WILLINGNESS TO PAY FOR SUSTAINABLE HOUSING: A TALE OF PAKISTANI BUYERS

A thesis submitted in partial fulfillment of the

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by

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THESIS ACCEPTANCE CERTIFICATE

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This thesis is dedicated to my family and my respected teachers!

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ABSTRACT

This study examines the sustainable housing sector of Pakistan by describing the sustainable housing buyers' profile and quantifying willingness to pay for sustainable housing uptake in the market. Willingness to pay (WTP) for sustainable housing is estimated through a survey of 354 perspective homebuyers. Hierarchical Bayesian model of adapted choice-based conjoint analysis is utilized to study the correlation of descriptive determinants on WTP for sustainable housing. The results suggest that demographical factors of age, gender and education level positively correlate with WTP whereas environmental knowledge and income level negatively correlate with WTP. The study contributes a vital empirical input to the literature by finding the potential sustainable homebuyers in Pakistan.

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Chapter 1

INTRODUCTION

1.1. Background

Buildings consume as much electricity as transport and industrial sectors combined (Balaras, Droutsa, Dascalaki, & Kontoyiannidis, 2005; Oh, Lalchand, & Chua, 2014; Vázquez-Canteli, Ulyanin, Kämpf, & Nagy, 2019), and produce 38% - 50% greenhouse gases (Stojiljković, Ignjatović, & Vučković, 2015; Sandanayake, Zhang, & Setunge, 2016; Amasyali, El-Gohary, & Reviews, 2018). Specifically, the residential buildings consume a 40% of total energy produced due to heavy cooling and heating loads as well as electrical appliances (Swan & Ugursal, 2009; E. J. O. J. E. U. Council, 2010; *US EIA, "Annual energy review - Energy consumption by sector," 2013*, 2013). Various efforts are made at policy and practice levels to control this massive energy consumption. At policy level, the public bodies promote the uptake of green buildings (Alberini, Banfi, & Ramseier, 2013; Ghattas, Gregory, Miller, & Kirchain, 2015) in a response to alleviate excessive energy utilization and environmental impacts as sustainable buildings are capable of reducing 35% of CO_2 emissions compared to conventional buildings (U. G. B. Council, 2003). At the practice level, studies report behavioral training for energy optimization (Zainul Abidin, Yusof, & Othman, 2013; Xie, Lu, & Gou, 2017). The geographic and climatic factors, construction materials and methods, and the financial status of the homeowner are some of the variables that can increase energy optimization.

Sustainability of the built environment integrates energy-efficient buildings with the environment-friendly layout to reduce adverse environmental effects (Johar & Razak, 2015). Sustainable buildings provide significant benefits to residents such as health, wellbeing and productivity, reduced resources consumption, lesser maintenance expenses, and improved indoor environment (Ries, Bilec, Gokhan, & Needy, 2006; Balaban & de Oliveira, 2017; Darko & Chan, 2017), while developers can benefit from the improved corporate image and increased competitiveness (Isa, Rahman, Sipan, & Hwa, 2013). In the past two decades, the role of housing in the broader discussion on climate change has been emphasized (Ellis, 2009), resulting into a belief that it must commit to its environmental responsibility by delivering sustainable buildings (Maliene & Malys, 2009). Mere lip service cannot achieve a sustainable built environment for the community. In the face of such a push due to the significant share of carbon emissions due to the housing industry, it is starting to experience an exemplary transformation, making sustainable housing a new architectural reality (Yudelson, 2010; Olubunmi, Xia, & Skitmore, 2016). This transformation is evident in some developing countries like Malaysia (Jusoh, 2015) and China (Zhou, 2015) but other developing countries like Pakistan have not experienced a high level of sustainable development. However, there is a silver lining in this destitution due to potential sustainability gains in energy efficiency and sustainable development (Schwab, 2017). To realize these gains, sustainable practices must be introduced into new sectors including housing (Bertrand & North, 2010).

But inducing sustainability requires a market-oriented approach and the developing countries have a very feeble demand for sustainable housing (Yau, 2012b) mainly because of the scarcity of reliable and accurate evidence to convince owners to invest in sustainable housing (Luo, Kanzaki, & Matsushita, 2017). Although there is no data explaining that such information would actually encourage home buyers to invest in sustainable housing (Li Zhang, Sun, Liu, & Zheng, 2016), research should be conducted to investigate the buyers' willingness to pay (WTP) for sustainable housing in developing countries (Syahid, Tareq, & Zaki, 2016). As a developing country, Pakistan presents such characteristics which enhance the appeal of sustainable housing. The costly electricity is one such characteristic that can lead to better acceptance of sustainable housing (Gracia, Barreiro-Hurlé, & y Pérez, 2012). While constructing and promoting sustainable housing is up to the real-estate developers, homebuyers, being the last link of this supply chain, significantly influence this market through their WTP (Zhang, Sun, Liu, & Zheng, 2016). Research also suggests that recognizing early buyers and their characteristics promote the adoption of sustainable products in a market (Pinkse & Dommisse, 2009; Winston, 2010).

To identify and analyze the profile of early homebuyers, there are two necessary insights; an individual is willing to change and then willing to pay an additional upfront price for sustainable housing. Conjoint Analysis (CA) is the most famous method that has been utilized over the years to investigate these barriers (Huber, 2005). In a contingent value experiment, face to face interviews with future buyers are conducted by creating a representative (but imaginary) market setup that is initiated by explaining a technology or attribute and concluded over respondents expressing their WTP for it (Thiel, Alemanno, Scarcella, Zubaryeva, & Pasaoglu, 2012).

This study investigated the potential sustainable homebuyers in Pakistan and their characteristics. It evaluates their willingness to change before giving perspective homebuyers general information on the sustainable home and WTP after giving them this information. The quantification of WTP is also done to identify perspective sales of sustainable housing. ACBC (Adaptive Choice-Based Conjoint) analysis is utilized to investigate the influences of a group of descriptive factors on WTP for sustainable housing. Three relevant issues of knowledge, attitude, and behavior towards the environment are also measured to determine individual decision towards sustainable housing.

This study presents a significant experimental input to the literature by recognizing the possible pool of perspective sustainable homebuyers in Pakistan. The results reveal that a higher price premium (PP) affects perspective sustainable homebuyers' decisions in current conditions due to nonexistent government policies and subsidies. The results also confirm that willingness to pay positively correlates with age, and education level, and negatively correlates with income level and environmental knowledge.

1.2. Research problem

Sustainable housing is still a very new concept to Pakistan. Therefore, it is thought-provoking to promote sustainable housing because developers say there is no reliable information about demand. The point of view of buyers is that there is no information about sustainable housing attributes provided to them. This forms the origin of the study: A reliable information does not exist for developers and buyers of the Pakistan housing sector. Such research would identify early buyers' profile and preferred sustainable housing attributes for the promotion and adoption of sustainable housing in Pakistan.

1.3. Reasons for selection of the topic

Following are the reasons for selection of this topic:

1. There is a dearth of research that quantifies the willingness to pay for sustainable housing of potential home buyers in Pakistan.
2. To investigate the antecedents of households' intention to adopt and willingness to pay for green housing in Pakistan.
3. Lack of reliable and accurate information about green attributes of green housing that could in fact promote homebuyers' investment in green housing.
4. Lack of information about potential green home buyers that would make planners and designers realized to orient their business toward sustainable construction.
5. Inefficient energy utilization and excess greenhouse gases emission from residential buildings in Pakistan.
6. Lack of awareness about environmental attitude, environmental behavior and environmental knowledge in homeowners in Pakistan.

1.4. Research objectives

The objectives of this research are:

1. To identify determinants and factors that effects willingness to pay of potential home buyer in Pakistan.

2. To quantify willingness to pay of potential home buyers so that green housing demands can be determined.
3. Quantification of premium for preferred green attributes over the conventional counterpart.
4. To recommend policy implications and improve understanding of green consumer behavior in Pakistan.

1.5. Advantages of the research work

Following are the advantages that are obtained through this research;

1. Identification of determinants that effects willingness to pay of potential home buyer in Pakistan.
2. Quantification of willingness to pay of potential home buyers.
3. Collection of information about potential home buyers that will orient the planners and designers to make sustainable housing.
4. Suggestions for policy implications and improve understanding of green consumer behavior.

1.6. Areas of application, scope, and limitation

The research is particularly related to housing sector of Pakistan with reference from homebuyers. The research focus is on eight cities of Pakistan. The area selection is based on an industrialization and educated level of residents. The data was collected from 504 respondents based on their demographics and willingness to change and willingness to pay.

1.7. Thesis organization

The study is organized such that Section 2 reviews the literature for determinates affecting willingness to pay. Section 3 explains the empirical application of the ACBC experiment, the questionnaire structure, and the sample. Section 4 presents the descriptive outcomes of the survey, the quantification of WTP and discusses the results of the ACBC analysis. Finally, Section 5 draws conclusions and highlights future recommendations.

Chapter 2

LITERATURE REVIEW

2.1. Determinants of WTP

It is incontestable that developers and homeowners can reap several benefits from sustainable housing, but many determinants, several of which do not have pure monetary considerations, effect this potential investment (Reddy, 2013). For example, socio-demographic variables such as income (L. Zhang, Liu, Wang, & Tang, 2018) negatively and educational level (Poortinga, Steg, Vlek, & Wiersma, 2003; Amador, González, & Ramos-Real, 2013; Stigka, Paravantis, & Mihalakakou, 2014) positively influence green purchase intention. In contrast, age and gender correlation with green purchase have mixed results (Hu, Geertman, & Hooimeijer, 2016; Ding, Wang, Liu, & Long, 2017; Joshi & Rahman, 2017) such that older people are less likely to adopt energy saving measure (Mahapatra & Gustavsson, 2008) but the recent studies suggest that age has a moderating effect on WTP for sustainable products (Wai & Bojei, 2015; Ding et al., 2017; Prete et al., 2017).

This indicates that technological and economic barriers are no longer a hurdle in promoting sustainable buildings. Instead, social, psychological and behavioral aspects create such hurdle (Hoffman & Henn, 2008). Their importance has been recognized in the promotion of sustainable housing (Zuo & Zhao, 2014). The role of determinants in influencing the homeowners to buy sustainable housing is reported in an ambiguous way. For example; Vicente-Molina, Fernández-Sáinz, and Izagirre-Olaizola (2013); Bigerna and Polinori (2014); Liu et al. (2018) reports that better environmental knowledge positively reinforces the green purchase intention but

Juan, Hsu, and Xie (2017) reports consumers having pro-environment behaviors and attitudes are found to pay more for sustainable housing and have higher environmental concerns. This results into an overall confusion, lack of trust and perceived value on green products and reduced WTP (Chen & Chang, 2012; E. Park & Kwon, 2017), deterring the advancement of sustainable housing (Liu et al., 2018). For developing nations like Pakistan, lack of awareness and knowledge(Soon & Ahmad, 2015) is a serious impediment. Therefore, it is imperative to study homeowners' acceptance of sustainable housing, its psychological factors, and issues related to the successful promotion of sustainable housing in developing countries (Darko & Chan, 2016).

To achieve this target, 35 determinants affecting WTP are identified from the literature and ranked based on their normalized literature score, as shown in Table 2-1. This score is based on a combined content analysis which uses frequency of appearance of a determinant in the reviewed literature as a quantitative score and its contextual qualitative significance on a 5-point Likert scale (1=very low; 2=low; 3=medium; 4=high; 5=very high). The literature score is the product of both scores. Age, gender, personal income, education level, environmental knowledge and attitude, and behavior are shortlisted as the most significant factors affecting buyers WTP based on their highest normalized literature score following Pareto distribution (Ahmad, Thaheem, & Maqsoom, 2018).

Table 2-1: Determinants affecting WTP

Rank	Determinants affecting WTP of Buyers	Literature Score	Normalized Score	Accumulated Score	References
1	Personal income	130	0.174966	0.174966353	(Yau, 2012b; Hori, Kondo, Nogata, & Ben, 2013; M. Park, Hagishima, Tanimoto, & Chun, 2013; T. H. Tan, 2013; Yue, Long, & Chen, 2013; Achtnicht & Madlener, 2014; Guo et al., 2014; Hu, Geertman, & Hooimeijer, 2014b; Wang, Zhang, & Li, 2014; Zhao, Gao, Wu, Wang, & Zhu, 2014; Ma et al., 2015; Muzaffar, 2015b; Carroll, Aravena, & Denny, 2016; Encinas, Marmolejo Duarte, Sánchez, & Aguirre, 2016; Hu et al., 2016; Lee & Heo, 2016; Oerlemans, Chan, & Volschenk, 2016; Syahid et al., 2016; Li Zhang et al., 2016; Prete et al., 2017; Liu et al., 2018; Portnov et al., 2018; Tapsuwan, Mathot, Walker, & Barnett, 2018)

2	Education level	100	0.13459	0.309555855	(Yau, 2012a; M. Park et al., 2013; T. H. Tan, 2013; Yue et al., 2013; Achtnicht & Madlener, 2014; Guo et al., 2014; Hu, Geertman, & Hooimeijer, 2014a; Wang et al., 2014; Zhao et al., 2014; Ma et al., 2015; Muzaffar, 2015b; Carroll et al., 2016; Encinas et al., 2016; Hu et al., 2016; Lee & Heo, 2016; Oerlemans et al., 2016; Syahid et al., 2016; Li Zhang et al., 2016; Ding et al., 2017; Joshi & Rahman, 2017; Prete et al., 2017; Portnov et al., 2018; Tapsuwan et al., 2018)
3	Environmental knowledge	95	0.12786	0.437415882	(Banfi, Farsi, Filippini, & Jakob, 2008; Chau, Tse, & Chung, 2010; Guo et al., 2014; Wang et al., 2014; Zalejska-Jonsson, 2014b; Zhao et al., 2014; Johar & Razak, 2015; Karatu & Mat, 2015; Ma et al., 2015; Muzaffar, 2015a; Soon & Ahmad, 2015; Hu et al., 2016; Lee & Heo, 2016; Oerlemans et al., 2016; Ding et al., 2017; Joshi & Rahman, 2017; Prete et al., 2017; Liu et al., 2018; Portnov et al., 2018)

4	Environmental attitude	60	0.080754	0.518169583	(Yau, 2012a; T. H. Tan, 2013; Wang et al., 2014; Zhao et al., 2014; Johar & Razak, 2015; Ma et al., 2015; Muzaffar, 2015b; Oerlemans et al., 2016; Joshi & Rahman, 2017; Prete et al., 2017; Schaffner, Ohnmacht, Weibel, & Mahrer, 2017; Liu et al., 2018)
5	Age	27	0.036339	0.554508748	(Borchers, Duke, & Parsons, 2007; Chau et al., 2010; T. H. Tan, 2013; Yue et al., 2013; Achtnicht & Madlener, 2014; Guo et al., 2014; Hu et al., 2014a; Wang et al., 2014; Zalejska-Jonsson, 2014b; Zhao et al., 2014; Ma et al., 2015; Muzaffar, 2015b; Carroll et al., 2016; Hu et al., 2016; Lee & Heo, 2016; Oerlemans et al., 2016; Syahid et al., 2016; Li Zhang et al., 2016; Ding et al., 2017; Joshi & Rahman, 2017; Prete et al., 2017; Liu et al., 2018; Portnov et al., 2018; Tapsuwan et al., 2018)

6	Environmental behavior	24	0.032301	0.586810229	(Hori et al., 2013; Yue et al., 2013; Zhao et al., 2014; Johar & Razak, 2015; Tapsuwan et al., 2018; Lin Zhang, Chen, Wu, Zhang, & Song, 2018)
7	Gender	23	0.030956	0.617765814	(Borchers et al., 2007; Chau et al., 2010; Yau, 2012b; Hori et al., 2013; M. Park et al., 2013; T. H. Tan, 2013; Yue et al., 2013; Achtnicht & Madlener, 2014; Guo et al., 2014; Zalejska-Jonsson, 2014b; Zhao et al., 2014; Ma et al., 2015; Muzaffar, 2015b; Hu et al., 2016; Oerlemans et al., 2016; Li Zhang et al., 2016; Ding et al., 2017; Joshi & Rahman, 2017; Prete et al., 2017; Liu et al., 2018; Portnov et al., 2018; Tapsuwan et al., 2018)
8	Subjective norms	21	0.028264	0.64602961	(T. H. Tan, 2013; Wang et al., 2014; Muzaffar, 2015b; Joshi & Rahman, 2017; Prete et al., 2017; Liu et al., 2018; Lin Zhang, Chen, Wu, Xue, & Dong, 2018)

9	Perceived behavioral control	21	0.028264	0.674293405	(T. H. Tan, 2013; Wang et al., 2014; Karatu & Mat, 2015; Muzaffar, 2015b; Prete et al., 2017; Schaffner et al., 2017; Lin Zhang, Liwen Chen, Zezhou Wu, Sizhen Zhang, et al., 2018)
10	House ownership	20	0.026918	0.701211306	(M. Park et al., 2013; Ma et al., 2015; Oerlemans et al., 2016; Tapsuwan et al., 2018; Lin Zhang, Liwen Chen, Zezhou Wu, Sizhen Zhang, et al., 2018)
11	Price	20	0.026918	0.728129206	(Hu et al., 2014a, 2014b, 2016; Glumac & Wissink, 2018)
12	Information quality	20	0.026918	0.755047106	(Wang et al., 2014; Zalejska-Jonsson, 2014b; Soon & Ahmad, 2015; Ding et al., 2017)
13	Social pressure from family and friends	20	0.026918	0.781965007	(T. H. Tan, 2013; Zhao et al., 2014; Muzaffar, 2015b; Oerlemans et al., 2016; Schaffner et al., 2017)
14	Number of children	18	0.024226	0.806191117	(Achtnicht & Madlener, 2014; Zalejska-Jonsson, 2014b; Encinas et al., 2016; Lee & Heo, 2016; Prete et al., 2017; Portnov et al., 2018)

15	Purchase intention	18	0.024226	0.830417227	(T. H. Tan, 2013; Karatu & Mat, 2015; Ding et al., 2017; Joshi & Rahman, 2017; Liu et al., 2018; Lin Zhang, Liwen Chen, Zezhou Wu, Sizhen Zhang, et al., 2018)
16	Environmental awareness	15	0.020188	0.850605653	(Guo et al., 2014; Karatu & Mat, 2015; Soon & Ahmad, 2015)
17	Number of households	14	0.018843	0.869448183	(Borchers et al., 2007; Yue et al., 2013; Achtnicht & Madlener, 2014; Guo et al., 2014; Zalejska-Jonsson, 2014b; Lee & Heo, 2016; Oerlemans et al., 2016)
18	Perceived self-identity	12	0.016151	0.885598923	(T. H. Tan, 2013; Zhao et al., 2014; Schaffner et al., 2017)
19	Employment	9	0.012113	0.897711978	(Zhao et al., 2014; Syahid et al., 2016; Prete et al., 2017)
20	Area of living/ location	9	0.012113	0.909825034	(Hori et al., 2013; T. H. Tan, 2013; Ding et al., 2017)
21	Monthly electricity bill	8	0.010767	0.920592194	(Borchers et al., 2007; Guo et al., 2014; Ma et al., 2015; Oerlemans et al., 2016)

22	Housing conditions (rental)	8	0.010767	0.931359354	(Banfi et al., 2008; Zalejska-Jonsson, 2014b)
23	Professional category, occupation, and status	6	0.008075	0.939434724	(M. Park et al., 2013; Ma et al., 2015)
24	Membership to E\environmental organization	6	0.008075	0.947510094	(Guo et al., 2014; Joshi & Rahman, 2017)Joshi et al. (2017), Guo et al. (2014)
25	Practical denotation of building environmental assessment	5	0.006729	0.954239569	(Zalejska-Jonsson, 2014b)

26	Demography	4	0.005384	0.959623149	(Johar & Razak, 2015; Encinas et al., 2016)
27	Family situation	4	0.005384	0.965006729	(Achtnicht & Madlener, 2014; Hu et al., 2014a, 2016; Ding et al., 2017)
28	Distrust of construction	4	0.005384	0.97039031	(Hu et al., 2014a)
29	External moderator	4	0.005384	0.97577389	(Zhao et al., 2014)
30	Perceived consumer effectiveness	4	0.005384	0.98115747	(Liu et al., 2018)
31	Recycling behavior	4	0.005384	0.98654105	(Zhao et al., 2014)
32	Marital status	3	0.004038	0.990578735	(T. H. Tan, 2013; Ding et al., 2017; Prete et al., 2017)

33	Perceived marketplace influence	3	0.004038	0.99461642	(Joshi & Rahman, 2017)
34	City	2	0.002692	0.99730821	(Muzaffar, 2015b)
35	Geological location	2	0.002692	1	(Portnov et al., 2018)

2.2. Selection of sustainable housing attributes and their levels

The first stage of creating the choice-based conjoint design includes the identification of the most significant housing features for the decision-making process. Also known as attributes, these features can have several levels showing different standards of an attribute. The purpose is to select the most relevant and appropriate attributes from the buyers' and developers' perception while keeping a manageable number. This ensures that the respondents are not strained by the questionnaire design. This study limited the number of attributes to six to avoid exhausting the respondents (McCullough, 2002).

The selection of attributes was carried out in two stages. In total, 23 attribute were identified from review of previous studies (Abuamer & Boolaky, 2015b; Luo et al., 2017; Portnov et al., 2018; Tapsuwan et al., 2018; Lin Zhang, Liwen Chen, Zezhou Wu, Hong Xue, et al., 2018; Lin Zhang, Liwen Chen, Zezhou Wu, Sizhen Zhang, et al., 2018) and ranked based on their normalized literature score, as shown in Table 2-2. This score follows the same method explained for the determinants (Ahmad et al., 2018).

Table 2-2: Attributes of Sustainable Housing

Rank	Attributes	Literature Score	Normalized Score	Accumulated Score	References
1	Reduction of electricity calls	100	0.148368	0.14836795	(Zulkepli[1], Sipan, & Jibril; Chau et al., 2010; Bryant & Eves, 2011b; Mandell & Wilhelmsson, 2011; Bryant & Eves, 2012; Hong, 2013; Mousavi, Khan, & Javidi, 2013; M. Park et al., 2013; Hu et al., 2014b, 2014a; Zalejska-Jonsson, 2014b; Abuamer & Boolaky, 2015a; Bond, 2015; Syahid et al., 2016; Portnov et al., 2018; Tapsuwan et al., 2018)
2	Indoor air quality	69	0.10089	0.24925816	(Zulkepli[1] et al.; Banfi et al., 2008; Chau et al., 2010; Mousavi et al., 2013; M. Park et al., 2013; Hu et al., 2014b, 2014a; T.-H. Tan, 2014; Abuamer & Boolaky, 2015b; Bond, 2015; Jusoh, 2015; Syahid et al., 2016; Li Zhang et al., 2016; Luo et al., 2017; Portnov et al., 2018; Lin Zhang, Liwen Chen, Zezhou Wu, Sizhen Zhang, et al., 2018)

3	Insulated roofs	52	0.077151	0.3264095	(Zulkepli[1] et al.; Chau et al., 2010; Eves & Kippes, 2010; Bryant & Eves, 2011a; Mandell & Wilhelmsson, 2011; Bryant & Eves, 2012; Hu et al., 2014b; T.-H. Tan, 2014; Bond, 2015; Encinas et al., 2016; Luo et al., 2017; Tapsuwan et al., 2018)
4	NS orientation of house	45	0.066766	0.39317507	(Zulkepli[1] et al.; Eves & Kippes, 2010; Bryant & Eves, 2011b; T.-H. Tan, 2013a, 2014; Abuamer & Boolaky, 2015a; Bond, 2015)
5	Noise insulation	44	0.065282	0.45845697	(Zulkepli[1] et al.; Chau et al., 2010; Hu et al., 2014b, 2014a; Abuamer & Boolaky, 2015b; Syahid et al., 2016; Luo et al., 2017; Portnov et al., 2018; Tapsuwan et al., 2018; Lin Zhang, Liwen Chen, Zezhou Wu, Sizhen Zhang, et al., 2018)
6	Insulated walls	44	0.065282	0.52373887	(Zulkepli[1] et al.; Banfi et al., 2008; Eves & Kippes, 2010; Mandell & Wilhelmsson, 2011; Hu et al., 2014b, 2014a; Bond, 2015; Encinas et al., 2016; Luo et al., 2017; Tapsuwan et al., 2018)

7	Sustainable materials	39	0.057864	0.58160237	(Zulkepli[1] et al.; T. H. Tan, 2011; Yau, 2012a; Mousavi et al., 2013; T.-H. Tan, 2013a; Hu et al., 2014a, 2014b; T.-H. Tan, 2014; Yau, Chiu, & Lau, 2014; Abuamer & Boolaky, 2015a; Li Zhang et al., 2016; Luo et al., 2017; Tapsuwan et al., 2018)
8	Low-E glass	36	0.053412	0.63501484	(Banfi et al., 2008; Eves & Kippes, 2010; Mandell & Wilhelmsson, 2011; T.-H. Tan, 2013a, 2014; Bond, 2015; Encinas et al., 2016; Hwang, Shan, Xie, & Chi, 2017)
9	Photovoltaic cells	32	0.047478	0.68249258	(Zulkepli[1] et al.; Eves & Kippes, 2010; Mandell & Wilhelmsson, 2011; T. H. Tan, 2011; Yau, 2012a; Mousavi et al., 2013; T.-H. Tan, 2013a, 2014; Yau et al., 2014; Bond, 2015; Syahid et al., 2016; Luo et al., 2017; Glumac & Wissink, 2018; Tapsuwan et al., 2018)
10	LED lightings systems	30	0.04451	0.72700297	(Yau, 2012a; T.-H. Tan, 2014; Bond, 2015; Li Zhang et al., 2016; Hwang et al., 2017; Luo et al., 2017; Portnov et al., 2018; L. Zhang et al., 2018)

11	Water saving water heads	30	0.04451	0.77151335	(Zulkepli[1] et al.; Mandell & Wilhelmsson, 2011; Yau, 2012b; T.-H. Tan, 2013a, 2014; Yau et al., 2014; Abuamer & Boolaky, 2015a; Hwang et al., 2017; Portnov et al., 2018)
12	Reduction of water Consumption	27	0.040059	0.8115727	(Chau et al., 2010; Bryant & Eves, 2011a, 2011b; Mandell & Wilhelmsson, 2011; Bryant & Eves, 2012; Hu et al., 2014a, 2014b; Portnov et al., 2018; Tapsuwan et al., 2018)
13	Reduction of VOC emissions	21	0.031157	0.84272997	(Zulkepli[1] et al.; M. Park et al., 2013; T.-H. Tan, 2014; Bond, 2015; Jusoh, 2015; Luo et al., 2017; Portnov et al., 2018; L. Zhang et al., 2018)
14	Insulated floors	16	0.023739	0.86646884	(Eves & Kippes, 2010; Bond, 2015; Luo et al., 2017)
15	Natural lighting harness	15	0.022255	0.88872404	(Yau et al., 2014; Tapsuwan et al., 2018)
16	High roofs	15	0.022255	0.91097923	(T.-H. Tan, 2013a, 2014; Tapsuwan et al., 2018)
17	Incorporation of IT	15	0.022255	0.93323442	(Zulkepli[1] et al.; Bryant & Eves, 2012; M. Park et al., 2013; Hwang et al., 2017; Luo et al., 2017)
18	Rain-water Harvesting System	14	0.020772	0.95400593	(Zulkepli[1] et al.; T. H. Tan, 2011; T.-H. Tan, 2013a, 2014; Jusoh, 2015; Luo et al., 2017; Tapsuwan et al., 2018)

19	Gated community	10	0.014837	0.96884273	(T.-H. Tan, 2013a; Hu et al., 2014a)
20	Landscaping	8	0.011869	0.98071217	(Zulkepli[1] et al.; Chau et al., 2010; T.-H. Tan, 2013b; Hu et al., 2014a; T.-H. Tan, 2014; Jusoh, 2015; Syahid et al., 2016; Tapsuwan et al., 2018)
21	Pre-fabricated building elements	6	0.008902	0.98961424	(Yau, 2012a; Mousavi et al., 2013; Yau et al., 2014)
22	Grey-water Recycling system	4	0.005935	0.99554896	(Yau, 2012a; Yau et al., 2014)
23	Dimmer switch	3	0.004451	1	(Hwang et al., 2017)

Chapter 3

METHODOLOGY

3.1. Adaptive choice-based conjoint analysis

There are various methods for estimating the monetary value of environmental goods. Stated preference methods are used for the products that have not been introduced in the market because they depict hypothetical buyer behavior by utilizing contingent valuation and choice modeling (Boxall, Adamowicz, Swait, Williams, & Louviere, 1996; Oerlemans et al., 2016). Questionnaire-based research utilizing the stated preferences investigates if the introduction of sustainable products can be effective with respect to the buyer perspective. Self-explained techniques, such as the contingent valuation method, directly ask buyers to rank and choose different product bundles (Franke & Nadler, 2019). This contrasts with indirect decomposition techniques, such as choice experiments. A drawback of contingent valuation method is the separate estimation of the likely influential conditions which are identified as self-report and choice biases as well as statistics and planned biases (Amecke, 2012; Hausman, 2012) which has highlighted that whether prospective buyers can state their preferences or choice reliably when asked directly (Toubia, 2018) .

In order to avoid the above limitations, conjoint analysis method, a type of stated preference-based methods, can be used (Theil, 1970). It has a strong influence on particularly those areas where scholars want to measure buyer choice rather than consumer perceptions and preferences (Huber, 2005). It helps researchers in quantifying and comparing the importance of various combinations of product or service attributes from buyer preference while mitigating social-desirability bias (Halvorsen, 1996). Conjoint analysis method achieves both goals by simulating a purchase decision where the respondent ranks or chooses between different product packages over several iterations by using all possible scenarios of product attributes combinations. Conjoint surveys are powerful because they model authentic behavior over stated intentions and closely model real-life purchasing situations. Many recent sustainable housing studies have used conjoint analysis method to find buyer preference and ranking (Rofè, Pashtan, & Hornik, 2017; Franke & Nadler, 2019; Hille, Weber, & Brosch, 2019).

This study uses adapted choice-based conjoint (ACBC) analysis to estimate WTP which is the latest evolution of conjoint methods and is extensively utilized to simulate buyer preferences toward product packages. Preferences are estimated as part-worth utility scores that compute the input of every attribute to the total utility of an alternative package (O. Toubia, Hauser, & Simester, 2004). Part-worth utility scores are obtained by using a hierarchical Bayesian approach that calculates combined and specific attribute utility scores and establishes the difference between individual attribute utilities and the mean utility of the whole sample data (Hauser & Rao, 2004).

Adapted choice-based conjoint is better than conjoint analysis because it presents precise quantification of consumer preferences and WTP along with better imitation of real-world purchasing decisions with lower standard errors and better utility score (O. Toubia et al., 2004). Specifically, this approach is suitable to quantify the preferences and WTP for new products or for products which are not available in the market yet (Breidert, Hahsler, & Reutterer, 2006). Regardless of their complication and long completion time, adapted choice-based conjoint surveys are more fetching and yield better quality data than conventional surveys (Chapman, Alford, Johnson, Weidemann, & Lahav, 2009; Cunningham, Deal, & Chen, 2010).

3.2.Structure and design of the survey

The survey used in this study is designed with Lighthouse Studio Version 9.6.1 by Sawtooth Software Inc. who specialize in adapted choice-based conjoint and market simulation. The survey consists of two sections; the first section inquired about the socio-economic and psychological characteristics of respondents because WTP and preferences are known to be correlated with them (Juan et al., 2017; Prete et al., 2017). It furthers by inquiring about willingness to change and WTP without any prior information. Before moving to the second section, a detailed presentation of concepts of sustainable housing attributes was presented to see if the respondent is willing to change and pay more for sustainable housing. The second section is the core of the survey and is divided into two parts: choice tasks and calibration tasks. In choice tasks, respondents were asked to choose a preferable set from different sets of different attribute levels. To reduce the difficulty of the choices, attribute levels that were same across the choice sets were highlighted. The preferred concept from each choice task moved on to succeeding task, and the choice task proceeded until the most preferred bundle was determined. To achieve a higher level of accuracy, test design was performed using 300 dummy respondents to ensure that every level should appear three times for one respondent. Standard error, relative efficiency and D-Efficiency of design are 0.04, 88.18% and 80.13%, respectively. The loss in relative efficiency is due to the following reasons; first because prohibitions are placed to avoid two or more higher price attribute levels appearing in one choice set and secondly, dominant concepts are avoided because they can affect the quality of utility score (Bradley, 1988). The D-efficiency of adapted choice-based conjoint design of concepts is lesser than conventional full-profile arrays that are level-balanced and orthogonal. This is expected from the choice-based conjoint process and leads to part-worth utili9ties with typically greater accuracy than the D-optimal approach (Chapman et al., 2009). The benefits of the adapted choice-based conjoint process outweigh the losses due to using less statistically efficient designs.

An in-house advisory committee reviewed the draft survey and it was sent to respondents online. Some respondents stated that the questionnaire is exceedingly difficult to understand and expressed concern about questionnaires' length. Survey's length cannot be shortened because previous studies report a higher completion rate of 51.8% which shows a higher interest rate in adapted choice-based conjoint surveys (Johnson & Orme, 2007). So, keeping in view the difficulty in understanding the survey, it was decided to conduct face-to-face interviews to ensure a higher response rate, improve the accuracy of results and avoid less serious respondents. The average completion time of the survey was 21 minutes which shows the engagement rate of respondents.

Chapter 4

RESULTS AND DISCUSSION

4.1. Shortlisting of housing attributes

since the reviewed literature does not sufficiently capture the context of this study, a local data collection was performed in which separate surveys were carried out to obtain the preference from 30 local developers and 30 public respondents on the identified sustainable housing attributes. Score calculated from both surveys is a product of the mode of the frequency of a housing attribute and respondent score. To calculate the combined score from surveys, multiple combinations of different weighting ranges of field survey and public survey were tested and analyzed. A similar approach is used to combined survey score with literature score. Equation 1 is used to calculate the final score (*FS*), where *DS* represents developers' score, *PS* represents public score and *LS* represents literature score.

$$FS = 0.5(0.5DS + 0.5PS) + 0.5LS \qquad Equation\ 1$$

Following this scoring, the top six sustainable housing attributes include, reduction of electricity bills, solar orientation, air quality, insulated roofs, and noise insulation and price premium. Price Premium was considered as default attribute because it has more reported significance in literature in terms of affordability and economic stability (Aroul & Hansz, 2012; Hu, Geertman, & Hooimeijer, 2015; L. Zhang et al., 2018). It is reported in the literature that price premium can have several defined levels but the problem with that is lower price premium can appear with the premium choice set (Orme, 2009). In this study, the summed price premium is used. Random price variation within the specified range of -30% to +30% is used to ensure a high degree of balance across the choice tasks. Using the summed pricing approach leads to product concepts that show realistic price.

4.2. Description of sample

The survey was conducted in the several developed cities of Pakistan based on their industrialization and education levels. Face-to-face interviews of respondents were conducted at their homes and in public places such as malls, restaurants, etc. The survey was conducted from November 2018 to January 2019. The total sample of respondents was 504 homeowners, but 150 responses were excluded based on their WTC and WTP. The sample included representation from cities of Gujrat (3.955%), Gujranwala (10.45%), Islamabad (18.93%), Karachi (18.08%), Lahore (16.38%), Multan (8.575%), Peshawar (11.86%) and Sialkot (11.58%). Table 3 shows the socio-demographic characteristics of the sample. The lower number of female respondents (25%) is due to both cultural and educational barriers compared to the male respondents (75%) (Opoku & Abdul-Muhmin, 2010; Rehman, Jingdong, & Hussain, 2015). In other socio-demographic factors, the following subgroups have maximum respondents in their corresponding socio-demographic factor: 31–40 years age group (36.44%), PKR150,000 (US$ 1075)-200000 (US$ 1432) income group, and bachelor’s degree-holding educational level (64.12%). Several other demographics are reported in Table 4-1.

Table 4-1: Description of Sample

Categories	Levels	N	Percent
Gender	Male	266	75
	Female	88	25
Age	21 to 30 years	109	30.791
	31 to 40 years	129	36.4407
	41 to 50 years	65	18.3616
	51 to 60 years	42	11.8644
	above 60 years	9	2.54237
Education	Matric	2	0.56497
	Intermediate	12	3.38983
	Bachelor	227	64.1243
	Masters	105	29.661
	Doctorate	7	1.9774
	Other	1	0.28249
Income	PKR 100,101 - PKR 150,000	86	47.5138
	PKR 150,001 - PKR 200,000	87	48.0663
	PKR 200,001 - PKR 250,000	79	43.6464
	PKR 250,001 - PKR 300,000	34	18.7845
	PKR 300,001 - PKR 350,000	30	16.5746
	PKR 350,001 - PKR 400,000	15	8.28729
	PKR 400,001- PKR 500,000	10	5.52486
	Above PKR 500,000	13	7.18232

4.3. Descriptive results

This section describes the respondents' knowledge, behavior, and attitude regarding environmental concerns along with WTC and WTP before and after being exposed to sustainable housing concepts. As given in Table 4-2, a major portion of respondents has a slight to moderate environmental awareness and positive attitude towards sustainable living which is due to the current environmental crisis (Faruqui, 2004) resulting into green movement and plantation drives in the country (Dawn, 2018). The majority of respondents reported switching of lights (62.14%), turning off water tap (59.32%) and tree plantation (49.15%) as major behavioral markers in response to electricity and water crises faced by Pakistan over the years (Faruqui, 2004; Chaudhry, 2010). This proves that respondents are more interested in the energy conservation (Zalejska-Jonsson, 2014a).

Table 1-2: Environmental knowledge, attitude, and behavior

Categories	Levels	N	Percent
Environmental Knowledge	No understanding	5	1.41243
	Slight	212	59.887
	Moderate	129	36.4407
	Advanced	8	2.25989
Environmental Attitude	Not Important at all	0	0
	Not Very Important	7	1.9774
	Important	146	41.2429
	Quite Important	131	37.0056
	Very Important	70	19.774
Environment Behavior	Frequency of Recycling	70	19.774

Turn off Water Tap	210	59.322
No Plastic	64	18.0791
Public Transport/Walking	84	23.7288
Natural Tree Planting	174	49.1525
Use of Fluorescent Lamp	118	33.3333
Switch off Light	220	62.1469
Others	5	1.41243

Table 4-3 reports the findings of WTC and WTP descriptive questions stating that 63.7% respondents are willing to change and pay more for sustainable housing without any prior information. After being briefed with the sustainable housing information, 6.54% (33) respondents changed their view in favor of sustainable housing, while none of the respondents changed negatively. This proves that an exposure to sustainable housing concepts plays a significant role in influencing the buyers' decision of investing in sustainable housing. Overall, more than 70% respondents, despite being new to the concept of sustainable housing and struggling in finding the developers or contractors who can deliver such projects, are both willing to change and willing to pay more for sustainable housing. However, 29.76% respondents are not willing to change their preference of conventional housing and therefore, did not express any willingness to pay for sustainable housing.

Table 4-3: WTC and WTP descriptive results

Categories	YES/NO (%YES)
Without providing any information on sustainable housing	
WTC From conventional housing	**321/504 (63.7%)**
WTP more for sustainable housing	**321/504 (63.7%)**
After providing any information on sustainable housing	
WTC From conventional housing	**354/504 (70.24%)**
WTP more for sustainable housing	**354/504 (70.24%)**
Never WTC from conventional housing	**150/504 (29.76%)**

4.4. Preference by attribute level

Integrated hierarchical Bayesian model in Lighthouse Studio was used to calculate average utilities by attribute levels using a scaling method of zero-centered difference method as given in Table 4-4. A negative utility value does not indicate lower significance of a specific attribute, rather it implies that the attribute is preferred lesser than others. Such as, while the utility value of *basic solar orientation* was negative, it was still preferred by some respondents. Whereas *basic design with louvers on sun-facing windows* and *basic design with louvers and double-glazed windows facing sun* were more preferred by respondents than *basic solar orientation*. Participants evidently preferred some advanced attribute level because the result suggests that the entry level of each attribute received the lowest scores except the *rat-trap bond of wall insulation*. For all attributes, the most inclusive packages received the maximum utility score, which also shows a higher acceptance level. It was reported by the respondents that if they are going to purchase a set of housing attribute, they would rather purchase the most inclusive one. Yet, their preferences and likely buying decisions were projected to be controlled by price premium (PP) levels.

Table 4-4: Average utility score by attribute level

Attribute	Level	Level Description	Average Utility score*
Energy saving	1	Energy Saving 20%	-59.44
	2	Energy Saving 40%	17.19
	3	Energy Saving 60%	42.26
Air Quality	1	Passive Air Ventilation Basic	-2.66
	2	Volatile Organic Compound Minimization	2.30
	3	VOC and Formaldehyde Minimalization	0.35
House Orientation	1	Basic Solar Orientation Design	-10.77
	2	Basic Design with Louvers on sun-facing windows	-7.11
	2	Basic design with Louvers and Double-Glazed Windows facing the sun	17.88
Sound Insulation	1	No Insulation	-8.45

	2	Basic Sound Insulation	8.45
Walls Insulation		Rat-Trap Bond	0.03
		Thermophore Insulation (Exterior Insulation)	-0.03

***RLH= 0.84**

4.5. WTP estimation results

Preferred price premium was selected for each respondent after series of choice and calibration tasks. So, count analysis was performed to calculate the price premium that respondents are willing to pay. The average WTP was 11.07% with *SD* of 4.606 and a median of 11. The maximum premium selected by respondent was 36% but it is insignificant to compare relative importance than absolute numbers. The count analysis also helped in creating the breakdown point for the price premium so that the average utilities can be calculated at these points. The average utilities expressed by the respondents for a price premium are shown in Figure 4-1 which implies that respondent utility scores are extremely sensitive to premium levels. Highest utility score is for 0% and price premium utility becomes negative at 11% which is constrained due to affordability. Although the premium levels expressed through summed pricing were calculated using prices estimated through a market survey and are sensitive to inflation, the utility scores expressed by the respondents remains a decisive factor in willingness to pay. To see if respondents' WTP changes if price premium interacts with some specific attribute levels, the analysis was performed integrating different interactions and results are shown in Figure 4-2. Attribute level "Energy Saving 40%" positively influences the WTP because it is preferred by respondents on higher premium levels which concurs with Zalejska-

Jonsson (2014a). The second attribute that correlated positively with WTP is VOC minimization which may be in response to high air pollution rate in major cities of Pakistan (Nasir & Rehman, 2011). Respondents living in industrialized cities like Lahore, Karachi, Gujrat and Sialkot reported facing various kinds of breathing difficulties due to bad air quality, specifically in winter. Third attribute level with high premium level is the basic solar orientation of the house. The respondents declared receiving no information from the developers regarding this aspect which is crucial for any house design and also showed their willingness to pay more for such. Thus, it is significant to increase homebuyers' awareness of sustainability issues. Also homebuyers value price over sustainability which is a huge constraint toward sustainable living (Li, Yang, He, & Zhao, 2014).

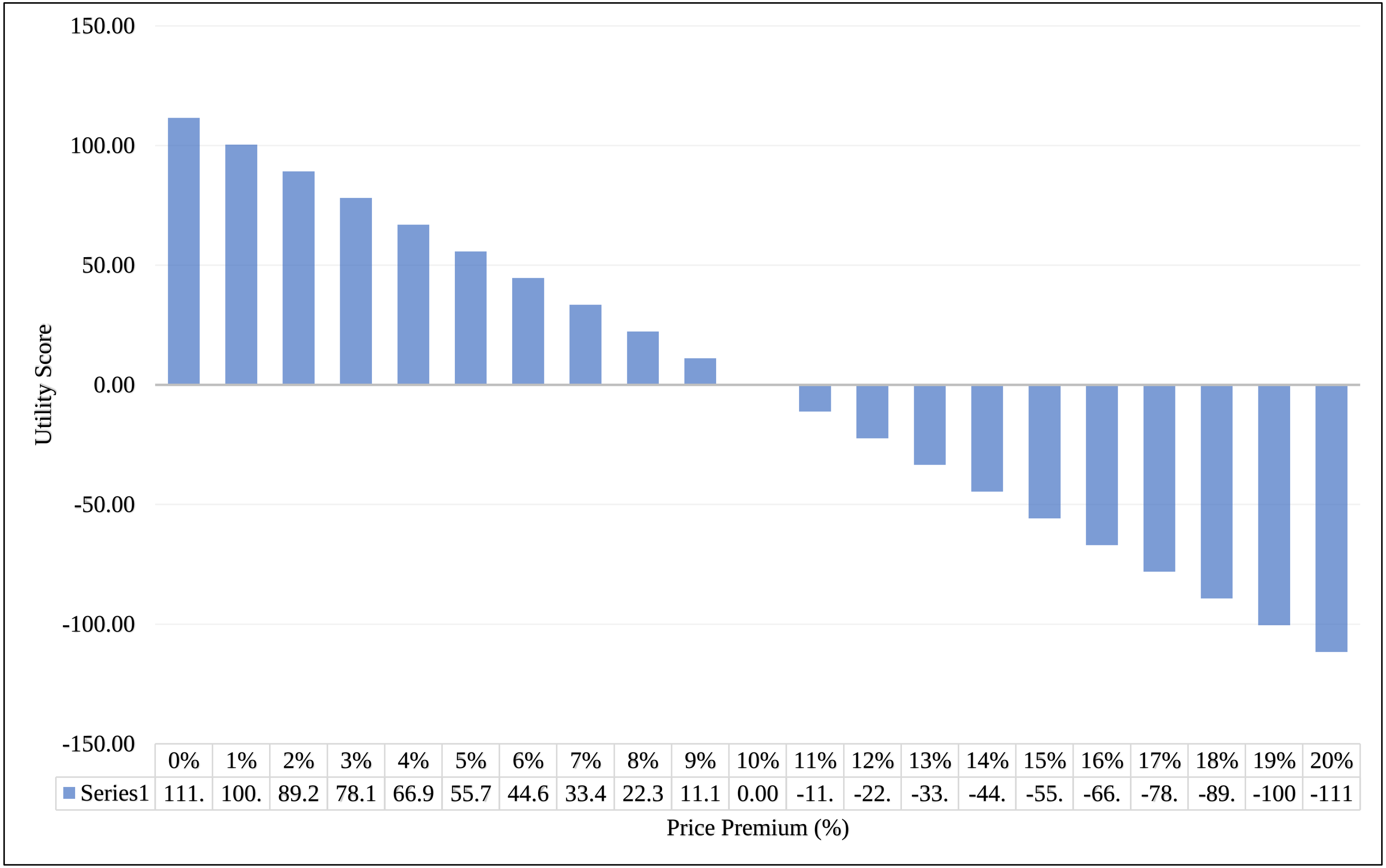

Figure 4-1: Average utility score of price premium (PP)

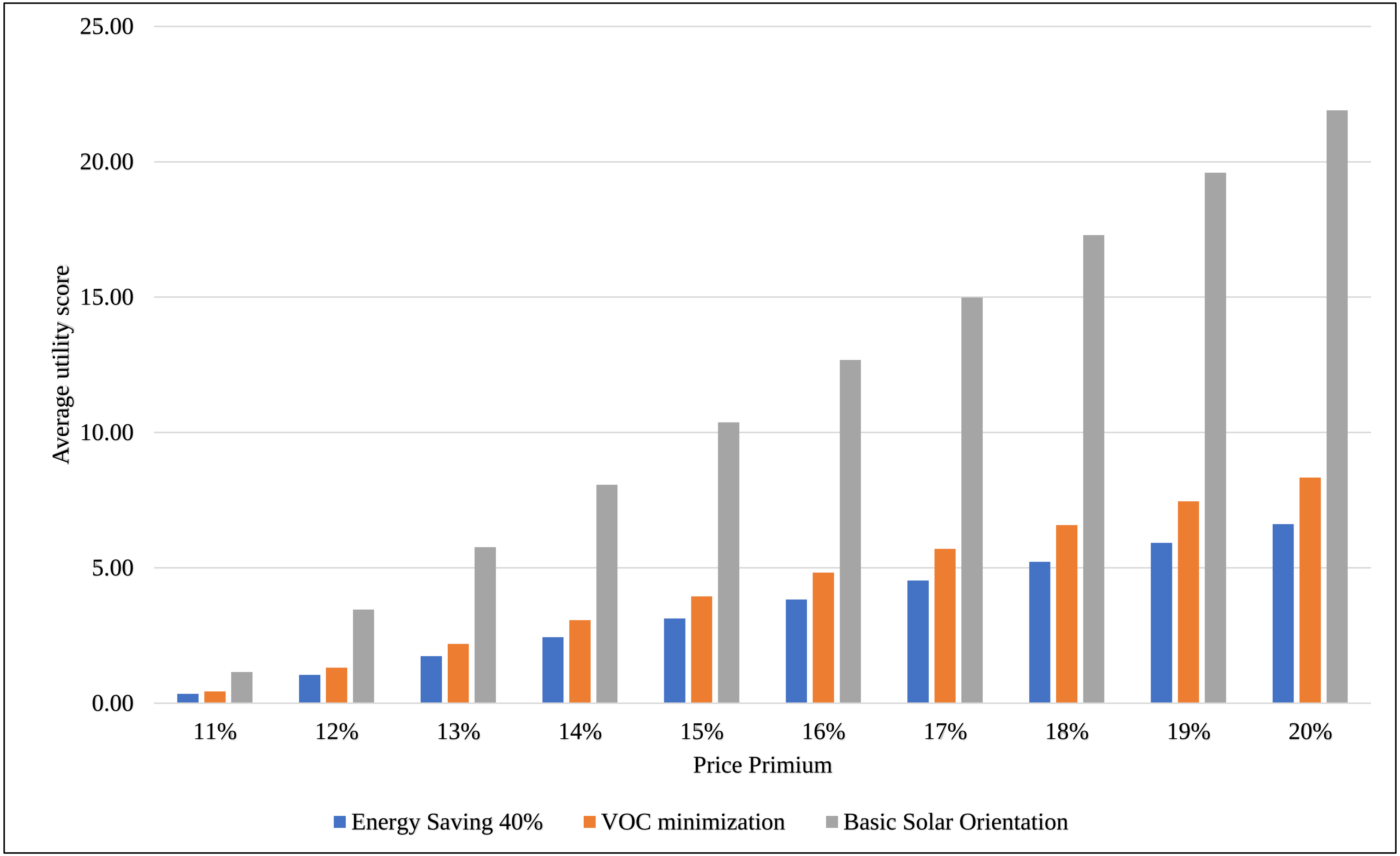

Figure 4-2: Effect of different attribute levels on WTP (2LL P-value <0.005)

4.6. Relative importance of attributes

The relative importance of attributes, presented in Figure 4-3, is calculated by mean of all ratios of importance scores by an individual respondent to the total importance scores. Mathematically, it is calculated by dividing the choice of utilities of an attribute by the sum of all choices. Larger the choice range of attribute, larger will be the relative average importance of that attribute. The relative importance describes the significance of the induvial attribute in the total utility of the bundle due to a positive correlation between them. In correlation with utilities, the price premium has the highest relative importance. From the overall housing attributes, reduction of electric energy has higher relative importance followed by the noise insulation and solar orientation of the house.

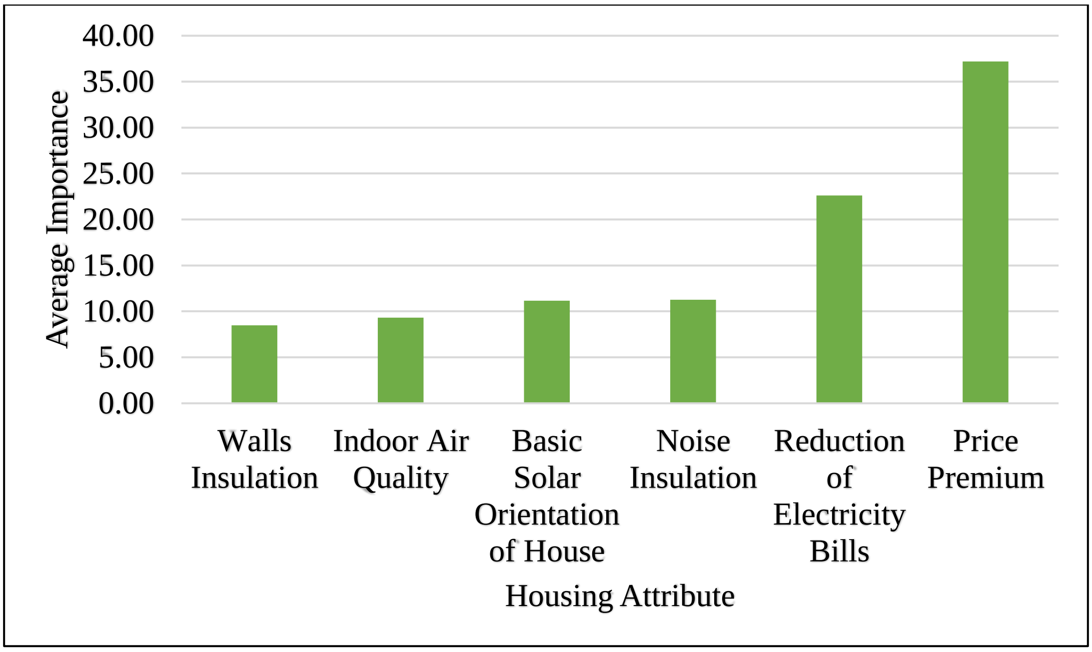

Figure 4-3: Average importance of attributes

4.7. Significance of demographics and environmental knowledge on WTP

The demographics have an impact on the WTP and the preferences as reported by previous studies (Poortinga et al., 2003; Yang & Zhao, 2015; Ding et al., 2017; Joshi & Rahman, 2017). First of all, all demographics are significant for WTP for sustainable housing. WTP for males is higher than females according to the utility scores given to price premium because women are very careful at what they are going to buy and are more risk-averse than their male counterparts (Charness & Gneezy, 2012). Older people are willing to pay more for sustainable housing and there are two reasons for that; first, following cultural norms, most elder people are family heads and decision makers of household and secondly, they tend to make decisions based on environmental concern and trust other people's opinions. The younger respondents have more environmental knowledge but they have low WTP because of affordability and economic stability. Results suggest that education have a significant influence on WTP and the utilities increase with increase in education level which agrees with Prete et al. (2017). The reason behind sensitivity to price premium is that buyers consider sustainability as an issue but they are constrained by their economic capabilities. The second reason is lack of awareness about green housing which constrains their purchasing decision as most of them stated a lack of reliability on sustainable products (L. Zhang et al., 2018). The income level has a negative correlation with WTP in contrast to Yang and Zhao (2015) and coherent with Prete et al. (2017). The correlation between environmental knowledge and WTP was also analyzed in these studies and WTP seems to decrease with increase in environmental knowledge (L. Zhang et al., 2018). The decrease in lower WTP because of high environmental awareness is very interesting because other studies also reported that in developing countries, people prefer to consume more energy to increase their comfort level rather than having environment friendly living and, rather wait for their saving after the payback period is complete (Lin, 2015).

4.8. Scenario testing

The inbuilt market simulator feature of Lighthouse Studio is used to compute the respondent preference for 100 attribute packages defined presuming these were the only available packages in the marketplace. These packages were derived from respondents based utility scores and relative importance. Multiple simulations were performed so that maximum number of packages can be found with a maximum number of respondent count that are willing to purchase these at their respective price premium. Out of 100 packages, 6 were found most attractive to respondents based on their utility scores and relative importance to the attributes. Characteristics of these packages are presented in Table 4-5. The share of preference, total utility and purchase likelihood of shortlisted packages are shown in Figures 4-4,4-5 and 4-6 respectively. Share of preference is the share of a specific package out of total preference while total utility score illustrates the attractiveness of this package. The purchase likelihood explains the chances of the package to be purchased. In scenarios 4 and 6, although the packages have high premium level, no noise insulation attribute level was considered due to which their utility decreased and similarly their purchase likelihood. Scenario 4's share of preference is lesser as compared to other scenarios. The simulation results are validated by above findings which explain that noise insulation is the 2nd highest attribute with respect to utility value and its absence reduces the purchase likelihood of scenarios 4 ad 6. In scenario 3, air quality level is missing but due to its less significant utility score, the total utility and purchase likelihood are maximized. Scenario 1 has the highest purchase likelihood because of inclusion of higher level of energy saving attribute to which respondents have given highest relative importance.

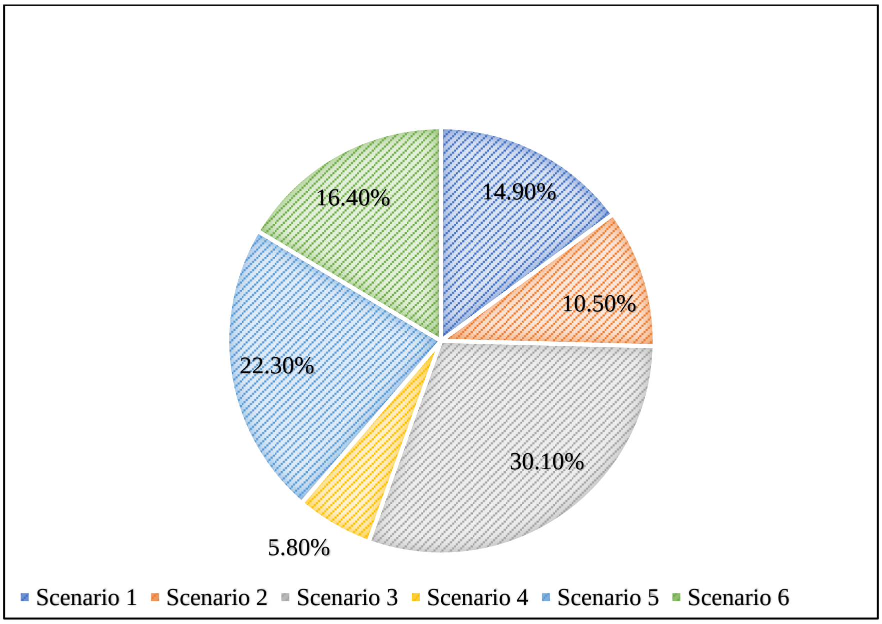

Figure 4-4: Share of Preference

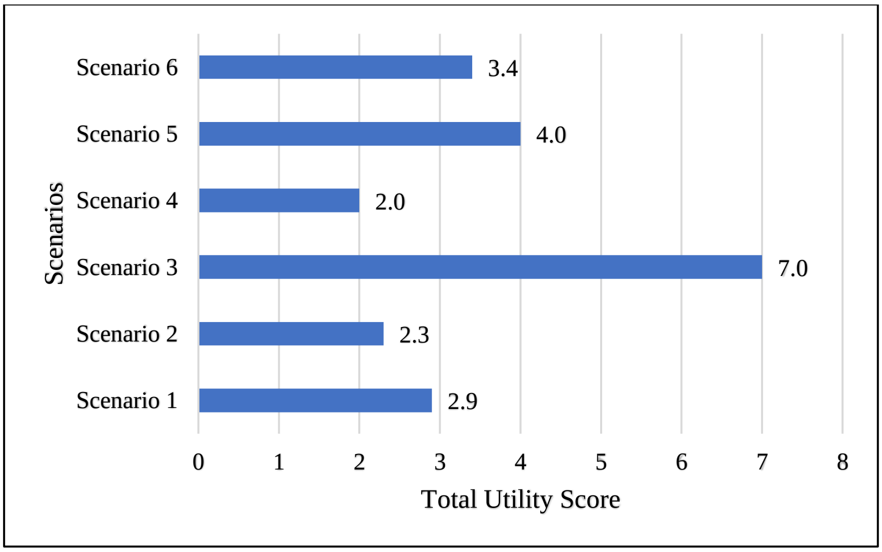

Figure 4-5: Total Utility Score

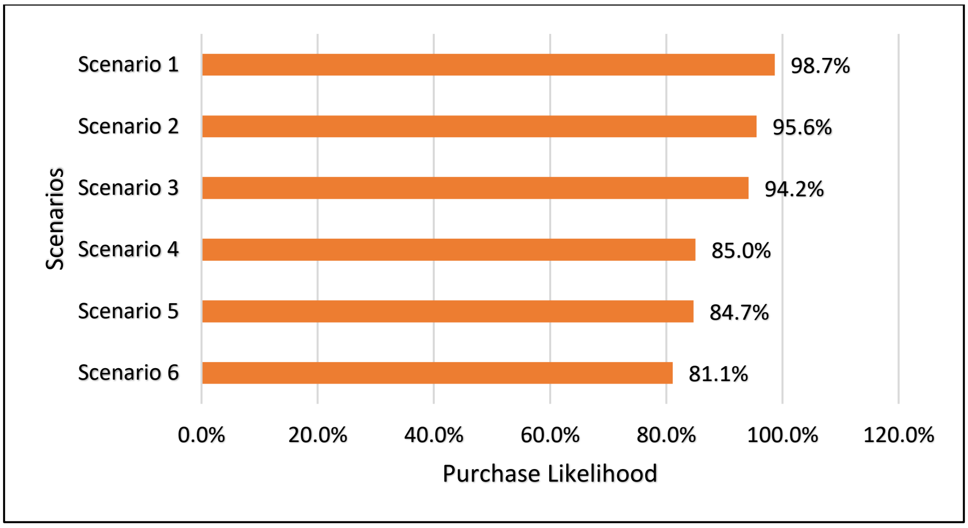

Figure 4-5: Purchase likelihood of scenarios

Table 4-5: Scenario for market simulator

Label	Reduction of Electricity Bills	Indoor Air Quality	Solar Orientation of House	Noise Insulation	Walls Insulation	Price Premium
Scenario 1	Level 3	Level 1	Level 1	Level 1	Level 1	9.00%
Scenario 2	Level 3	Level 3	Level 3	Level 1	Level 2	13.00%
Scenario 3	Level 3	No Level	Level 3	Level 1	Level 2	8.00%
Scenario 4	Level 3	Level 3	Level 2	No Level	Level 2	12.00%
Scenario 5	Level 3	Level 2	Level 3	Level 1	Level 2	11.00%
Scenario 6	Level 3	Level 2	Level 2	No Level	Level 2	10.00%

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

This study examines the sustainable housing market of Pakistan by describing the early-adopters and quantifying potential sustainable house sales. WTP for sustainable housing was estimated using data from 354 perspective homebuyers. Hierarchical Bayesian model was used to study the impact of sets of descriptive variables on WTP for sustainable housing. This study contributes an important empirical input to the literature by identifying the potential early adopters of sustainable housing in Pakistan.

The key results from the descriptive investigation of the survey are that:

- the profile of Pakistani homebuyers differs from other developing countries on certain characteristics including lack of environmental awareness about sustainable housing. They possess responsible environmental behavior embodied through efficient use of electricity and water, and tree plantation; and

- 63.7% of respondents were willing to change from conventional housing to sustainable housing without any prior information. Additionally, once technical material on sustainable housing was presented, 6.32% respondents changed their opinion towards buying sustainable housing. Thus, they show a high level of readiness such that over 70% respondents were willing to buy a sustainable house.

Regarding the description of early adopters, the key results of the empirical study are that:

1. WTP increases with age as respondents aging between 51–60 are found willing to pay more as compated to all the other age groups. Moreover, environmental knowledge is negatively correlated with WTP;

2. males respondents have higher WTP than their female counterparts. Education level positively correlates with WTP and highly educated people have better awareness of environmental issue but WTP is constrained because of economic capabilities;

3. respondents' utilities are highly sensitive to the increment in price premium level which is due to the lack of awareness about sustainable housing; and

4. energy saving seems to have the highest relative importance among other housing attributes followed by noise insulation.

5.2. Policy implications

Considering the unexplored potential of sustainable housing in Pakistan, following policy implications are proposed to promote sustainable housing.

1. Currently, there is no govertment policy being implemented to promote sustainable housing development in Pakistan. This results suggests that introducing finacial incentives on national level such as property tax reduction and rebate program sand have been proven to effectively

increase willingness to pay of buyers in countries like Malaysia and India (Shazmin, 2016). Reveal of financial information such as energy saving costs and running cost of sustainable buildings have also been proven to be effective in attrating perspective homebuyers (Franke & Nadler, 2019). Thus financial information about houses are more significant for higher willingness to pay for buyers rather than saved enegy units (Ramos, Gago, Labandeira, & Linares, 2015).

2. Subsequently, housing sector consume significant portion of the energy produced today, motivating a larger part of the population into sustainable housing is very important. Thus, understanding residents' from a psychological perception is an important step in order to effective marketing policies and information campaigns to sustainable housing attractive to buyers (Schaffner et al., 2017). Public-oriented policies should be implemented which should be based on determinants indentified such as knowledge and accurate information about sustainable housing features and environment friendly construction materials which is potentially significant barrier towards the acceptance of sustainable housing, thus result suggests prioritizing it on provincial level can be very effective (Vicente-Molina et al., 2013).

5.3. Limitations

Being one of its kind of research conducted in Pakistan, data was collected from only eight cities. Only six housing attributes were considered to avoid the complexity of the questionnaire.

5.4. Future work

1. Future research could repeat the analysis by covering more cities.

2. More housing attributes such as smart metering could be included in future research.

3. The same analysis can be used to find willingness to pay for low-cost sustainable housing.

4. More psychological barriers such as perceived risk and lack of reliability could be investigated.

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