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The Influence of Green Building Certification Schemes on Real Estate Investor Behaviour: Evidence from Singapore

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Abstract

Based on an adaptive choice-based conjoint analysis, the aim of this paper is to ascertain the extent to which various characteristics of a condominium unit, and in particular the Building and Construction Authority (BCA) Green Mark Scheme, influence prospective real estate investors' preferences for condominium units in Singapore. Through the analysis, this study determines that premium buyers would be willing to pay for property certified by the Green Mark Scheme. The results suggest that the price premium buyers would be willing to pay for green certification varies within the different levels of the Green Mark Scheme, ranging from 3.78 per cent for the Certified award to 7.98 per cent for the Platinum award. The results thus suggest a strong business case for developers of green buildings.

1. Introduction

Buildings are responsible for almost one-quarter of total global carbon dioxide emissions and are the largest contributors to climate change (Levine *et al.*, 2007). At the same time, buildings also offer one of the largest potentials for greenhouse gas abatement (Enkvist *et al.*, 2007; Levine *et al.*, 2007). The economics underlying green buildings, however, commonly act as an obstacle to their diffusion. The construction of green buildings by developers is often impeded by a lack of willingness from investors to pay for the additional costs. Investors in turn are unwilling to release additional funding because they believe there is no demand amongst property buyers for such buildings. Property buyers, in contrast, who seek green buildings, are therefore

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confounded by a lack of supply. Finally, construction firms do not build such properties despite already possessing technical expertise because developers do not want them to do so. This misalignment of incentives has been commonly reported as the 'vicious circle of blame' (Cadman, 2000; RICS, 2008; Falkenbach *et al.*, 2010).

An opportunity to address the split incentive dilemma is provided by fully disclosing environmental information of a building. Green building certifications play a fundamental role in overcoming information asymmetries in the property market and may serve to reduce some of the cost/benefit disparities by providing incentives to defray the higher development costs of green buildings (Retzlaff, 2009). In the past few years, many countries have therefore developed a growing interest in such schemes, including Singapore, which introduced the BCA (Building and Construction Authority) Green Mark scheme in 2005. As developing green buildings often implies a cost premium over code-compliant buildings, developers and investors commonly question the economics of 'green design'—i.e. whether adopting green practices in property development will actually result in higher occupancy, rents or selling prices (Wiley *et al.*, 2010). A thorough analysis of the positive impacts of such certification schemes in influencing property purchasers is thus a prerequisite for convincing developers and investors to adopt green practices in property development. For Singapore, however, very little market information is available on the demand for green buildings, particularly on the premium buyers would be willing to pay for green certification. The aim of the present study is to contribute to this research gap by empirically investigating the impact of the Green Mark Scheme on potential real estate investors' decisions. Based on an adaptive choice-based conjoint analysis, this paper ascertains the extent to which various characteristics of a condominium unit, and in particular the Green Mark Scheme, influence prospective real estate investors' preferences for condominium units in Singapore. Through the analysis, this study determines that the premium buyers would be willing to pay for property certified by the Green Mark Scheme. Our results suggest that an otherwise equal building certified with a Green Mark Certified award could be sold at a premium of 3.78 per cent. The increment in selling price for a building certified by the Green Mark Platinum award may be as much as 7.98 per cent. For comparison, a preliminary study by the Building and Construction Authority indicates that the construction cost premium of Green Mark Certified buildings over code-compliant buildings ranges between 0.3 per cent and 1 per cent whereas the cost premium for Green Mark Platinum buildings ranges from 2 per cent to 8 per cent (BCA, 2008). In light of the fact that it is expected that this cost premium will steadily decrease in the future resulting from economy of scale and learning effects of industry players (BCA, 2011b), our results thus suggest a strong business case for developers of green buildings.

2. Context

2.1 Singapore's BCA Green Mark Scheme

The buildings sector in Singapore was responsible for 6235 kilo tonnes of CO_2 emissions or around 16 per cent of Singapore's greenhouse gas emissions in 2005 (NCCS, 2010). Being a small city-state without any significant energy resources, Singapore heavily depends on fossil fuel imports from its neighbouring countries. Given the challenges Singapore has to face in terms of energy security, Singapore aims to become a smart energy economy, with

energy efficiency being an integral part of Singapore's sustainable development strategy (NEA, 2010). Therefore, Singapore's government has created a comprehensive energy efficiency blueprint known as Energy Efficient Singapore (E^2 Singapore) (NEA, 2012). As part of the E^2 Singapore plan, the Building and Construction Authority (BCA) has created the BCA Green Mark Scheme to incentivise developers towards constructing energy-efficient buildings to mitigate the climatic impact of the local building sector (BCA, 2011a). It is a point-based benchmarking scheme that aims to create a more environmentally friendly and sustainable urban environment. The total number of points scored in the overall assessment determines the rating of particular buildings—from the Green Mark Platinum, Gold^{Plus}, Gold to the Certified rating. By certifying a building through the Green Mark scheme, potential buyers of private property are provided with quantifiable information of the cost savings gained through lower electricity bills, lower water bills, as well as more qualitative information on the benefits from improved living environments (BCA, 2011a).

2.2 Development of the Condominium Market in Singapore

Singapore gained independence in 1965 and the twin housing problems of severe overcrowding in slum housing conditions in the city centre and the acute shortage of affordable and sanitary housing was a domestic issue high on the new government's agenda. The government thus applied a broad housing programme to provide affordable public housing for a large part of the population (Deng *et al.*, 2012). The programme was a success and 82 per cent of all residential households in Singapore currently live in Housing and Development Board (HDB) public housing flats. Sustained decades of strong economic development, however, have driven strong demand for more up-market housing developments, particularly with the growing higher-income groups. The HDB started building Executive Condominiums in order to meet that trend, also instituting an income ceiling of an average gross monthly household income of S$12 000 in order to be eligible for buying such property (HDB, 2012). With more than 20 per cent of households having an average household income of S$12 818 or above in 2010 (Singstat, 2010), this growth in income has led to an effective increase in the relative proportion of private housing, especially for condominium developments. In 2010, 11.2 per cent of the population lived in condominiums and private flats, nearly double the amount in 2000 (Singstat, 2011). This growth has also been fuelled by the particular importance attached to condominiums in Singapore as a widely accepted sign of personal success (Chua, 2003; Koh, 2006). Owning private property has become part of the 'Singapore dream' in tandem with the growth of the middle class for its prestige effects, improved quality of living and relative privacy (Ong, 2000; Wong and Yap, 2003).

2.3 State-of-the-art Research in the Field of Green Building Rating Systems

Markets for environmental goods are commonly characterised by information asymmetries. Such information asymmetries among market participants often result in market failure and the risk of adverse selection, which have been identified as among the main reasons to argue in favour of environmental product information. However, consumers usually cannot judge the validity

of the environmental information delivered to them (Stø *et al*., 2005). As a result, third-party certified eco-labelling or certification schemes can be introduced as a means to overcome such information asymmetries and to increase consumer confidence in the validity of the environmental information. The impact of third-party certified environmental information on consumer behaviour has been studied extensively for different kinds of product categories, including forest products (Thompson *et al*., 2010) and energy-efficient appliances (Sammer and Wüstenhagen, 2006), to name two. Despite the world-wide proliferation of green building certification schemes, however, there is a scarcity of research investigating the impact of such schemes on property choices (Addae-Dapaah and Chieh, 2011).

The few studies available have mostly focused on the commercial real estate sector in the US (for example, Fuerst and McAllister, 2011; Miller *et al*., 2008; Eichholtz *et al*., 2010). Of the few existing studies that have been undertaken to try to ascertain the impact of the Singaporean Green Mark Scheme on real estate investors' behaviour, the revealed preference methodology has been the predominant approach. For instance, Deng, Li and Quigley (2012) provided evidence that the price premiums in asset values that the Green Mark Scheme commands in the market ranged from 10 per cent for projects awarded Certified to 21 per cent to projects awarded Platinum. Nevertheless, such a revealed preference approach, which analyses housing transactions based on real market data, also has several shortcomings. For instance, difficulties can arise when strong correlations between explanatory variables of interest exist, making it difficult to measure model parameters which mirror the proper trade-off ratios (Kroes and Sheldon, 1988). Contrary to examining actual choices, a stated preference study on the other hand investigates the preferences for hypothetical products (Louviere and Timmermans, 1990). Through such laboratory conditions, it is therefore possible to achieve better control of the stimuli under consideration (Walker *et al*., 2002). In addition, it allows the inclusion of all possible characteristics of a home which might not always be available when analysing real market data. Addae-Dapaah and Chieh (2011) demonstrate for the Singaporean market that stated and revealed reference data indeed can produce very different results. They found that the premium that green certification commands extracted from sales data was in the range from 9.61 per cent to 27.74 per cent and thus was much higher than the premium the authors extracted from a stated preference survey. The authors asked respondents to state directly the premium they would be willing to pay for Green Mark certified private property; it was found that certified residential properties would be able to fetch a price premium ranging from 5.47 per cent for Certified to 6.82 per cent for Platinum awarded properties.

We build on the work by Addae-Dapaah and Chieh (2011) by applying a highly sophisticated stated preference methodology, an adaptive choice-based conjoint analysis, to elicit indirectly the stated preferences of prospective property buyers. Indirect measures are generally seen as less susceptible to social desirability response bias than direct elicitation methods (Fisher, 1993). In addition, in contrast to the study conducted by Addae-Dapaah and Chieh (2011), we have chosen property buyers in the process of purchasing a newly launched condominium unit as the main target group of our study, instead of selecting Singapore's general population as the target group. This facilitated the validity of our study as our empirical investigations were conducted in the context of real purchases.

3. Design of Study and Methodological Approach

3.1 Methodology

Conjoint analysis has proved useful in deepening insights into the relative importance of housing attributes in the subjective process of residential property buying decisions in a wide variety of housing market studies (for example, Timmermans *et al.*, 1994; Molin *et al.*, 1996; Earnhart, 2002; Hoshino, 2011). However, conjoint analysis has only been applied by a few scholars to measure the impact of environmental criteria of housing options on consumers' choices (for example, Leishman *et al.*, 2012; Banfi *et al.*, 2008; Farsi, 2010; Achtnicht, 2011). We are not aware of any conjoint study that has measured the impact of a green building certification scheme on property buyers' choices.

The underlying idea of a conjoint experiment is that a product is defined by a bundle of attributes and that the total utility of a product is the sum of the individual utilities of the attributes of that product (Hair *et al.*, 1998; Louviere, 1988). There are different conjoint methods available, including the adaptive conjoint analysis, choice-based conjoint analysis and the adaptive choice-based conjoint analysis (ACBC). The main objective of the latter two methodologies is to mimic real decision-making processes as closely as possible. Briefly described, a choice-based conjoint experiment considers a quasi-realistic buying situation, where consumers choose between one or more products from a restricted product set. By choosing the most beneficial product from this restricted set, the preferences of the respondents can be directly derived (McFadden, 1974).

ACBC, the latest methodological refinement, is particularly suitable for complex products with five attributes or more. This methodology is able to capture more information at the individual level than traditional, non-adaptive conjoint methodologies. It is a methodology particularly suitable when respondents employ non-compensatory decision-making (Johnson and Orme, 2007). It recognises that, in complex choice tasks, respondents first eliminate alternatives with unacceptable levels from their consideration set and only make choices among products which conform with such screening rules (Johnson and Orme, 2007; Johnson, 2008). The condominium buying process can be considered as such a complex situation where there are usually many attributes involved that influence the choice situation under investigation. It represents a typical purchase decision that involves non-compensatory decision-making, where consumers start with narrowing down all available options in order to identify acceptable options and then continue by trading-off the remaining products' alternatives levels (Steiner *et al.*, 2011). A detailed description of the ACBC questionnaire can be found in section 3.4.

3.2 Target Population

This study concentrated on newly launched private condominiums as property characteristics differ significantly between different sub-markets (Phang and Wong, 1997; Sing *et al.*, 2006; Deng *et al.*, 2012). The main target group of this study was property buyers who were in the process of buying a newly launched condominium unit. Thus, as a core element of this study, the survey took place in the context of real purchases. The target group comprised both property buyers who were looking to buy a property for occupation and property investors. The on-line survey took place during a two-month period in autumn 2011. We recruited respondents by distributing letters of invitation at permanent displays of condominium units (i.e. show-flats) through three major

real estate agencies and one project developer. In addition, three real estate agencies agreed to send out email invitations with the questionnaire to their potential clients. As a consequence of this recruitment procedure, we are unable to determine the exact response rate. We could not receive any permission from the project developers to approach the prospective respondents at show-flat locations through the team members of this project. The major reason stated by the developers for this decision were concerns that property buyers may not appreciate the disruption to their show-flat viewing experience. In addition, due to privacy concerns, none of the developers and the real estate agents was able to provide us with emails or mail address database. Finally, this study was reviewed by the NUS Institutional Review Board and their requirements precluded the inclusion of incentives for survey respondents.[1] Despite the constraints of the recruitment possibilities, we managed to recruit 62 respondents performing 3967 choice tasks in total or an average of 64.0 tasks per respondent.

3.3 Selection of Attributes and Attribute Levels

The first stage in the design of this study involved the identification of the most important product attributes and corresponding attribute levels for buying a condominium unit. An attribute is a characteristic of a product (for example, size of a condominium), made up by a range of different levels of that particular characteristic (for example, 1400 square feet, 1100 square feet, etc.). In order to select decision-relevant product attributes, we reviewed relevant literature and marketing documents (catalogues of developers, etc.). One available study conducted by KFCB (1993) showed that factors concerning the price, the location and the quality of the condominium, its facilities and the individual housing units were most important in forming preferences for condominium units in Singapore. The study also revealed that accessibility to shops and public transport was highly valued by condominium buyers. In addition, high-quality interior design and layouts were also highly preferred by the respondents. Finally, a 99-year leasehold tenure (i.e. on expiry of the lease, the title and interest in the property will revert to the government) was regarded as unacceptable by more than half of the respondents. In addition, in a more recent study, Addae-Dapaah and Chieh (2011) revealed that price was the most important factor in affecting the respondents' decisions to buy a condominium, followed by accessibility, location, amenities and facilities. Based on these two studies and on discussions with experts in the real estate sector, 12 attributes, being the upper limit recommended to be carried forward into the ACBC questionnaire, and relevant attribute levels were chosen for the ACBC design (see Table 1).

We defined the attribute levels for the attribute *area* as per the Urban Redevelopment Authority's (URA) categories, which include three areas—namely, the Core Central Region (CCR), Rest of Central Region (RCR) and Outside Central Region (OCR). The levels of the attribute *size* (i.e. 500 square feet, 800 square feet, 1100 square feet and 1400 square feet) allowed for estimates of buyers' preferences for different unit sizes. We included two levels for the attribute *tenure type* (freehold and 99-year leasehold) in order to determine how important it is for buyers to purchase a condominium unit that is granted a freehold term instead of a leasehold 99-year term. For the levels of the attribute expected temporary occupation permit (TOP), which indicates that a building can only be occupied when TOP is granted, we included four attribute levels ranging along a continuum from the year 2011 to the year

Table 1. Attributes and attribute levels of the ACBC study

Attribute	*Attribute levels*			
Area	CCR (+ S$1100)	RCR (+ S$700)	OCR (+ S$0)	
Size (square feet)	1400	1100	800	500
Tenure type	Freehold	99-leasehold		
Expected TOP	2011	2013	2015	2017
Distance to MRT (km)	Below 0.2	0.2-0.5	0.5-1.5	Above 1.5
Distance to shopping centre (km)	Below 0.2	0.2-0.5	0.5-1.5	Above 1.5
Main aspect of living room	South-facing	West-facing	North-facing	East-facing
Floor level	High floor	Mid floor	Ground floor	
BCA Green Mark	Platinum	Certified	No certification	
Condominium facilities	Prestige	Family	Basic	
Unit facilities	Luxurious with balcony	Luxurious without balcony	Standard with balcony	Standard without balcony
Purchase price per square foot	Base price of S$1000 + level price depending on the area + variation			

Notes: For the attribute price per square foot, we applied the attribute as a continuous variable. We specified a base price of S$1000. For the two attribute levels RCR and CCR, we associated these levels with the median level price increase of S$700 and S$1100, respectively.

2017. Using the attributes *distance to MRT station* and *distance to shopping centre*, we aimed to determine how much buyers value the accessibility to public transport and shopping. Using the attribute *main aspect of living room* with four attribute levels (north-facing, east-facing, south-facing, west-facing), we aimed to determine the importance of the aspect and the corresponding daylight. The *floor level* was used to determine how important it is for buyers to live at a high floor level. The levels of the attribute *BCA Green Mark* included two award rating levels of the Green Mark Scheme (Platinum and Certified) along with a level that indicates that the condominium has not been certified at all. When the respondents moved their mouse cursor over the respective attribute levels, they were informed about the aim and the benefits of this scheme and on the scoring criteria for achieving the different certification levels. The attributes *condominium facilities* and *unit facilities* tried to identify how much value buyers place on the facilities provided by a condominium and a unit. When the respondents moved their mouse cursor over the respective attribute levels, they were informed about the specific details.[2,3] The attribute levels for both condominium facilities and unit facilities were constructed with reference to the actual differences in provision across the classes of Singaporean condominiums. Finally, for the attribute *price per square foot*, we applied the attribute as a continuous variable. We specified a base price of S$1000, representing the approximate median price for all sold newly launched condominium units in the OCR in the period of July 2010–June 2011. For the two attribute levels RCR and CCR, we associated these levels with the median level price increase of S$700 and S$1100 respectively. In order to disassociate the effect of these price changes on product choice from the price

increments attached to the individual price levels, we summed the prices associated with the level of the area and the base price and then varied the summed price by a randomly drawn price variation from −20 per cent to +40 per cent (Sawtooth Software, 2009a). Finally, we rounded the prices, after being disturbed randomly, to the nearest S$100.

3.4 Overview of interview

As housing choices are often regarded as being a multiple-person process (Molin *et al.*, 1999), respondents were reminded at the beginning of the survey to answer the questionnaire on the behalf of each member of their household. The interview started with a 'build-your-own' (BYO) section where respondents were asked to describe the condominium unit they would be most likely to buy. Respondents were asked to indicate their preferred level for those attributes without an *a priori* preference order, taking into account the corresponding feature-dependent prices depending on the area. The questionnaire continued then with a screening section, where five condominium units were presented at a time. Respondents were asked to indicate whether they would consider buying those condominium units which were described by the 12 product attributes. Respondents did not have to make final choices, but rather indicate whether (s)he would consider each one as 'a possibility'. In total, eight such screening sections were presented to the respondents. The design per each individual respondent was customised and near orthogonal; the product concepts were constructed to be near-neighbours to the BYO-specified product (Orme and Johnson, 2008). These answers were scanned to identify whether respondents were using non-compensatory screening rules. The respondent could indicate that critical attribute levels were an absolute requirement (a 'must have') or totally unacceptable. This procedure had the advantage of creating product concepts that seemed to be relevant to the respondents. Finally, respondents were given a series of choice tasks presenting product concepts marked as 'possibilities' and were asked which product, among three randomly chosen concepts, they would most probably choose to buy (Johnson and Orme, 2007).

4. Results: Empirical Findings

4.1 Sample Characteristics

The respondents were predominantly male (67.7 per cent), of Singaporean nationality (85.5 per cent), mainly in the age group of 35–44 years (51.6 per cent) and characterised by having a household income above S$6000 per month. Of the respondents, 58.1 per cent were planning to buy a condominium for investment purposes whereas 41.9 per cent were planning to buy a condominium for self-occupancy. Further details with regards the composition of the sample can be found in Table 2.

4.2 Results of the Hierarchical Bayes Model

We applied the hierarchical Bayes (HB) model to analyse the collected dataset of our study. The hierarchical Bayes (HB) model is called hierarchical because it uses a lower- and an upper-level model to estimate the part-worth utilities of individual respondents. Part-worth utilities indicate the contribution of specific attribute levels to the overall utility of a product. At the lower individual level, it is assumed that the probability a respondent will choose a particular alternative is governed by a multinomial logit model. In the upper-level model, it is assumed that individuals are drawn from a single multivariate normal distribution.

Table 2. Demographic characteristics of the sample ($n = 62$)

	Frequency	*Percentage*
Nationality		
Singaporean	53	85.5
Singaporean permanent resident (PR)	6	9.7
Foreigner	3	4.8
Purpose of buying property		
For investment (for reselling the condominium unit)	8	12.9
For investment (for renting out the condominium unit)	28	45.2
For self-occupancy	26	41.9
Income level (S$)		
Below 6000	8	12.9
6000–12 000	28	45.2
Above 12 000	26	41.9
Gender		
Male	42	67.7
Female	20	32.3
Education		
Post-secondary or below	2	3.2
Diploma and professional qualification	9	14.5
University	51	82.3
Current home situation		
HDB (owned)	19	30.6
HDB (rented)	3	4.8
Executive condominium (owned)	2	3.2
Executive condominium (rented)	1	1.6
Condominium (owned)	23	37.1
Condominium (rented)	6	9.7
Landed property (owned)	6	9.7
Landed property (rented)	1	1.6
Not specified	1	1.6
Current home location		
Core Central Region (CCR)	16	25.8
Rest of Central Region (RCR)	16	25.8
Outside Central Region (OCR)	30	48.4
Current size of home (Square feet)		
500–800 sqft.	1	1.6
800–1100 sqft.	17	27.4
1100–1400 sqft.	23	37.1
Above 1400 sqft.	21	33.9
Age (years)		
Below 30	7	11.3
30–34	7	11.3
35–39	16	25.8
40–44	16	25.8
45–49	5	8.1
50–54	6	9.7
Above 55	5	8.1
Number of cars		
0	10	16.1
1	34	54.8
2	13	21.0
3	4	6.5
4	1	1.6
Number of persons in household		
1	3	4.8
2	9	14.5
3	14	22.6
4	18	29.0
5	11	17.7
6 or more	7	11.3

Under a Bayesian framework, the vector of means of the distribution of individuals' part-worths and the matrix of variances and covariances of the distribution of part-worths across individuals are estimated iteratively by conducting several thousand

iterations (Sawtooth Software, 2009b; see Rossi and Allenby (2003) for a more detailed discussion of hierarchical modelling).

Table 3 summarises the results, presenting the mean part-worth utility values of the estimated model as well as the corresponding standard deviations. In addition, Table 3 presents the means and standard deviations of the relative importance scores of the attributes examined in this survey. They describe how much influence each attribute has on the purchase decision of a property buyer. Finally, we report the percentage of respondents who regard a given attribute level as 'unacceptable' for buying a condominium unit.

Table 3 highlights that the *purchase price per square foot* received by far the highest importance score (28.83 per cent), followed by the *size of the condominium unit* (20.06 per cent). Larger dwellings were, on average, preferred over smaller unit sizes. More specifically, 72.58 per cent of the respondents indicated that they would not buy a condominium unit with a unit size of 500 square feet. However, the standard deviations of the part-worth utilities were quite large, reflecting the heterogeneity in condominium buyers' preferences. There were a significant number of respondents who had a clear preference towards smaller-sized condominium units. The attribute *location* (12.16 per cent) received the third-highest important score. The results indicate that, on average, condominiums located in the CCR and the RCR were clearly favoured over those located in the OCR, despite the fact that these areas were associated with an incremental price increase. Again, there was a high level of heterogeneity in the preferences of condominium buyers. Also, the number of respondents who indicated that they would not buy a condominium that was located in one of the three areas was relatively low. Furthermore, a surprising finding was that the attribute *main aspect of the living room* (7.46 per cent) was the fourth most important attribute, being almost on par with the attribute *distance to MRT* (7.39 per cent). There was a clear preference by the condominium buyers towards condominium units with living rooms faced towards south and north. The attribute *distance to MRT* scored the fifth-highest attribute value. More specifically, 33.87 per cent and 12.90 per cent of the respondents consider living in a condominium which is situated more than 1.5 km or between 0.5 and 1.5 km respectively, away from a MRT station as unacceptable. The attributes *temporary occupation permit (TOP)* and *floor level* were rated at medium importance with 6.05 per cent and 4.66 per cent respectively. The utilities reveal a preference for earlier TOP dates amongst the respondents. In addition, a condominium located on a high floor was preferred over a condominium unit located on a mid floor or on the ground floor. Interestingly, only 19.35 per cent see the location on the ground floor as an elimination criterion. Surprisingly, the attribute *tenure type* (3.88 per cent) received a rather low importance score; a relatively low number of respondents (16.13 per cent) perceived a 99-year leasehold tenure as unacceptable. Thus, in contrast to the finding of KFCB (1993), which revealed that a 99-year leasehold tenure was regarded as unacceptable by more than half of the respondents, our results did not support this finding. Finally, the four lowest importance scores were attributed to the attributes *distance to shopping* (3.10 per cent), *unit facilities* (2.89 per cent), *condominium facilities* (1.96 per cent) and *certification with the BCA Green Mark scheme* (1.56 per cent). The results show that for those attributes, few buyers have critical minimum requirements and thus are much more willing to use compensatory decision-making when evaluating opportunities.

The results indicate that the BCA Green Mark scheme certainly would not be a high motivator for consumers to opt for a specific condominium unit if the price or other

Table 3. Results of the hierarchical Bayes model

Attribute	*Percentage importance*	*S.D.*	*Average utilities*[a]	*S.D.*[a]	*Unacceptable attribute level*[b]
Purchase price (S$ /square foot)[c]	28.83	(7.33)			
800			173.00	(43.97)	
2940			−173.00	(43.97)	
Size (Square feet)	20.06	(7.91)			
1400			81.60	(72.83)	4.84
1100			51.65	(33.99)	14.52
800			−3.74	(45.30)	40.32
500			−129.52	(68.37)	72.58
Area	12.16	(7.07)			
Core Central Region (CCR)			65.62	(45.39)	6.45
Rest of Central Region (RCR)			14.66	(25.18)	6.45
Outside Central Region (OCR)			−80.28	(43.13)	8.06
Main aspect of living room	7.46	(2.83)			
South-facing			23.25	(19.78)	4.84
West-facing			−45.25	(30.97)	30.65
North-facing			16.79	(28.10)	0.00
East-facing			5.21	(21.36)	4.84
Distance to MRT (km)	7.39	(2.93)			
Below 0.2			25.38	(9.53)	0.00
0.2–0.5			23.39	(13.55)	1.61
0.5–1.5			9.53	(9.59)	12.90
Above 1.5			−58.30	(25.39)	33.87
Temporary occupation permit	6.05	(3.26)			
2011			9.32	(31.08)	0.00
2013			14.83	(25.36)	0.00
2015			3.09	(27.55)	8.06
2017			−27.23	(29.38)	27.42
Floor level	4.66	(2.96)			
High floor			19.76	(15.78)	1.61
Mid floor			10.46	(17.99)	1.61
Ground floor			−30.22	(21.16)	19.35
Tenure type	3.88	(3.75)			
Freehold			23.31	(22.48)	0.00
99-leasehold			−23.31	(22.48)	16.13
Distance to shopping centre (km)	3.10	(1.71)			
Below 0.2			14.00	(8.27)	0.00
0.2–0.5			10.08	(10.63)	0.00
0.5–1.5			−6.84	(6.51)	1.61
Above 1.5			−17.23	(13.46)	9.68
Unit facilities	2.89	(1.38)			
Luxurious with balcony			17.38	(6.78)	0.00
Luxurious without balcony			−1.87	(6.45)	0.00
Standard with balcony			1.76	(8.05)	0.00
Standard without balcony			−17.27	(10.67)	1.61

(continued)

Table 3. (Continued)

Attribute	*Percentage importance*	*S.D.*	*Average utilities*[a]	*S.D.*[a]	*Unacceptable attribute level*[b]
Condominium facilities	1.96	(1.26)			
Prestige			1.93	(10.88)	1.61
Family			7.73	(13.60)	0.00
Basic			−9.66	(4.78)	3.23
BCA Green Mark	1.56	(0.68)			
Platinum			9.24	(3.19)	0.00
Certified			0.24	(3.64)	0.00
No certification			−9.48	(5.47)	0.00
None			233.01	(77.49)	

[a]In order to obtain the final individual part-worth estimates, we used a total of 20 000 preliminary iterations and 10 000 additional iterations with each 10th replicated saved to obtain the final part-worth utilities. In order to resolve out-of-order utility relationship for those attributes with an *a priori* preference order, we enforced constraints on orders of part-worths within those attributes. To calculate the average utilities of each attribute level of the HB model, we rescaled the raw part-worth utilities by a method called zero-centred Diffs (Sawtooth Software, 1999).
[b]Percentage of respondents that regard given attribute levels as 'unacceptable' for buying a condominium unit.
[c]To model the effect of price on product choice, we estimated price as a continuous function by choosing the linear coding method.
Note: The average root likelihood (RLH) was used as a measure of fit to assess convergence of HB estimates (Sawtooth Software, 2009b). In this study, it would be predicted that each alternative would be chosen with a probability of 1/3. RLH was 0.67 for this model, indicating a good fit of the model.

important characteristics did not meet certain expected criteria. Nevertheless, the certification scheme certainly has an effect on buyers' decisions on the margin when deciding between two otherwise-similar condominium units. The marketing for the BCA Green Mark scheme should be combined with certain classical buying criteria and not be marketed in its own right.

In Table 4, we present how much influence each attribute has on the purchase decision both of property buyers who were looking to buy a property for occupation and property investors. In order to test whether there is a significant difference between the two groups, a Mann–Whitney U-test was performed. The tests reveal that only the attributes *size* and *unit facilities* were significantly more important and *area* was significantly less important for property buyers who were looking to buy a property for occupation than for property investors ($p < 0.05$).

4.3 Willingness-to-pay for the BCA Green Mark Scheme

Willingness-to-pay is defined as the premium prospective buyers would be willing to pay for a unit located in a condominium which is certified by one of the Green Mark Scheme rating awards. In order to conduct this analysis, we subtracted the 1000 values of the part-worth distribution of the base attribute level indicating 'no certification' from the part-worth distribution of either the Platinum or the Certified attribute level. These differences in attribute level utility

Table 4. Importance of attributes for segments split according to the purpose of buying property

	Purpose of buying property (percentages)				
	For investment (n = 36)		*For self-occupancy (n = 26)*		
Attribute	*Importance*	*S.D.*[a]	*Importance*	*S.D.*	*p value*[b]
Purchase price per square foot	30.08	(6.57)	27.11	(8.08)	0.120
Size	17.64	(6.05)	23.41	(9.03)	0.001**
Area	13.50	(6.82)	10.31	(7.13)	0.049*
Main aspect of living room	6.91	(2.57)	8.21	(3.05)	0.062
Distance to MRT	7.59	(3.17)	7.11	(2.59)	0.578
Temporary occupation permit	5.78	(3.33)	6.44	(3.18)	0.648
Floor level	4.87	(3.12)	4.37	(2.76)	0.559
Tenure type	4.50	(4.19)	3.03	(2.90)	0.209
Distance to shopping centre	3.01	(1.77)	3.22	(1.66)	0.369
Unit facilities	2.59	(0.93)	3.30	(1.77)	0.039*
Condominium facilities	2.01	(1.22)	1.89	(1.33)	0.690
BCA Green Mark	1.53	(0.69)	1.61	(0.68)	0.458

[a]Standard deviations are shown in parentheses.
[b]The test of significance was a Mann–Whitney U-test.
Notes: $p < 0.05$; ** $p < 0.01$.

per individual respondent were then divided by the corresponding 1000 values of the part-worth distribution of the price vector (see Sattler *et al.*, 2010, for a similar computation). We then calculated the mean of the resulting price premium distributions in order to obtain a point estimate of the average price premiums per square foot the individual respondents would be willing to pay. The mean for the entire sample indicates that the Certified award could yield a mean price premium of S$60.54 per square foot on the sales price of a condominium unit. The estimated mean price premium of S$13.61 would be larger for units certified with the Platinum award. The results suggest that an otherwise equal building certified with a Certified award could be sold at a premium of 3.78 per cent per square foot. The increment in selling price for a building certified by the Platinum award may be as much as 7.98 per cent (see Table 5).

5. Discussion and Conclusions

The results suggest that the price premium buyers would be willing to pay for green certification varies within the different levels of the Green Mark Scheme, ranging from 3.78 per cent for the Certified award to 7.98 per cent for the Platinum award. This premium is lower than the analysis of real market transactions as revealed by different studies would suggest (for example, Deng *et al.*, 2012). Nevertheless, our results should encourage developers and investors to bear the additional costs of developing green buildings since the reward for doing so in terms of reaping higher sales premiums proves to be promising. A preliminary study by the Building and Construction Authority indicates that the cost premium of Green Mark Certified buildings over code-compliant buildings ranges between 0.3 per cent and 1 per cent whereas the cost

Table 5. Mean price premium per square foot and in terms of percentage on the sales price

Rating award category	*Price premium (S$) per square foot (square metre)*	*Price premium (percentage)*[a]
Certified	60.54 (651.65)	3.78
Platinum	133.61 (1438.17)	7.98

[a]In order to ascertain the premium in terms of percentage on the sales price of a condominium unit we proceeded as follows: for each individual respondent, we calculated the ratio of the price premium per square foot individual respondents would be willing to pay by the purchase price of the condominium unit individual respondents have chosen in the build-your-own section. Based on those results, we calculated the mean of the sample by dividing the sum of individual results by the number of respondents.

premium for Green Mark Platinum buildings ranges from 2 per cent to 8 per cent (BCA, 2008). In light of the fact that it is expected this cost premium will steadily decrease in the future resulting from economy of scale and learning effects of industry players (BCA, 2011b), our results thus suggest a strong business case for developers of green buildings.

While one of the strengths of the methodology we used, the adaptive choice-based conjoint analysis, is that meaningful results can also be obtained with a small sample size (Johnson and Orme, 2007), we are aware that the small sample size obviously limits the ability to generalise our results. Therefore, we consider all of our analysis to be exploratory by nature which will provide useful insights into condominium buyers' preferences for residential properties in an area where comparable research is scarce. Nevertheless, it is essential to acknowledge the limitations of this study. The presented scenarios were, in essence, hypothetical; although we were able to include a relatively large number of attributes in our design, in reality, consumers may consider even more information when making a decision about buying a property. In addition, consumers did not actually have to pay the purchase price of the condominium; as a result, the tendency to underestimate the importance of the price attribute has to be acknowledged. It is also important to recognise that the level of importance of individual attributes might have been influenced by the survey design, including the selection of the number and range of attribute levels (Orme, 2010). For instance, if we had chosen a different range of attribute levels for the attribute 'size'—for instance, ranging from 300 square feet to 2000 square feet—would most likely have scored a higher importance value than that revealed in this study. In a similar vein, by having included a different number of levels for different attributes—for instance, two attribute levels for the attribute 'tenure' and four attribute levels for the attribute 'size'—we have to acknowledge that there is a risk that a number-of-levels effect could have occurred. Moreover, consumers typically invest much more time and effort when taking a decision in the real world than when making such choices in an on-line survey (Huber *et al.*, 1992). Furthermore, the risk of social desirability can never be completely avoided when using a stated preference approach. Nevertheless, by use of an ACBC, we were able to limit socially desired answers to a large degree. Finally, our sample size was relatively small and we suggest that further research should aim at validating our findings with larger sample sizes.

Findings from this study provide a springboard for future research. Future research could focus on the identification of influencing factors (such as

demographic factors) affecting the importance of such green building schemes in consumers' decision-making. These factors should be further explored in order to generate a richer understanding of the buyer segment that is likely to be influenced by a green building certification scheme. Another extension of this research would be to investigate preferences of other consumer segments in the Singaporean market, including buyers of public housing or landed property. Measuring preferences of these consumer segments would provide significant additional insights of buyers' preferences in the Singaporean market. Finally, for future research, we would suggest further investigation of why consumers care about the BCA Green Mark Scheme. Are they paying a premium for green buildings or simply energy savings? The motivations for environmentally friendly consumption on the part of end-users are complex and interact with a range of intellectual, moral and practical considerations (Moisander, 2007). Green behaviour is thus a highly contingent matter and cannot be assumed to be a direct product of more generalised attitudes of environmental consciousness. While longitudinal surveys indicate a growing environmental awareness amongst Singaporeans, this growing consciousness does not necessarily translate to specific instances of green behaviour. For instance, it has been argued that the success of Singapore's national recycling programme has been driven more through economic incentives and social ideals than through environmental messages (Neo, 2010). Therefore, prestige-seeking behaviour and energy savings may be more important than the desire for a more environmentally friendly building. These factors must remain speculations in the absence of a concrete study on the motivations of green building purchasers.

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Notes

1. The NUS Institutional Research Board is a research ethics committee that is responsible for reviewing and providing ethics approval for research projects that involve human subjects in order to protect the rights and welfare of research subjects.
2. The 'basic' level indicated that the condominium included a small swimming pool, a small fitness centre and a covered parking lot. The 'family' level indicated that the condominium included 24-hour security, a large swimming pool with water slides, a large fitness centre, a BBQ-area, a mini-mart, a big children's playground and park, a squash hall, an outdoor and indoor tennis court, a clubhouse, mini golf and a covered parking lot. The 'prestige' level indicated that the condominium included 24-hour security, a large swimming pool, a mini-mart, a large fitness centre, a covered parking lot, a rooftop terrace, a Jacuzzi, massage beds, a sauna, a spa pool and a spa pavilion.
3. The levels 'standard without balcony' and 'standard with balcony' indicated that the unit did not contain any bathtub, was equipped with a standard kitchen and standard fittings, and was equipped either without or with a balcony respectively. The levels 'luxurious without balcony' and 'luxurious with balcony' indicated that the unit was equipped with a large bathtub, a large and modern

equipped kitchen with designer kitchenware, luxurious fittings with top-quality materials and without or with a balcony respectively.

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