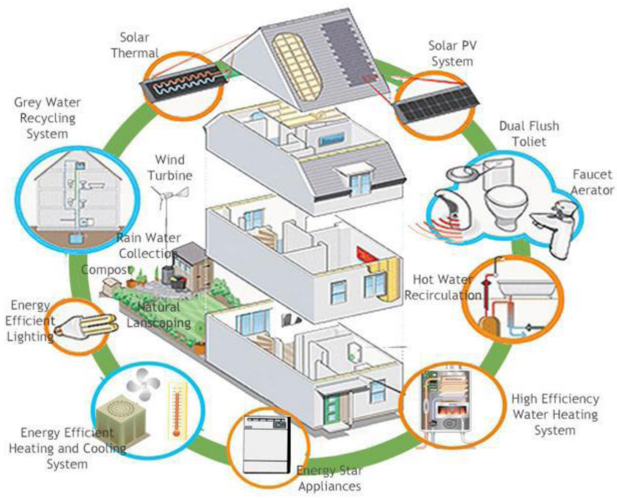

Figure 2. Illustrated list of sustainable features in homes.

This survey also includes a set of primer questions (see Figure 2) that is meant to shift respondents' thoughts towards sustainability and sustainable behaviour. The survey provides respondents with a list of sustainable features and sustainable behaviours [24] for them to acknowledge either knowing or performing.

While this section of the survey is not analysed further, the authors believe it is useful to get respondents who would not have otherwise thought of sustainability and sus-tainable features in homes to consider the breadth of possibilities in sustainable housing.

3 Results

3.1 Respondent demographics and home ownership

This survey sustainable home buying preferences from 50 respondents. A summary of respondent demographics is given in Table 2.

Table 2. Summary of respondents‟ demographics (number of respondents, n=50).

Category		n (%)
Age		
18-25	6	(12%)
26-35	23	(46%)
36-45	12	(24%)
46-55		4 (8%)
>55		3 (6%)
Prefer not to say		2 (4%)
Education		
High school or lower		1 (2%)
Undergraduate Degree	24	(48%)
Postgraduate Degree or higher	24	(48%)
Prefer not to say		1 (2%)
Annual Income		
less than MYR 10,000	6	(12%)
MYR 10,000 - MYR 35,000	12	(24%)
MYR 35,000 - MYR 70,000	15	(30%)
more than MYR 70,000	12	(24%)
Prefer not to say	5	(10%)
Employment		
Unemployed		4 (8%)
Student		4 (8%)
White collar	34	(68%)
Blue collar	8	(16%)

Table 3. Summary of respondents‟ housing circumstances (number of respondents, n=50).

Category		n (%)
Current house type		
Apartment/Condominium	21	(42%)
Detached/Semi-Detached	8	(16%)
Terrace/Town-house	20	(40%)
Prefer not to say		1 (2%)
Home ownership length		
Not home owner	22	(44%)
Less than 2 years	7	(14%)
Between 2 - 5 years	6	(12%)
More than 5 years	15	(30%)
First home		
True	8	(16%)
False	8	(16%)
Not applicable	14	(28%)
Unknown	20	(40%)
Planned future purchase		
No purchase intention	13	(26%)
MYR 100,000		2 (4%)
MYR 100,001-200,000	5	(10%)
MYR 200,001-300,000	6	(12%)
MYR 300,001-400,000	7	(14%)
MYR 400,001-500,000	9	(18%)
MYR 500,001-600,000		3 (6%)
MYR 600,001-700,000		1 (2%)
MYR 800,001-900,000		3 (6%)
MYR 900,000		1 (2%)

Following these questions, respondents are given a preamble on the main part of the survey and a choice of selecting one of six blocks prepared for this DCE. Each block consists of six questions each with two options and a null option.

Due to the respondent sampling methodology, it was expected that age groups, income, employment, and education demographics are skewed towards young, lower mid-income, white collar university graduates. Majid *et al.* [25] has shown that these demographic factors are major determinants to home ownership and that a previous study on first time home buyers in Syahid *et al.* [26] exhibit these same demographic characteristics.

From a home ownership perspective, this study also evaluated respondents' present housing situation, enquiring about their current house type, ownership status and length, as well as their future housing situation; their bud-get and purpose for future house purchases. These are summarised in Table 3.

Here, we can see that the most respondents are not home owners, but instead are renting the condominiums, apartments, terraces, or town-houses they are currently living in. This is symptomatic of the sampling methodology, which relies on the authors' personal acquaintances through social media channels. Most are willing to spend upwards of MYR 500,000 to purchase their future house.

While it would be interesting to see how demographics such as age and income affect home ownership, limited data prevents competition of this study against more through analyses such as in Tan [27].

3.2 Home buyer stated preferences

Based on a sample of 300 responses[3], the following esti-mations were run using the "support.CEs" program [11]. After the survey responses are encoded into a form legible by the program and supplementing it with previously generated survey design information, the commands are run to provide estimates for Malaysian home buyers' WTP for sustainable features using the conditional logit framework, shown in Table 4.

The results show the estimated coefficient; *coef*, its exponential; *exp(coef)* and standard error; *se(coef)*, z-, and p-values for each variable. The former three form the ba-sis for further WTP estimations while the latter indicate the results' statistical significance, which evidence all vari-ables to be statistically significant. Similarly, the p-value of the likelihood ratio test, which tests the null hypothesis of all coefficients being zero, also show that the estimation as a whole is statistically significant.

Table 4. Conditional logit estimation results.

	coef	exp(coef)	se(coef)	z	p
ASC	0.44	1.55	0.62	0.70	$4.80e^{01}$
No Renewables	-0.85	0.43	0.34	-2.5	$1.20e^{02}$
Enhanced Soundproofing	0.64	1.89	0.35	1.81	$7.10e^{02}$
Enhanced Ventilation	0.44	1.55	0.32	1.36	$1.70e^{01}$
Energy	0.06	1.06	0.013	4.47	$7.70e^{06}$
Landscaping	0.035	1.04	0.02	1.76	$7.80e^{02}$
Price	-0.03	0.97	0.019	-1.58	$1.10e^{01}$

Likelihood ratio test=93.9 on 7df, p=0 n=360, number of events=120

[3] Based on the sample calculation methodology highlighted in Aizaki et al. [12]: Number of respondents questions per respondent

Table 5. Marginal WTP estimations.

	MWTP	2.50%	97.50%
No Renewables	-27.802	-234.293	155.671
Enhanced Soundproofing	20.909	-94.779	166.089
Enhanced Ventilation	14.352	-93.299	154.339
Energy	1.829	-9.82	14.629
Landscaping	1.152	-6.594	11.176

method = Krinsky and Robb

Further goodness of fit tests are conducted using the "gofm()" function, with the output as follows:
Rho-squared = 0.36
Adjusted rho-squared = 0.30
Akaike Information Criterion (AIC) = 183.79
Bayesian Information Criterion (BIC) = 203.31
Number of coefficients = 7
Log likelihood at start = -131.83
Log likelihood at convergence = -84.90

The rho-squared and adjusted-rho squared values also indicate a good fit, since it lies between 0.2 and 0.4 [7]. Because this study does not include comparisons between models, the Akaike and Bayesian information criteria will not be analysed further.

The conditional logit estimates are then fed into the "mwtp()" function which calculates the average marginal WTP as well as the two-tailed 5% confidence intervals. The latter is produced using the Krinsky and Robb method [28], which calculates simulated WTP values, sorts these values, and selects values corresponding to the desired confidence levels.

All the marginal WTP estimations show the expected signs for the presence (or absence, as in the case of renew-able energy generation) of sustainable features. All fig-ures are shown as percentage increase or decrease in house prices.The confidence intervals mainly indicate that, given the simulated WTP values generated through the Krinsky and Robb method, that there is 95% confidence the results lie in between the values tabulated in Table 5.

Table 6. Marginal WTP in monetary terms.

	MWTP
No Renewables	-91312.89
Enhanced Soundproofing	68673.52
Enhanced Ventilation	47137.71
Energy	6007.17
Landscaping	3783.63

All figures given are in MYR

4 Discussion

The results indicate that for all sustainable features highlighted, Malaysian home buyers are willing to pay a premium to have these features included in their homes. The survey is worded in such a way to imply that these are new home purchases, therefore these results are not applicable for retrofitting of such features, which is shown to be a different kettle of fish altogether [29]. Unlike buying a new home, more factors need to be taken into account in sustainable retrofitting works [30], thus would require a different approach compared to the relative genericisation of the home buying process used in this study.

This study also chimes with previous works on Malaysian sustainable home buying behaviour. Jusoh *et al.* [2] showed that Malaysian home buyers are keen on sustainable housing features; CO_2 emissions, rainwater harvesting, natural ventilation, and landscaped areas, although the analysis does not show home buyers' WTP for these features individually. Bertrand [1] also gives evidence that the majority of interested sustainable housing buyers in Malaysia are willing to pay a 5% premium over conventional housing.

Because this study uses percentage increases in house prices to represent the cost of including sustainable features in lieu of an actual price [2], it is not possible to replicate real world price comparisons as seen in Park et al. [21]. However, taking a simple average of prices respondents are willing to pay for their next house; MYR 328,440, and using the marginal WTP results produced in this study (see Table 5), it is possible to show how much the average home buyer is willing to pay for the sustainable features highlighted in this study, as tabulated in Table 6. The fact that no studies have been done to compare WTP with market prices highlight the need to have such research conducted amongst Malaysian home buyers.

5 Conclusion

This study has shown that amongst Malaysian home buyers, there exists positive WTP for sustainable housing. This information is presented as percentage premia over the price of conventional housing, which could be useful for developers in deciding the limits they can charge for any one sustainable feature, given current house prices.

While sustainable premia in dollar terms is unclear based on this study, it would be interesting to see if the linear relationship between house prices and sustainable features implied in this study carries over when real prices are applied. Additionally, the respondents in this study are mainly highly educated urban dwellers within the Kuala Lumpur conurbation, will be overcome in future studies.

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