Green Mark Certification: Does the Market Understand?

Authors Kwame Addae-Dapaah and Su Jen Chieh

Abstract A corollary to the green building revolution is the certification of green buildings by relevant organizations. The pertinent question is whether the market understands the certification. The paper addresses the issue via a quantitative (hedonic model) and psychographic (survey) study of the Singapore residential green building market. The results reveal that green certification commands a statistically significant premium. However, the market is confused by the different tiers of certification as evidenced by incommensurate premia for the different tiers. Furthermore, the fact that the premium varies with tenure (freehold/leasehold) and location after controlling for all other attributes may imply that the premium may not be solely attributable to green certification.

The fear of Armageddon resulting from environmental catastrophe, coupled with the perceived benefits of green building, is fuelling the green revolution. As succinctly concluded by The Ecologist (1972), sustainability is a survival imperative. The urgency emanating from this awareness has given rise to various schemes/programs to drive the green advocacy. One such program buoying the green revolution is the emergence of worldwide rating systems such as the Building Research Establishment Environmental Assessment Method (BREEAM) in the United Kingdom, Leadership in Energy and Environmental Design (LEED) and ENERGY STAR in the United States, Green Globes in the United States and Canada, Green Mark in Singapore, and BOMA-Best in Canada. These rating systems are meant to encourage environmentally and socially responsible building practices by awarding ''badges'' for buildings' different degrees of ''green,'' as well as differentiating green from non-green buildings. Thus the rating systems are helping to promote a built environment that balances economic and social forces against the environmental imperatives of resource conservation and renewal for the world of tomorrow.

In Singapore, the Building and Construction Authority (BCA) launched the Green Mark scheme in January 2005 to promote sustainability in the built environment and raise environmental awareness among developers, designers, and builders to eventually deliver ''healthier'' products to end-users. Thus, Singapore became the first Asian country to adopt an eco-labeling system.

Despite the world-wide proliferation of eco-labeling systems, there are only a few studies on the impact of these rating systems on property values. These few studies, which mainly focus on the U.S., deal with commercial properties. There

is virtually no systematic body of knowledge on Asian countries. Similarly, there appears to be no study that relates eco-labeling to residential properties in Asia. Apart from Brounen and Kok's (2011) paper that relates to the European Union, there appears to be no study on eco-labeled residential properties. Thus, the first motivation of this paper is to fill the gap in the literature relating to eco-labeling vis-à-vis property values in an Asian country, Singapore. The second motivation is to fill the gap in the literature on the impact of eco-labeling on residential property value by providing evidence from Singapore. Thirdly, the success of the rating scheme is a function of the market's acceptance of it, which may be predicated on the market's understanding of the ratings.

Singapore is a cosmopolitan city, which has become an important financial center in Southeast Asia. Thus, any insight into the impact of eco-labeling on property value based on a study in Singapore may have a cosmopolitan flavor that appeals to a wide audience.

In view of the above motivations, the paper is aimed at ascertaining the premium (if any) commanded by the Green Mark (GM) certification. The second objective is to determine the Singapore residential market's understanding of the GM certification as evidenced through the premium paid for the hierarchy of ratings and the results of a survey conducted for the study. If the market understands the GM certification, any premium paid will be commensurate to the GM-tier. A higher GM-tier reflects a building that is more environmentally friendly and energy efficient than a lower GM-tier building. People may go for higher GM-tier buildings purely for an ideological reason or for the perceived economic and social benefits. Therefore, the third objective is to examine the premium-cost-ratio (PCR) for the various tiers of certification to ascertain their relative profitability. This will be followed by an incremental benefit-cost ratio (IBCR) from the perspective of the owner-occupier to see how appealing eco-labeled building is from an economic point of view.

The results of the analysis of the sales data and survey show that green certification commands a statistically significant premium. The premia for green certification extracted from the sales data and survey range from 9.61% to 27.74% and 5.47% to 6.82%, respectively. Furthermore, the results of the sales data analyses display illogical allocation of premia among the different tiers of green certification—lower tier commands a higher premium than some higher tier green certification. Moreover, it is found from the survey that out of the 33.67% of the respondents who had heard of the green certification, 83.2% were not aware of the differences among the four tiers of green certification in Singapore. As far as profitability is concerned, the results show that on the basis of the premium-cost ratio, it is more beneficial for residential property developers and investors to aim for the basic green certification rating. However, the results of the IBCR analyses show that eco-labeled private apartments are not appealing to the owner-occupier. This is consistent with the result of the survey that green features do not have much impact (with a rating score of 2.49 out of 5; 1 being minimum impact and 5 being maximum impact) on the respondents' choice of residential units to buy.

The rest of the paper proceeds as follows. The next section is a review of the extant relevant literature. This is followed by a brief description of the GM rating,

data sourcing, and management, after which the results of the data analysis are presented and discussed. The last section contains concluding remarks.

Literature Review

A number of studies demonstrate the effect eco-labeling on the price of commercial offices. All the studies utilize the hedonic model and the CoStar database. Miller, Spivey, and Florance (2008) do not find any statistically significant sales price premium. However, other studies have found a rental/sales price premium for eco-labeling. Wiley, Benefield, and Johnson (2008) find a rental premium of 15%–17% for LEED and 7%–9% for ENERGY STAR (ES) certified office buildings. The premia in terms of sales price per square foot are US$130 and US$30 for LEED and ES rated office buildings, respectively. Similar results have been replicated by Fuerst and McAllister (2008) and Miller, Spivey, and Florance (2008). Furthermore, Eichholtz, Kok, and Quigley (2009) found 3% rental and 19% sales price premium for ES rated office buildings albeit no statistically significant rental/price premium for LEED rated office buildings. Similarly, Fuerst and McAllister (2009) found a price premium of 35%/31% for ES/LEED certified office buildings. Other studies that replicate similar results are Eichholtz, Kok, and Quigley (2010), Fuerst and McAllister (2011), and Reichardt, Fuerst, Rottke, and Zietz (2012). Brounen and Kok (2011), the only study that relates to housing, found that green-labeled homes sell at 3.6% premium.

All the above studies, with exception of that by Brounen and Kok (2011), which centers on the European Union, focus on the U.S. and utilize the CoStar database. This makes this paper unique in the sense of being the first on residential properties in an Asian context. This is significant as the Asian perception of the green revolution may differ in substance from the Western perception, as evidenced by negotiations on carbon emission. While the Asian lauds the ideals of the green revolution, there is a lingering fear that a full commitment to the green revolution may scuttle the Asian economic revolution, which has firmly put Asia on the geopolitical landscape of the world. Economics takes precedence over sustainability ideals. As noted by Addae-Dapaah, Liow, and Neo (2009), location and accessibility are the primary consideration of Singaporeans in the choice of commercial buildings; green features are of secondary importance. This contrasts with the West where institutional and corporate investors think highly of and use sustainable space because of several reasons, including enhancement of public image as being socially responsible, which improves corporate financial performance (Orlitzky, 2003), increased worker productivity and retention rates of employees, and reduced employee absenteeism (Turban and Greening, 1997; Miller, Progue, Gough, and Davis, 2009) and cost savings from improved energy efficiency (Kats, 2003; Fowler and Rauch, 2008). The above rationale for consuming green space may not incentivize the Singaporean consumer of housing who, being an individual, may care less about corporate social responsibility, increased worker productivity, and even rental premium. Singaporeans buy condominiums for owner-occupation. Condominium ownership, regardless of green label, is one of the five badges of achievement. This is different from the

West and thus, makes the Asian perspective of relevance to the debate on green premium.

GM Rating Scheme in Singapore

The Singapore GM Scheme was developed by the Building and Construction Authority (BCA) of Singapore and supported by the National Environment Agency (NEA) of Singapore in January 2005 to drive Singapore's construction industry towards building more environment-friendly buildings. It is intended to promote sustainability in the built environment and raise environmental awareness among developers, designers, and builders and eventually deliver ''healthier'' products to end-users. Singapore's Master Greenplan is aimed at 80% of all buildings in Singapore having GM certified rating by 2030. Incentives (monetary and additional floor area above GPR) are given to developers/projects that meet the requirements of GM certification (Exhibit 1). According to the Building Control amendment act 2008, all new buildings in Singapore with gross floor area (GFA) of not less than 2,000 m^2 must meet GM Gold rating.

There are four different ratings of GM certification: Green Mark Certified (GMC), Green Mark Gold (GMG), Green Mark Gold Plus (GMGP), and Green Mark Platinum (GMPL). Any building that is assessed under the scheme (after application has been made to that effect) is awarded a plaque according to the points scored (Exhibit 2). A maximum of 140 points is awarded in the five categories in Exhibit 1 (with an additional 20 bonus points for renewable energy).

Methodology

The data for the study are analyzed via the hedonic price model, which has been widely employed to explore locational and neighborhood attributes namely: quality of public schools (Haurin and Brasington, 1996; Clauretie and Neill, 2000); proximity to shopping complexes (Sirpal, 1994; Rosiers, Lagana, Theriault, and Marcel, 1996); places of worship such as churches (Carroll, Clauretie, and Jensen, 1996); hospitals (Huh and Kwak, 1997), as well as structural attributes such as floor area or size (Mok, Chan, and Cho, 1995; and Carroll, Clauretie, and Jensen, 1996). Mok, Chan, and Cho (1995) and Tse and Love (2000) also use the hedonic price model to estimate the implicit price of sea view and cemetery views, respectively.

However, finding the correct specification of the hedonic relationship requires researchers to identify both the correct list of independent variables and the true functional forms (Linneman, 1980). Some studies give primary importance to physical/structural traits such as number of rooms, bathrooms (Linneman, 1980) and age of the building (Kain and Quigley, 1970); some focus on amenities such as churches (Carroll, Clauretie, and Jensen, 1996) and schools (Clauretie and Neill, 2000) while others emphasize the role of the neighborhood traits (Goodman and Thibodeau, 1998). Ideally, all housing traits considered in valuing a property should be included in the hedonic model.

Exhibit 1 | Residential Building Evaluation Criteria and Point Allocation

Category	Point Allocation
Part 1: Energy Efficiency	
Energy Related Requirements[a]	
RB 1-1 Thermal Performance Building Envelope—RETV	15
RB 1-2 Naturally Ventilated Design and Air-Conditioning System	22
RB 1-3 Daylighting	6
RB 1-4 Artificial Lighting	10
RB 1-5 Ventilation in Car Parks	6
RB 1-6 Lifts	1
RB 1-7 Energy Efficient Features	7
RB 1-8 Renewable Energy	20
Category Score	87
Part 2: Water Efficiency	
Other Green Requirements[b]	
RB 2-1 Water Efficient Fittings	10
RB 2-2 Water Usage Monitoring	1
RB 2-3 Irrigation System and Landscaping	3
Category Score	14
Part 3: Environmental Protection	
Other Green Requirements[b]	
RB 3-1 Sustainable Construction	10
RB 3-2 Sustainable Products	8
RB 3-3 Greenery Provision	8
RB 3-4 Environmental Management Practice	8
RB 3-5 Green Transport	4
RB 3-6 Stormwater Management	3
Category Score	41
Part 4: Indoor Environment Quality	
Other Green Requirements[b]	
RB 4-1 Noise Level	1
RB 4-2 Indoor Air Pollutants	2
RB 4-3 Waste Disposal	1
RB 4-4 Indoor Air Quality in Wet Areas	2
Category Score	6

Exhibit 1 | (continued)
Residential Building Evaluation Criteria and Point Allocation

Category	Point Allocation
Part 5: Other Green Features	
Other Green Requirements[b]	
RB 5-1 Green Features & Innovations	7
Category Score	7
Green Mark Score	155

Notes: The exhibit presents the framework and points allocation for the residential building evaluation criteria for the BCA GM Certification. A residential building must achieve a minimum GM score of 50 points of which 30 and 20 must come from energy related, and other green, features respectively.
[a]Minimum 30 points
[b]Minimum 20 points

Exhibit 2 | Green Mark Ratings

Green Mark Score	Green Mark Rating
90 and above	Green Mark Platinum
85 to < 90	Green Mark Gold Plus
75 to < 85	Green Mark Gold
50 to < 75	Green Mark Certified

Notes: The exhibit presents the GM scores required for a residential building in Singapore to be awarded the respective GM Ratings. The higher the GM Rating, the more environmentally friendly and thus, more sustainable, a residential building is supposed to be.

Some studies are concerned about the collinearity between housing attributes and thus, omit a large number of housing traits (Constantine, 1994). However, this does not necessarily solve the problem. In fact, ''.....the omission of variables that should be in the model only confounds the problem because the least square regressor yields consistent and efficient estimates only when the model is correctly specified. The omission of important traits on the basis of multicollinearity insures that both the standard errors and hedonic coefficients of the remaining traits are biased,'' (Consumer Reports, 1996).

Thus, researchers using the hedonic pricing technique face a tradeoff, including highly correlated variables causes collinearity to reduce the precision of parameter estimates, while omission of variables that should be in the regression model may result in biased estimates. Herein may lie the wisdom in the statement of Taylor and Wilson (1964) that ''To seek perfect specification for quantitative analysis of

human behavior is to seek the stars. Earth bound creatures must be content with approximate correct specification.''

According to Butler (1982), the intrinsic clustering of characteristic combinations into a relatively small number of configurations leads to considerable multicollinearity in estimates employing a generous selection of the relevant variables. He postulates that it is inevitable for any estimate of a hedonic relationship to be mis-specified as there is a need to omit some of the relevant independent variables. He finds that even severely restricted specification appears to suffer only limited coefficient biases, with a negligible impact on the explanatory and predictive powers of the equation. Similarly, Mok, Chan, and Cho (1995) favor using a smaller number of variables as they argue that biases due to missing variables are small. For example, Mok, Chan, and Cho (1995) do not include the number of rooms as an independent variable in their study since number of rooms is highly correlated with floor area.

Given that property attributes do not function independently to create value, it is inevitable that multicollinearity should exist in a hedonic model. Thus, multicollinearity in hedonic models should be welcomed so far as it is within tolerable levels. In view of this, all the property variables in Exhibit 3, which fall under the five broad categories of factors that affect property prices: structural features, neighborhood attributes, facility attributes, locational factors, time-related attributes, and environmental amenity (Nicholls and Crompton, 2005) are used in the analyses.

Furthermore, hedonic theory offers very little guidance on the correct functional form. As economic theory is ambiguous about the appropriate form, using linear and logarithmic functional forms in housing market analysis is not uncommon. Colwell, Gujral, and Coley (1985) test their hypotheses on six functional forms (Linear, Semi-Log, Exponential, Log-Linear, Inverse, and Inverse-Inverse). The Log Linear Model is selected because of the ease in interpreting the regression coefficient while its log likelihood at the 95% level of confidence is not significantly different from the maximum log likelihood given by other models. Similarly, Rosiers, Lagana, Theriault, and Beaudoin (1996) demonstrate that all tested functional forms (Linear, Semi-Log, Log-Linear, and Inverse models) yield satisfactory results although the best performance is obtained using either a log-linear or the inverse model.

Data

The repeat sales and property specific data for the study, which relate to 34 BCA certified (i.e., eco-labeled) and 34 non-certified private condominium/apartment developments in Singapore were obtained from the real estate information system (REALIS), which is a database for the Urban Redevelopment Authority of Singapore (URA). The URA transaction database (REALIS) records open market sale prices obtained from caveats lodged with Singapore Land Authority (i.e. Registrar of Title Deeds). The data are updated fortnightly on the first and sixteenth of every month. REALIS is the most reliable public database that is used

Exhibit 3 | Variables of Hedonic Models

Variable	Code	Description	Expected Sign
Dependent Variables			
Transacted Price	*PRICE*	Actual selling price of property in Singapore dollars.	Nil
Structural Features			
Floor Area	*LNAREA*	Floor area of property in square meters.	+
Floor Level	*LEVEL*	Floor level of property.	+
Age	*LNAGE*	From completion date to 2009	−
Property Type	*PTYTYPE*	Binary variable 1 for condominium and 0 otherwise.	−
Facility Attributes			
BBQ Pits	*BBQ*	Binary variable 1 for condominiums with BBQ pits and 0 otherwise.	+
Club House	*CLUBHSE*	Binary variable 1 for condominiums with club house / function room / multi-purpose hall facilities and 0 otherwise.	+
Water Features	*WFEATURES*	Binary variable 1 for condominiums with water features and 0 otherwise	+
Swimming Pool	*SWIM*	Binary variable 1 for condominiums with swimming pool and 0 otherwise.	+
Tennis Court	*TENNIS*	Binary variable 1 for condominiums with tennis court and 0 otherwise.	+
Gymnasium	*GYM*	Binary variable 1 for condominiums with gymnasium and 0 otherwise.	+
Location			
Central Region	*CR*	Binary variable 1 for property in CR and 0 otherwise.	+
North-East Region	*NER*	Binary variable 1 for property in CR and 0 otherwise.	−
East Region	*ER*	Binary variable 1 for property in ER and 0 otherwise.	−
West Region	*WR*	Binary variable 1 for property in WR and 0 otherwise.	−
Neighborhood Attributes			
Distance to shopping mall	*LNSHOP*	Linear distance to shopping mall (km).	−
Proximity to public housing	*PUBHSG*	Binary variable 1 for property within 400m radius of public housing and 0 otherwise.	−
Distance to MRT	*LNMRT*	Linear distance to MRT (km).	−
Proximity to expressway	*EXPRESS*	Binary variable 1 for property within 400m of expressway and 0 otherwise.	+
Time			
Adjustment for time	*T1–T3*	Binary variable 1 for property sold in period t and 0 otherwise.	To be defined

Exhibit 3 | (continued)
Variables of Hedonic Models

Variable	Code	Description	Expected Sign
Environmental Amenities			
Green Mark Certified	*GMC*	Binary variable 1 for building with green mark certified rating and 0 otherwise.	+
Green Mark Gold	*GMG*	Binary variable 1 for building with green mark gold rating and 0 otherwise.	+
Green Mark Gold Plus	*GMGP*	Binary variable 1 for building with green mark gold plus rating and 0 otherwise.	+
Green Mark Platinum	*GMPL*	Binary variable 1 for building with green mark platinum rating and 0 otherwise.	+

Notes: A positive sign is indicative of an expectation of a premium while a negative sign portends reduction in value. Quality is a function of the facilities that a condominium has. *NER, ER,* and *WR* constitute outside *CR* (OCR) in relevant models.

by property market researchers in Singapore. Repeat sales data are used as they more reflect market forces than new sales data in Singapore which are predominantly fixed by developers. Furthermore data for proximity to the nearest MRT (train station in the West), shopping mall, school and public house were obtained from the Singapore Street Directory Online Portal.

The 68 condominium/apartment developments house approximately 21,000 strata-titled units, that is, individual apartments/flats. The eco-labeled 34 developments account for approximately 11,400 strata-titled units while the remaining 9,600 strata-titled units come from the 34 non-certified developments. The BCA certification applies to whole developments of condominiums/apartments. Thus, certification of a development means that all the individual apartment units/flats in it are certified green. Furthermore, the 34 eco-labeled developments used for the study is the exact number of private condominium/apartment developments in Singapore that had received the BCA certification at the time of the study. To ensure comparability, both certified and non-certified developments for each region were chosen from the same neighborhood. Difference in quality is depicted by the types of amenities (e.g., swimming pool, barbeque pit, gym, tennis court, etc.) that a condominium project has.

The sales data that are used for the study, 13,899, relate to sales of individual strata-titled units, which are predominantly bought by private individuals. The sales data span the period from July 2005 to June 2009. Of the 13,899 sales data, about 66.25% (9,208) relate to private high-rise residential properties (condominiums/apartments) in the Central Region (CR) of Singapore while the remaining 33.75% (4,691) are from outside the CR (OCR) comprising North-East, East, and West Regions; the North Region is not included as there were no eco-labeled private apartment there at the time of the study. This is reflective of the

fact that 27 of the 34 BCA certified condominiums/apartments in Singapore are found in the CR. Furthermore, 65.9% (9,161) of the sales data relate to BCA certified buildings. The remaining 34.1% (4,738) are not eco-labeled. Of the 9,161 sales data relating to eco-labeled condominiums/apartment (henceforth referred to as private apartments), GMC buildings account for 18.8% (1,722), GMG buildings account for 59% (5,408), GMGP buildings account for 17% (1,565) and GMPL buildings account for the remaining 5.2% (479).

It is worth noting that of the 1,722 sales data relating to GMC buildings, only 227 (13.18%) are from the CR; the remaining 86.82% come from the OCR. Furthermore, all the GMGP and GMPL buildings, and 80% of the GMG buildings, are located in the CR. In view of the concentration of the eco-labeled buildings in the CR, the analyses will be carried out at the aggregate (i.e., both CR and OCR together) and disaggregate (i.e., separate analyses for CR and OCR) levels.

The above data are complemented with data from a face-to-face random survey of 300 Singaporeans, which was conducted in October 2009 to ascertain the respondents' appreciation of the BCA certification and the premium that they are willing to pay for eco-labeled private properties in Singapore. The survey was done both during the day and in the night to ensure a fairly good representation of the population. Similarly, the survey was conducted at Woodlands MRT (North), Boon Lay MRT (WEST), Tampines MRT (East), and Raffles Place MRT (Central) in an attempt to ensure that people from different parts of Singapore are fairly well represented in the sample.

The survey was done with the aid of a structured questionnaire, which consisted of four sections, A–D (Appendix 1). Section A was aimed at ascertaining the respondents' understanding of the phrase ''green building,'' while section B further probed the respondents' perception of and attitude towards green buildings, as well as their awareness of BCA's Green Mark ratings and willingness to pay a premium for green residential property. Section C solicited information on factors that would significantly impact their decision to purchase a condominium unit. This was meant to find out whether green features would be an important factor in their choice of condominium unit to buy. The final section, section D, solicited the respondents' demographic data.

Empirical Model

The data in Exhibit 3 are analyzed via the hedonic model in equation (1):

$$\ln(price) = \alpha + \beta_1 X_i + \delta_1 T_i + \varphi_1 N_i + \rho_1 Z_i + \gamma_1 E_i + \varepsilon, \qquad (1)$$

where the dependent variable is the logarithm of the selling price of sampled properties, and α and ε are the constant and error term, respectively. X_i is the vector of structural and facility attributes of property i, N_i is the vector of

neighborhood characteristics, Z_i is the vector of location, and E_i is the vector of certification. The added time effect, T_i (with July 2005 to June 2006 as the base), is to control for macro-economic attributes (Exhibit 3). β_1, δ_1, φ_1, ρ_1, and γ_1 are the estimated coefficients, with γ_1, measuring the GM premium, which is the coefficient of interest.

Twelve models of equation (1) are used for the analyses:

Model 1: This is an aggregate model using the entire sample of 13,899 sales data to assess the average overall premium (if any) attributable to GM certification.

Model 2: This also is an aggregate model utilizing the full sample sales data to ascertain the differential premium for each tier of GM certification. This will give insight into whether the market understands the certification. A commensurate/incommensurate premium allocation to the tiers will imply that the market does/does not understand the certification.

Model 3: This is the first of the disaggregated models to provide further insight into the GM premium. Model 3 analyses data for only CR. This is interesting as the CR is the home for the most prestigious and expensive private apartments in Singapore. The private apartments in the OCR are of a different (relatively inferior) class. Thus, the results of Models 3 and 4 will show whether the GM premium is solely attributable to eco-labeling. If so, there should be no difference in the premium paid for the same tier certification, otherwise the GM premium may not be ''pure.''

Model 4: This model specifically analyzes sales data from the OCR to verify the ''purity'' of the GM premium as explained above.

Model 5: Investigates the premia for different GM tiered-buildings in the CR. This will be compared to Model 6 to further verify the ''purity'' of the GM premium.

Model 6: Analyzes the premia for different GM tiered-buildings in the OCR.

Models 7 & 8: Deal with GM premium by tenure (freehold/leasehold) for the CR. This is another elaboration on the ''purity'' of the GM premium.

Models 9 & 10: Provide evidence on the premia for GM tiered-buildings in the CR by tenure.

Model 11 & 12: Provide evidence on the premia for GM tiered-buildings in the OCR by tenure.

Results of Hedonic Models

The summary of all the results for the 12 hedonic models are presented in Exhibit 4. The detailed results are in the Appendix 2. The results in Exhibit 4 and Appendix 2 show that GM certified private apartments in Singapore command a premium. All the premia are statistically different from zero at the 0.01 level of significance. On the whole, all GM certified private apartments in Singapore command a premium of 11.69% of the sales price (Model 1). Models 3 and 4 (Exhibit 4) show that there is no appreciable difference between the premia for GM certified buildings in the *CR* (6.59%) and in the *OCR* (6.64%). However,

Exhibit 4 | Summary of Hedonic Model Results

Variable	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
GMC	0.1169	0.0000	0.1297	0.0000	0.0659	0.0000	0.0664	0.0000	−0.2861	0.0000	0.0985	0.0000
GMG			0.0964	0.0000					0.0990	0.0000	0.1073	0.0000
GMGP			0.0961	0.0000					0.0151	0.3221		
GMPL			0.2774	0.0000					0.0821	0.0001		
Variable	Model 7		Model 8		Model 9		Model 10		Model 11		Model 12	
GMC	0.0919	0.0000	0.1676	0.0000	0.0788	0.0825	0.1225	0.0000	0.1504	0.0000	0.0701	0.0000
GMG					0.0992	0.0000	0.3336	0.0000			0.0628	0.0000
GMGP					0.0238	0.2573	0.2110	0.0000				
GMPL					0.3239	0.0000	0.2426	0.0000				

Notes: The values are coefficients. Model 1 deals with the average premium commanded by eco-labeled apartments while Model 2 relates to the premia associated with different ratings (i.e., tiers) of eco-labeled apartments in Singapore. Models 3 and 4 relate to eco-labeled premium for apartments in the Central and Outside Central regions, respectively. Models 5 and 6 deal with the premia associated with different ratings of eco-labeled apartments in the Central and Outside Central regions, respectively. Models 7 and 8 relate to eco-labeled premia for Freehold (Fee Simple) and Leasehold (Leased Fee), respectively (i.e., by tenure/property right), for apartments in the Central Region. A noticeable observation is the market's illogical allocation of premia to the different GM ratings. Models 9 and 10 deal with the premia associated with different ratings of eco-labeled Freehold (Fee Simple) and Leasehold (Leased Fee) apartments, respectively, in the Central Region; Models 11 and 12 deal with their counterparts Outside Central Region.

apart from Models 6, 7, 8, and 11, all the other models provide evidence that the market is somewhat confused about the GM certification, as attested by the illogical allocation of premia to the various tiers. If Models 1, 7, 8, and 11, which deal with a single tier each, are discounted from the analyses, the results of all the remaining models virtually imply that the market is, to some extent, confused by the GM certification.

For example, Model 2 shows that *GMC* commands a higher premium (12.96%) than *GMG* (9.64%) and *GMGP* (9.61%) while *GMG* commands a higher premium than *GMGP*. This is symptomatic of confusion as an enlightened market would allocate higher premia to the higher-tiered certified buildings. Overall, only *GMPL* in Model 2 shows a logical allocation of premium. The results for Models 5, 9, 10, and 12 attest to a confused market, as evidenced by the illogical allocation of premia to the tiers. In Model 5, *GMC* commands a negative premium of 28.60%, which is considerably lower than the premia for the higher tiers. However, this negative premium is contrary to expectation as it implies that the GMC rating reduces the value of private apartments in the CR. This is the only model that returns a baffling negative premium; further research is required on this. Notwithstanding the unexpected negative premium for *GMC*, *GMG* commands a higher premium (9.90%) than *GMGP* (1.51%) and GMPL (8.21%) in Model 5. Similarly, while the premia for *GMC* (7.88%) and *GMPL* (32.4%) for Model 9 are logical, those for *GMG* (9.9%) and *GMGP* (2.4%) are illogical.

Furthermore, the results for Models 7 and 8 (Exhibit 4) cast doubts on the ''purity'' of the GM premia. Note that *GMC* (overall) for freehold buildings command a lower premium (9.19%) than for leasehold buildings (16.76%) in the *CR*. This illogical differential premium by tenure for properties in the same area is somewhat worrying. This is compounded by the fact that the same tier commands markedly different premium for both freehold and leasehold properties in the *CR* (Models 9 and 10). For example, while GMC (freehold properties in *CR*) command a premium of 7.88% (Model 9), *GMC* (leasehold properties in *CR*) commands a premium of 12.25% (Model 10). *GMG* commands a premium of 9.92% (Model 9) while it commands a premium of 33.36% in Model 10. The results of Models 9 and 10, and 11 and 12 in particular, appear to point to a market in confusion—a market that does not understand the tiering of the GM certification. The results of the hedonic models virtually make the ''purity'' of the GM premia questionable although the models control for other factors. More research is required to examine the purity of the GM premia.

Post Model Evaluation

The assumptions of the Classical Linear Regression Model are tested for heteroscedasticity, multicollinearity, and independence of residuals to verify the robustness of the models. Three tests: the White Test for heteroscedasticity, Pearson's Bivariate Correlation Test, and Multi-collinearity Test (via the variance inflation factor—VIF) are used for the purpose. As a rule of thumb, a VIF value of 10 and above is indicative of multicollinearity (Kutner, 2004).

The adjusted R^2 for each of the 12 models is relatively high (the lowest being 0.8385), which implies that each model is a good fit (Appendix 2). Furthermore, the results of the Pearson Bivariate Correlation test (Exhibit 5) reveal that the correlation between each pair of explanatory variables is relatively low. The only two explanatory variables with a correlation above 0.50 are Tennis and BBQ with a correlation of 0.615. Moreover, all the VIFs for all the models (Appendix 2) are reasonably well below the bench mark value of 10. This implies that multicollinearity is not much of a problem. However, the White Test revealed the presence of heteroscedasticity in every model. Thus all the figures for each model reported in the Appendix 2 have been adjusted for heteroscedasticity. The results are therefore robust.

Survey Results

The profile of the respondents is shown in Exhibit 6. Most of the respondents belong to age groups 40–49 (37.67%) and 50–59 (30.67%). Furthermore, 59.33% of the respondents think that green buildings are environmentally friendly while 20.67% think otherwise; the remaining 20% are not sure whether or not green buildings are environmentally friendly (Exhibit 7). In addition, 62.67% of the respondents accept that green buildings reduce water and electricity bills, 17% think otherwise while the remaining 30.33% are not sure (Exhibit 8).

As far as sustainability is concerned, only 44.67% or the respondents think that green buildings promote sustainability, 20.67% think otherwise while the remaining 34.67% are not sure (Exhibit 9). In contrast, 60% of the respondents will purchase green buildings as a result of increasing environmental concerns (Exhibit 10). Of those who would buy green buildings, 80% are willing to pay a premium for green features (Exhibit 11). Paradoxically, the results in Exhibit 12 show that green features, with a mean rating score of 2.49, have very little impact on the respondents' choice of private apartment to buy. This may be the rationale for the relatively low premium of 5.47% to 6.82% (Exhibit 11) that the respondents are willing to pay for green features. Moreover, the three most important factors that affect the respondents' choice of the private apartment to buy are: price (mean rating score of 4.86), accessibility (mean rating score of 4.53), and location (mean rating score of 4.25). In addition, 48.67% of the respondents think that green buildings cost more than conventional buildings, 18.67% think otherwise while the remaining 32.66% are not sure. These results may explain why real estate developers in Singapore do not use green features for marketing.

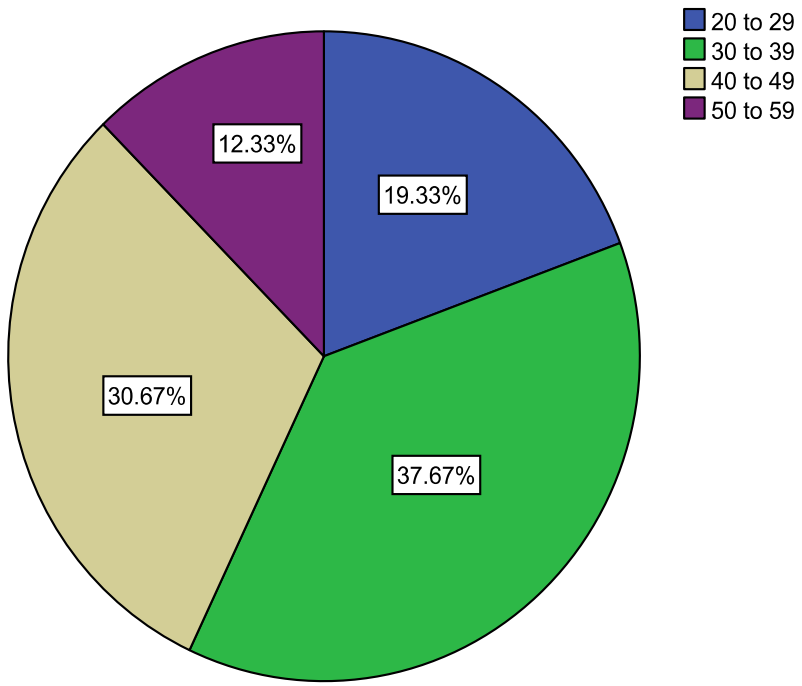
Astonishingly, only 33.67% of the respondents had heard of the Green Mark rating system at the time of the survey (Exhibit 13) although the system has been in existence since January 2005. Of this proportion, 83.2% are not aware of the differences among the four ratings. This may be attributable to the fact that the ratings (Exhibit 1) are couched in technical language that makes the system unintelligible to the general public. Furthermore, this lack of awareness may explain the apparent confusion in the market as evidenced by the illogical allocation of premium to the four different ratings (tiers).

Exhibit 5 | Pearson Bivariate Correlation Results

Variables	*LnAREA*	*BBQ*	*TENNIS*	*GYM*	*SWIM*	*WFEATURES*	*CLUBHSE*	*LEVEL*	*LnPRICE*	*PTYTYPE*	*TENURE*	*LnAGE*	*CR*	*T1*	*T2*	*T3*	*LnMRT*	*LnSHOP*	*EXPRESS*	*PUBHSG*	*GMC*	*GMG*	*GMGP*	*GMPL*
LnAREA	1.000	−0.027	−0.047	−0.104	0.012	0.211	−0.006	−0.135	0.660	0.140	0.075	0.070	−0.045	0.080	−0.007	−0.087	0.305	0.272	0.098	−0.152	−0.052	0.003	0.004	0.240
BBQ	−0.027	1.000	0.615	0.479	0.112	−0.078	0.382	−0.051	−0.192	0.113	−0.073	0.029	−0.210	−0.025	0.019	−0.040	−0.110	0.164	−0.159	0.165	0.104	−0.121	0.048	0.056
TENNIS	−0.047	0.615	1.000	0.334	0.160	−0.064	0.468	−0.032	−0.294	0.207	0.002	0.113	−0.327	−0.071	−0.014	−0.020	−0.177	0.071	−0.110	0.214	0.160	−0.032	0.114	−0.265
GYM	−0.104	0.479	0.334	1.000	0.442	0.038	0.483	0.111	−0.084	0.053	−0.080	−0.064	−0.114	0.070	−0.013	−0.020	−0.170	−0.079	0.041	0.058	0.049	−0.076	0.059	0.031
SWIM	0.012	0.112	0.160	0.442	1.000	0.082	0.213	0.038	0.052	0.130	−0.104	−0.133	−0.052	0.028	−0.045	−0.006	0.008	0.039	−0.066	−0.034	0.028	0.058	0.026	0.014
WFEATURES	0.211	−0.078	−0.064	0.038	0.082	1.000	0.185	0.033	0.198	0.031	−0.183	−0.332	−0.037	0.096	−0.018	0.006	−0.101	0.426	0.216	0.184	0.111	0.259	−0.116	0.169
CLUBHSE	−0.006	0.382	0.468	0.483	0.213	0.186	1.000	0.103	−0.079	0.168	−0.146	−0.160	−0.182	0.096	−0.112	−0.021	−0.068	0.170	0.070	0.012	0.122	0.115	0.027	0.065
LEVEL	−0.135	−0.051	−0.032	0.111	0.038	0.033	0.103	1.000	0.206	−0.307	−0.132	−0.224	0.339	0.037	−0.015	0.002	−0.359	−0.338	0.013	−0.072	−0.099	0.234	0.057	−0.073
LnPRICE	0.660	−0.192	−0.294	−0.084	0.052	0.198	−0.079	0.206	1.000	−0.155	0.205	−0.151	0.498	0.041	0.199	−0.069	0.186	−0.090	0.077	−0.370	−0.282	0.169	0.028	0.321
PTYTYPE	0.140	0.113	0.207	0.053	0.130	0.031	0.168	−0.307	−0.155	1.000	−0.091	0.240	−0.199	−0.029	0.032	−0.055	0.178	0.262	−0.054	0.061	0.201	−0.241	−0.120	0.052
TENURE	0.075	−0.073	0.002	−0.080	−0.104	−0.183	−0.146	−0.132	0.205	−0.091	1.000	−0.054	0.235	−0.076	0.004	0.019	0.205	−0.091	0.225	−0.001	−0.259	−0.204	0.388	−0.013
LnAGE	0.070	0.029	0.113	−0.064	−0.133	−0.332	−0.160	−0.224	−0.151	0.240	−0.054	1.000	−0.090	−0.084	0.025	−0.052	0.046	−0.114	0.038	0.041	−0.093	−0.352	−0.233	−0.124
CR	−0.045	−0.210	−0.327	−0.114	−0.052	−0.037	−0.182	0.339	0.498	−0.199	0.235	−0.090	1.000	−0.044	0.061	−0.059	−0.171	−0.318	−0.090	−0.125	−0.417	0.070	0.136	0.135
T1	0.080	−0.025	−0.071	0.070	0.028	0.096	0.096	0.037	0.041	−0.029	−0.076	−0.084	−0.044	1.000	−0.449	−0.364	−0.005	0.033	0.019	−0.049	−0.028	0.110	−0.061	0.080
T2	−0.007	0.019	−0.014	−0.013	−0.045	−0.018	−0.112	−0.015	0.199	0.032	0.004	0.025	0.061	−0.449	1.000	−0.192	0.021	0.028	−0.045	0.020	−0.050	−0.027	0.005	0.045
T3	−0.087	−0.040	−0.010	−0.020	−0.006	0.006	−0.021	0.002	−0.069	−0.055	0.019	−0.052	−0.059	−0.354	−0.192	1.000	−0.066	0.064	−0.010	0.100	0.092	−0.093	0.076	−0.049
LnMRT	0.305	−0.110	−0.177	−0.170	0.005	−0.101	−0.068	−0.359	0.186	0.178	0.205	0.046	−0.171	0.021	−0.066	1.000	0.277	0.201	−0.440	−0.192	−0.060	0.166	0.276	
LnSHOP	0.272	0.164	0.071	−0.079	0.039	0.426	0.170	−0.338	−0.090	0.162	−0.091	−0.114	−0.318	0.033	0.028	0.064	0.277	1.000	0.003	0.261	0.212	−0.170	0.224	0.266
EXPRESS	0.098	−0.159	−0.110	0.041	−0.066	0.216	0.070	0.013	0.077	−0.054	0.225	0.038	−0.090	0.019	−0.045	−0.020	0.201	0.003	1.000	−0.071	0.050	−0.057	0.133	−0.116
PUBHSG	−0.152	0.165	0.214	0.058	−0.034	0.184	0.012	−0.072	−0.370	0.061	−0.001	0.041	−0.125	−0.049	0.020	0.100	−0.440	0.261	−0.071	1.000	0.197	−0.016	0.141	−0.204
GMC	−0.052	0.104	0.160	0.049	0.028	0.111	0.122	−0.099	−0.282	0.201	−0.259	−0.093	−0.417	−0.028	−0.050	0.092	−0.192	0.212	0.050	0.192	1.000	−0.295	−0.134	−0.071
GMG	0.003	−0.121	−0.032	−0.076	0.058	0.259	0.115	0.234	0.169	−0.241	−0.204	−0.352	0.070	0.110	−0.027	−0.093	−0.080	−0.170	−0.057	−0.016	−0.295	1.000	−0.284	−0.151
GMGP	0.004	0.048	0.114	0.059	0.025	−0.116	0.027	0.057	0.028	−0.120	0.388	−0.233	0.136	−0.061	0.005	0.076	0.166	0.224	0.133	0.141	−0.134	−0.284	1.000	−0.067
GMPL	0.240	0.056	−0.255	0.031	0.014	0.169	0.065	−0.078	0.321	0.052	−0.013	−0.124	0.135	0.080	0.045	−0.049	0.276	0.265	−0.116	−0.204	−0.071	−0.151	−0.067	1.000

Notes: The exhibit reports the bivariate correlations to provide preliminary evidence for the existence of collinearity between pairs of variables used in the hedonic models.

Exhibit 6 | Survey Results: Age Profile



The premia that the respondents are willing to pay for green features are presented in Exhibit 11. These are substantially lower than the implicit premia revealed through the hedonic models. The results exemplify a tale of the ''haves'' and ''have-nots'' in Singapore. The survey was conducted on the general public, most of whom live in public housing. These are the ''have-nots'' as their household income is at most S$8,000 per month. The premia extracted from the hedonic model represent the ''haves.'' Furthermore the relatively low premium that respondents to the survey are willing to pay for green features is reflective of the relative low impact that green features have on the respondents' choice of private apartment to buy (Exhibit 12).

It is evident from Exhibit 14 that notwithstanding the relatively low premia that the respondents are willing to pay, it is still profitable for developers and investors to obtain GM certification (i.e., go green) as depicted by the PCR. GMC is the most profitable as measured by the PCR (Exhibit 14). Thus, as far as profitability is concerned, it is in the interest of property developers and investors to aim at the basic green mark certification—GMC—though that may not be the best route for sustainability.

Exhibit 14 shows that there is an economic incentive (profit) for developers and investors to think positively of green residential property development and investment. However, the story could be different from the vast majority of Singaporeans who purchase condominiums for occupation. From the owner-

Exhibit 7 | Green Building is Environmentally Friendly

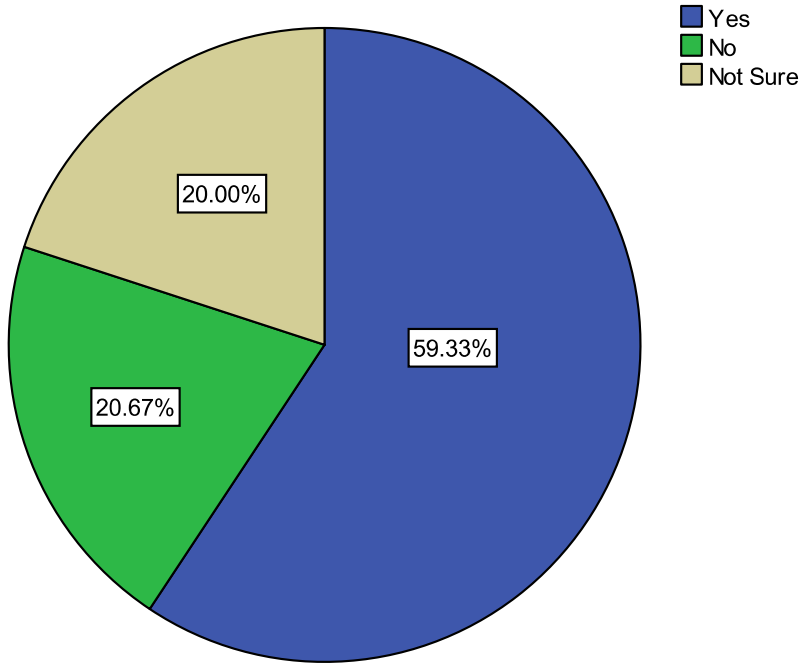


Exhibit 8 | Green Building Reduces Water and Electricity Bills

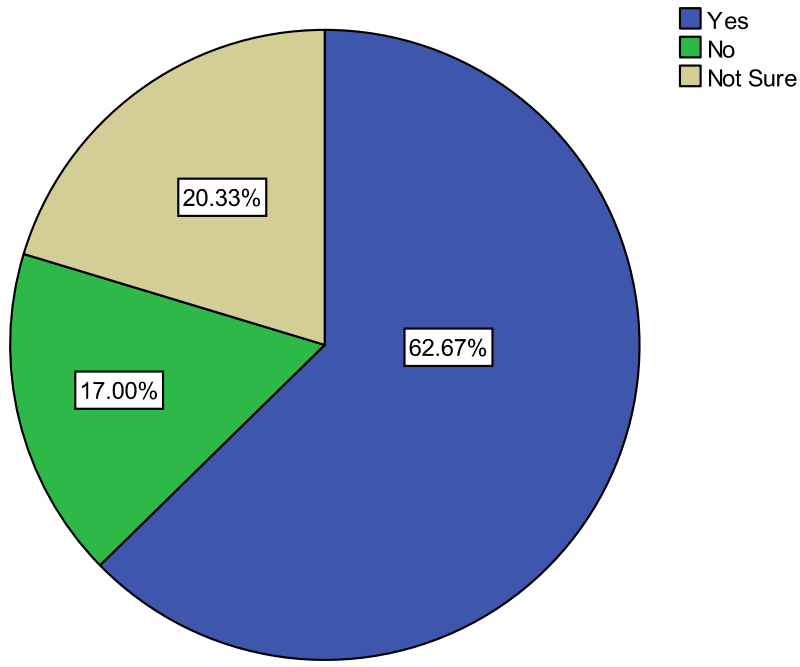


Exhibit 9 | Green Building Promotes Sustainability

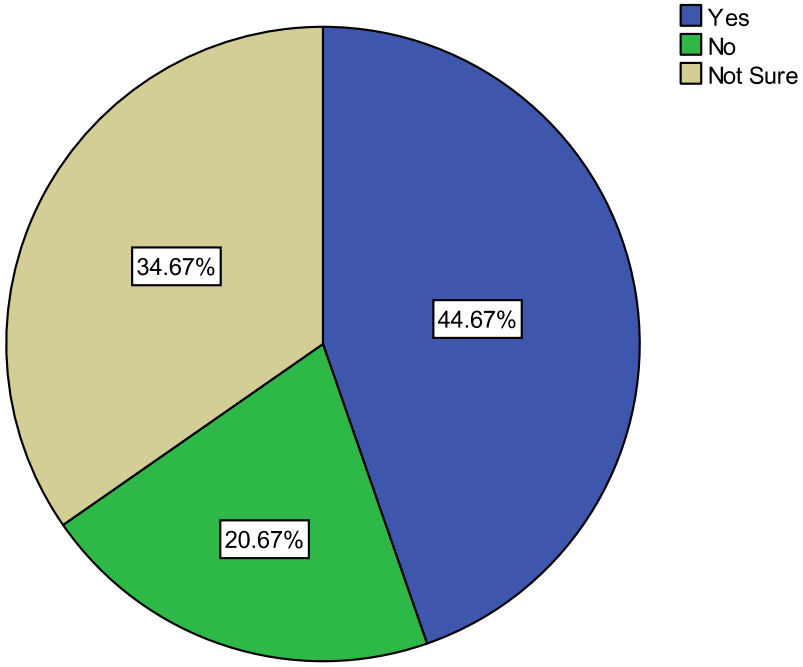


Exhibit 10 | Will Increasing Environmental Concerns Prompt You to Purchase Green Building?

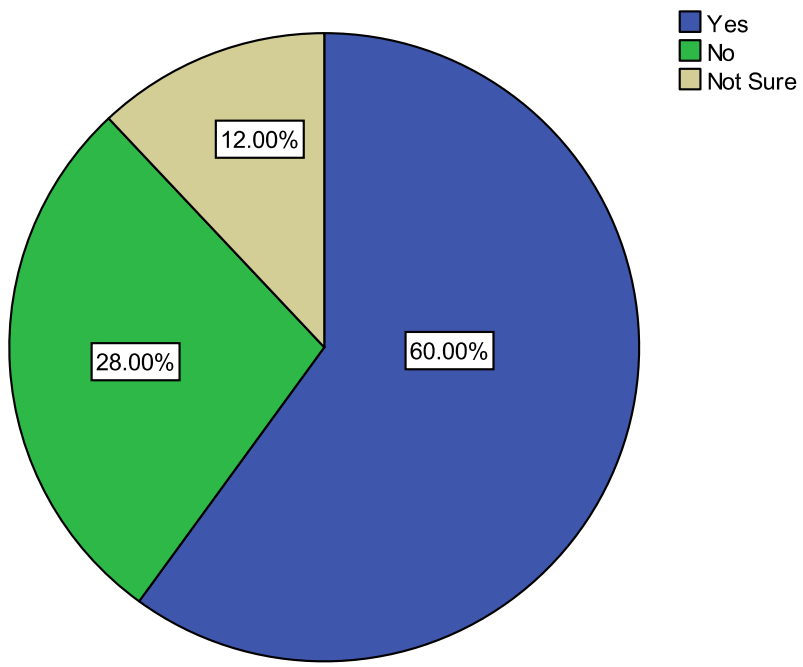


Exhibit 11 | Regression versus Survey Premia (Weighted Mean Bracketed)

Rating	Regression Results	Survey Findings
Platinum	27.74%	5.1%–10% (6.82%)
Gold Plus	9.61%	1%–6% (5.60%)
Gold	9.64%	5.1%–10% (5.58%)
Certified	12.97%	5.1%–10% (5.47%)

Notes: This exhibit presents the premia allocation among the different Green Mark ratings resulting from the hedonic model and the survey. Values in parentheses are weighted average premia that respondents who are aware of GM rRating system are willing to pay.

Exhibit 12 | Factors Affecting Respondents' Decision to Purchase Condominiums

	Likert Scale (1–5)						
Factors	1	2	3	4	5	Average Score	Ranking
Price	0	2	4	28	266	4.86	1
Accessibility	1	2	33	65	199	4.53	2
Location	1	3	6	201	89	4.25	3
Amenities	1	3	35	223	38	3.98	4
Facilities	2	11	198	65	24	3.33	5
Green features	34	157	53	41	15	2.49	6
Promotion	26	178	45	31	20	2.47	7
Developer	201	72	24	2	1	1.43	8

Notes: This exhibit reports the relative importance of factors that affect the respondents' decision to buy private apartment. Respondents were asked to state the impact of each factor by choosing a rating score from a Likert scale of 1–5, with 1 representing minimum impact and 5 representing maximum impact. The average score is the weighted average of the respondents score. The numbers under each Likert scale depict how many respondents chose that score for the corresponding factor. There were 300 respondents.

occupier's point of view, what may be of paramount importance is the relationship between the savings attributable to energy efficiency and the incremental cost of green building as economics, particularly price (Exhibit 12), is of paramount importance in the respondents' choice of private apartment to buy. Let us assume the cost of a condominium to be S$800,000 (this is lower than the average in Singapore). Assume that going green adds 3% to the cost. Note that GMPL can add 2% to 8% to the cost. Thus, the 3% assumption is conservative. This will add S$24,000 the cost which, if amortized over 30 years at a relatively low mortgage rate of 4.5% per annum monthly compounding, will add S$121.60 to the person's monthly bill. This is likely to be the minimum incremental cost as it

Exhibit 13 | Have You Heard of BCA Green Mark Ratings?

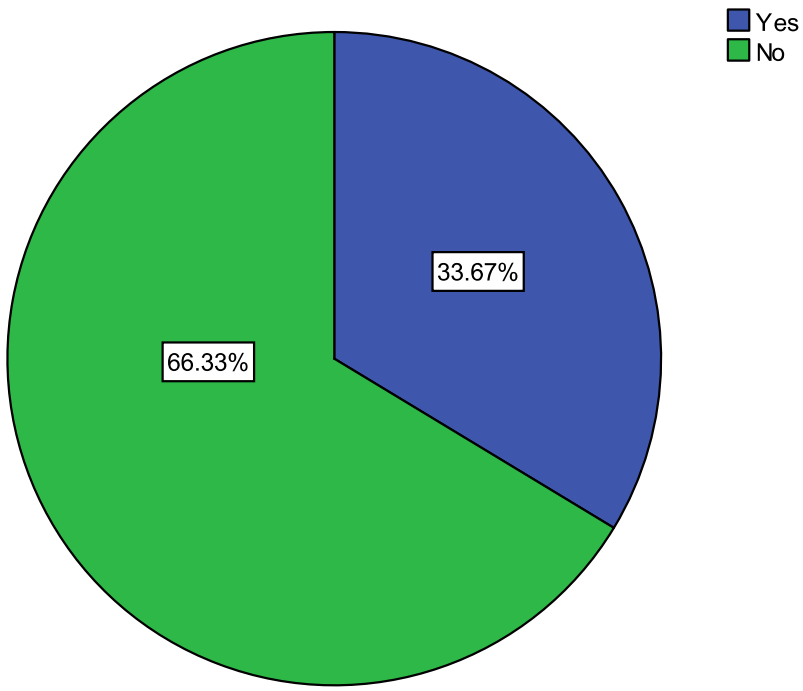


Exhibit 14 | Premium Cost Ratio

	Premium / sq. ft.*			PCR	
Rating	Hedonic	Survey	Cost / sq. ft.**	Hedonic	Survey
GMPL	554.80	136.40	56.00	9.91	2.44
GMGP	192.20	112.0	21.00	9.15	5.33
GMG	192.80	111.60	14.00	13.77	7.97
GMC	259.40	109.40	7.00	37.06	15.63
Overall	233.80	117.35	24.50		

Notes: We report in this table the premium cost ratio (i.e., (average premium / sq. ft.) / (average cost / sq. ft.)) for the different GM Ratings vis-à-vis hedonic model and survey results.
*Based on a modest average price of S$2000 / sq. ft.
**Based on highest construction cost for luxury condominium (S$700 / sq. ft. including professional fees & finance cost) calculated from figures in RLB Research & Development Report, and BCA maximum cost premium: 8% (*GMPL*), 3% (*GMGP*), 2% (*GMG*), and 1% (*GMC*).

is overly optimistic to think that one can get a mortgage over 30 years at a fixed or average mortgage rate of 4.5% per annum. This implies that if the incremental cost proves to be higher than the total maximum cost savings from green building, one will be hard put to justify investment on purely economic grounds for owner-occupiers unless one argues on the basis of hypothetical, yet-to-be-proven benefits.

The average monthly household electricity, gas, and water consumption in Singapore as shown on monthly utilities bills from February to August 2011 are about 659 kWh, 86 kWh, and 17.3 Cu M respectively. On the basis a unit cost of S$0.2728 per kWh, S$0.1961 per kWh, and S$1.17 per Cu M, respectively, for electricity, gas, and water, a waterborne fee of S$0.2803 per Cu M of water consumed, water conservation tax of 30%, and goods and services tax of 7%, the average household utility bill is about S$243 per month. Assuming energy efficiency of 30%, which is the maximum attributable to GMPL rating, we arrive at a saving in utilities cost of S$73.12 per month. A saving of S$73.12 resulting from a cost of S$121.60 per month, a benefit-cost ratio of 0.6, may be a dis-incentive more than an incentive for prospective owner-occupied private apartment purchasers to commit to a green condominium on purely an economic basis.

The foregoing analysis does not account for a possible capital gain from the sale of the property at a future date. However, it must be noted that potential future capital gain is, until realized, a pie in the sky. Furthermore, the owner-occupier must be able to keep ownership of the apartment through servicing the mortgage loan until the future date when a sale, which can also result in a loss, takes place. This implies that the net impact of going ‘‘green’’ on the cash flow position of owner-occupiers could be critical in their decision go ‘‘green.’’

Conclusion

The study set out to determine the premium (if any) commanded by eco-labeling of private apartments in Singapore and above all, to find out if the market understands the different GM ratings. Furthermore, it is aimed to ascertain the relative profitability of the GM ratings. All these are motivated by a desire to provide evidence on eco-labeling vis-à-vis residential properties in an Asian setting (which has never been done) to fill the gap in the extant literature. The objectives were operationalized through the analyses of secondary data of 13,899 private apartment sales data via hedonic model, and primary data from a random survey of 300 people in Singapore.

The results clearly show that eco-labeling in Singapore commands a premium. The premium ranges from an average of 9.61% for *GMGP* to 27.74% for *GMPL* (hedonic model) and 5.47% for *GMC* to 6.82% for *GMPL* (survey). These results are in harmony with the extant literature on commercial office properties in the U.S. However, the illogical allocation of premium to different GM ratings [e.g., *GMC* commanding a higher average premium (12.96%) than *GMG* (9.64%) and *GMGP* (9.64%)] hints of a market that is confused by the different GM ratings. This confusion is not surprising given that out of the 33.67% of the respondents

who had heard of the GM rating system, 83.2% were not aware of the differences among the four GM ratings, albeit the system have been operational for more than five years.

Furthermore, the fact that the same GM rating commands different premium by tenure and by location within a tiny city-state like Singapore (after controlling for other factors) casts doubt on the ''purity'' of the GM premia. On the whole, freehold/leasehold private apartments with eco-labeling command an average premium of 9.19%/16.76%, respectively. This phenomenon is difficult to explain and thus, calls for more research. Finally, it is more profitable, on the basis of PCR, for investors and developers to aim for the basic *GMC* rating. This will not, however, be in the best interest of sustainability as the highest tier rating (*GMPL*) is supposed to be the most energy efficient. Thus, mass education of the public on the Green Mark ratings, coupled with simplifying descriptions of the rating system to make it intelligible to the public, is required to enlighten the market for it to make logical allocation of premia to the tiers. This could make the higher tiers more profitable than the lower ones on the basis of PCR to encourage developers and investors to aim for GMPL rating to promote sustainability in private apartment development.

However, it is not economically beneficial for owner-occupiers, given an incremental benefit-cost ratio of 0.6, to commit to a green private apartment. There is therefore a dire need for a reduction in the incremental cost of green private apartments to make them appealing to owner-occupiers.

Appendix 1

Questionnaire for Survey

Please tick only where appropriate.

Section A. In your opinion, what is Green Building?

1.0 It is an environmentally-friendly building.
Yes ☐ No ☐ Not Sure ☐

1.1 It can reduce water and electricity usage and bills.
Yes ☐ No ☐ Not Sure ☐

1.2 It reduces potential undesirable environmental impact (e.g., global warming).
Yes ☐ No ☐ Not Sure ☐

1.3 It is designed and constructed to promote sustainability.
Yes ☐ No ☐ Not Sure ☐

1.4 It emphasizes the efficiency of resource use such as energy, water and materials.
Yes ☐ No ☐ Not Sure ☐

1.5 It provides cleaner and fresher air for the occupants.
Yes ☐ No ☐ Not Sure ☐

1.6 It has innovative features (e.g., lighting system to automatically switch lights off when not in use).
Yes ☐ No ☐ Not Sure ☐

Section B.

1.7 Are you aware that green buildings are built to meet the needs of homebuyers while at the same time minimizing environmental impact?
Yes ☐ No ☐ Not Sure ☐

1.8 Will the increasing environmental concern prompt you to purchase a green building?
Yes ☐ No ☐ Not Sure ☐

1.9 Do you think that green building is more costly than non-green building?
Yes ☐ No ☐ Not Sure ☐

2.0 Are you willing to pay a premium to purchase a unit in a green residential building?
Yes ☐ No ☐

2.1 Have you heard of the Building and Construction Authority's (BCA) Green Mark ratings in Singapore?
Yes ☐ (***Continue*** *with question 2.2 to 2.9*) No ☐ (***Skip*** *question 2.2 to 2.9*)

2.2 Do you know that there are four different Green Mark ratings: Green Mark Platinum, Green Mark Gold Plus, Green Mark Gold, and Green Mark Certified?
Yes ☐ No ☐

2.3 Are you aware of the differences among the above mentioned four Green Mark ratings?
Yes ☐ No ☐

2.4 A Platinum Mark Rating:

a. Fulfills the mandatory requirements.
Yes ☐ No ☐ Not Sure ☐

b. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 22 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

c. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 20 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

d. Uses ventilation simulation software for wind tunnel testing to identify the most effective building design and layout and has implemented the recommendations derived to ensure good natural ventilation.
Yes ☐ No ☐ Not Sure ☐

2.5 A Gold Plus Mark Rating

a. It fulfills the mandatory requirements.
Yes ☐ No ☐ Not Sure ☐

b. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 22 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

c. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 20 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

d. Uses ventilation simulation software for wind tunnel testing to identify the most effective building design and layout and has implemented the recommendations derived to ensure good natural ventilation.
Yes ☐ No ☐ Not Sure ☐

2.6 A Gold Mark Rating

a. Fulfills the mandatory requirements.
Yes ☐ No ☐ Not Sure ☐

b. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 22 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

c. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 20 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

d. Uses ventilation simulation software for wind tunnel testing to identify the most effective building design and layout and has implemented the recommendations derived to ensure good natural ventilation.
Yes ☐ No ☐ Not Sure ☐

2.7 A Certified Mark Rating

a. Fulfills the mandatory requirements.
Yes ☐ No ☐ Not Sure ☐

b. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 22 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

c. Has a building envelope design with residential envelope thermal transmittance value (RETV) of 20 W/m^2 or lower.
Yes ☐ No ☐ Not Sure ☐

d. Uses ventilation simulation software for wind tunnel testing to identify the most effective building design and layout and has implemented the recommendations derived to ensure good natural ventilation.
Yes ☐ No ☐ Not Sure ☐

2.8 How much premium are you willing to pay for residential property with the following BCA Green Mark ratings?

Platinum Green Mark:
0% ☐ 1%–5% ☐ 5.1%–10% ☐ 10.1%–15% ☐ More than 15% ☐

Gold Plus Green Mark:
0% ☐ 1%–5% ☐ 5.1%–10% ☐ 10.1%–15% ☐ More than 15% ☐

Gold Green Mark:
0% ☐ 1%–5% ☐ 5.1%–10% ☐ 10.1%–15% ☐ More than 15% ☐

Certified Green Mark:
0% ☐ 1%–5% ☐ 5.1%–10% ☐ 10.1%–15% ☐ More than 15% ☐

2.9 Do you wish to know more about The BCA Green Mark Scheme?
Yes ☐ No ☐

Section C.
What are the factors that would have impact on your decision-making to purchase a condominium unit? Based on a scale of 1–5 (1 is Minimum Impact' and 5 is Maximum Impact).

	1 Min. Impact	**2**	**3**	**4**	**5 Max. Impact**
3.0 Location	☐	☐	☐	☐	☐
3.1 Price	☐	☐	☐	☐	☐
3.2 Promotion	☐	☐	☐	☐	☐
3.3 Green features	☐	☐	☐	☐	☐
3.4 Accessibility	☐	☐	☐	☐	☐
3.5 Developer	☐	☐	☐	☐	☐
3.6 Amenities	☐	☐	☐	☐	☐
3.7 Facilities	☐	☐	☐	☐	☐

Section D.

3.8 Gender
Male Female

3.9 Age
20–29 30–39 40–49 50–59

4.0 Highest qualification
Primary Secondary Polytechnic Junior College University
Others:_____

4.1 Occupation

Administrative	Unemployed
Real Estate	Housewife
Sales & Marketing	Student
Engineering	Education
Retired	Manufacturing
Government	Others, please specify_____

4.2 Monthly income

$1,001–$2,000	$5,001–$6,000
$2,001–$3,000	6,001–$7,000
$3,001–$4,000	$7,001–$8,000
$4,001–$5,000	>$8,000

Appendix 2

Results of Hedonic Models

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Variable	β	Prob	β	Prob.	β	Prob.	β	Prob.	β	Prob.	β	Prob.
Constant	7.2221	0.0000	7.2535	0.0000	8.0059	0.0000	9.7953	0.0000	8.0393	0.0000	9.7540	0.0000
LNAREA	1.1576	0.0000	1.1520	0.0000	1.1497	0.0000	0.7943	0.0000	1.1397	0.0000	0.8012	0.0000
LEVEL	0.0025	0.0000	0.0027	0.0000	0.0018	0.0000	0.0068	0.0000	0.0014	0.0000	0.0055	0.0000
PTYTYPE	−0.1444	0.0000	−0.1530	0.0000	−0.1441	0.0000	−0.2186	0.0000	−0.1326	0.0000	−0.2123	0.0000
LNAGE	−0.0110	0.0028	−0.0159	0.0000	−0.0566	0.0000	−0.0716	0.0000	−0.0644	0.0000	−0.0723	0.0000
CR	0.6125	0.0000	0.6095	0.0000								
BBQ	0.0796	0.0000	0.0468	0.0009	0.0931	0.0000	0.0849	0.0000	0.0947	0.0000	0.1278	0.0000
CLUBHSE	0.0706	0.0000	0.0619	0.0000	0.0456	0.1105	−0.0449	0.0000	0.0172	0.1277	−0.0784	0.0000
GYM	−0.0507	0.0105	−0.0736	0.0007	−0.0349	0.0000			−0.0182	0.4050	−0.1929	0.0000
SWIM	0.6424	0.0000	0.6685	0.0000	0.481	0.3310			0.4980	0.0000	0.0936	0.0000
TENNIS	−0.0971	0.0000	−0.0564	0.0000	−0.0087	0.0000			0.0168	0.1244	0.3226	0.0000
WFEATURES	0.1828	0.0000	0.1772	0.0000	0.3051	0.0000	−0.1299	0.0000	0.2736	0.0000	0.2412	0.5841
T1	0.2258	0.0000	0.2247	0.0000	0.2400	0.0000	0.0899	0.0000	0.2218	0.0000	−0.0037	0.0000
T2	0.5172	0.0000	0.5146	0.0000	0.5637	0.0000	0.3200	0.0000	0.5419	0.0000	0.0855	0.0000
T3	0.3173	0.0000	0.3153	0.0000	0.3093	0.0000	0.2355	0.0005	0.2906	0.0000	−0.0547	0.0000
LNSHOP	−0.1587	0.0000	−0.1689	0.0000	−0.1674	0.0000	−0.063	0.0000	−0.1388	0.0000	0.0986	0.0000
LNMRT	0.0593	0.0000	0.0600	0.0000	0.1139	0.0003	0.0238	0.0000	0.1024	0.0000	0.1073	0.0000
EXPRESS	0.0044	0.3883	0.0159	0.0049	0.0247	0.0000	0.0544	0.0000	0.0984	0.0000	0.1278	0.0000

Appendix 2 (continued)

Results of Hedonic Models

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Variable	β	Prob	β	Prob.	β	Prob.	β	Prob.	β	Prob.	β	Prob.
PUBHSG	−0.2167	0.0000	−0.2010	0.0000	−0.288	0.0000	−0.0274	0.0000	−0.2800	0.0000	−0.0784	0.0000
GMC	0.1169	0.0000	0.1297	0.0000	0.0659	0.0000	0.0664	0.0000	−0.2861	0.0000	−0.1929	0.0000
GMG			0.0964	0.0000					0.0980	0.0000	0.0936	0.0000
GMGP			0.0961	0.0000					0.0151	0.3221		
GMPL			0.2774	0.0000					0.0821	0.0001		
R^2	0.8801		0.8819		0.8894		0.83902		0.8947		0.8462	
Adj. R^2	0.8800	0.0000	0.8817	0.0000	0.8891	0.0000	0.8385	0.0000	0.8944	0.0000	0.8457	0.0000
VIF	1.2817–2.2862		1.3002–2.901		1.397–3.671		1.089–7.726		1.409–3.833		1.081–6.486	

Appendix 2 (continued)

Results of Hedonic Models

	Model 7		Model 8		Model 9		Model 10		Model 11		Model 12	
Variable	β	Prob	β	Prob.	β	Prob.	β	Prob.	β	Prob.	β	Prob.
Constant	8.7033	0.0000	8.5668	0.0000	8.7888	0.0000	8.2223	0.0000	9.7699	0.0000	9.4499	0.0000
LNAREA	1.1334	0.0000	1.1098	0.0000	1.1040	0.0000	1.1583	0.0000	0.7749	0.0000	0.8081	0.0000
LEVEL	0.0053	0.0000	0.0033	0.0000	0.0083	0.0000	0.0017	0.0000	0.0077	0.0000	0.0047	0.0000
PTYTYPE	−0.0563	0.0000	−0.3935	0.0000	−0.0739	0.0000	0.0198	0.0544		0.0000	−0.1694	0.0000
LNAGE	−0.1304	0.0028	0.1385	0.0000	−0.1079	0.0000	−0.0027	0.7442	−0.1043	0.0000	−0.0778	0.0000
WFEATURES	0.3112	0.0000	0.4769	0.0000	0.2504	0.0000					−0.1603	0.0000
T1	0.1849	0.0000	0.3072	0.0000	0.1804	0.0000	0.3284	0.0000	0.1370	0.0000	0.0867	0.0000
T2	0.4846	0.0000	0.6005	0.0000	0.4582	0.0000	0.6205	0.0000	0.3202	0.0000	0.3150	0.0000
T3	0.1982	0.0000	0.4128	0.0000	0.2019	0.0000	0.3834	0.0005	0.2537	0.0000	0.2109	0.0000
LNSHOP	−0.1763	0.0000	−0.1822	0.0000	−0.1093	0.0000	−0.0924	0.0000				
LNMRT	0.0409	0.0000	0.1861	0.0000	−0.0925	0.0000	0.0803	0.0000				
EXPRESS	0.0323	0.3883	−0.0328	0.0049					−0.0521	0.0000		
PUBHSG	−0.4122	0.0000	−0.1331	0.0000	−0.4050	0.0000	−0.2401	0.0000				
GMC	0.0919	0.0000	0.1676	0.0000	0.0788	0.0825	0.1225	0.0000			0.0701	0.0000
GMG				0.0000	0.0992	0.0000	0.3336	0.0000	0.1504	0.0000	0.0628	0.0000
GMGP				0.0000	0.0239	0.2573	0.2110	0.0000				
GMPL				0.0000	0.3239	0.0000	0.2426	0.0000				
R^2	0.90255		0.90641		0.9109		0.8810		0.8709		0.8000	
Adj. R^2	0.90222	0.0000	0.90618	0.0000	0.9106	0.0000	0.8807		0.8695	0.0000	0.7995	
VIF	1.294–4.272		1.279–5.453		1.116–5.428		1.004–4.525		1.195–2.176		1.202–3.414	

References

Addae-Dapaah, K., K.H. Liow, and Y.S.S. Neo. Sustainability of Sustainable Real Estate Development. *Journal of Sustainable Real Estate*, 2009, 1:1, 203–25.

Brounen, D. and N. Kok. On the Economics of Energy Labels in the Housing Market. *Journal of Environmental Economics and Management*, 2011, 62:2, 166–79.

Butler, R.V. The Specification of Hedonic Indexes for Urban Housing. *Land Economics*, 1982, 58:1, 97–108.

Carroll, T., T. Clauretie, and J. Jensen. Living Next To Godliness: Residential Property Values and Churches. *Journal of Real Estate Finance and Economics*, 1996, 12, 319–30.

Clauretie, T.M. and H.R. Neill. Year-Round School Schedules and Residential Property Values. *Journal of Real Estate Finance and Economics*, 2000, 20:3, 311–22.

Constantine, J. Market Research: Survey of Homebuyers Shows Interest in Traditional Neighbourhood Development. *Land Development*, 1994, 5–7.

Consumer Reports. *Neighbourhood Reborn*. 1996, May, 24–9.

Colwell, P.F., S.S. Gujral, and C. Coley. The Impact of a Shopping Centre on the Value of Surrounding Properties. *Real Estate Issues*, 1985, Spring/Summer, 35–9.

Des Rosiers, F., A. Lagana, M. Theriault, and M. Beaudoin Marcel. Shopping Centres and House Values: An Empirical Investigation. *Journal of Property Valuation & Investment*, 1996, 14:4, 41–62.

Eichholtz, P.M.A., N. Kok and J.M. Quigley. Why Do Companies Rent Green? Working paper, USC Berkeley, 2009.

——. Doing Well by Doing Good: Green Office Buildings. *American Economic Review*, 2010, 100:5, 2492–2509.

Fowler, J. and E.M Rauch. Assessing Green Building Performance: A Post Occupancy Evaluation of 12 GSA Buildings. Pacific Northwest National Library, Richland, Washington, 2008.

Fuerst, F. and P. McAllister. Pricing Sustainability: An Empirical Investigation of the Value of Impacts of Green Building Certification. Paper presented at the American Real Estate Society Annual Meeting, April, 2008.

——. An Investigation of the Effect of Eco-Labeling on Office Occupancy Rates. *Journal of Sustainable Real Estate*, 2009, 1:1, 49–64.

——. Green Noise or Green Value? Measuring the Price Effects of Environmental Certification in Commercial Buildings, *Real Estate Economics*, 2011, forthcoming.

Goodman, A.C. and T.G. Thibodeau. Housing Market Segmentation. *Journal of Housing Economics*, 1998, 7, 121–43.

Haurin, D.R. and D. Brasington. School Quality and Real House Prices: Inter and Intra-metropolitan Effects. *Journal of Housing Economics*, 1996, 5, 351–68.

Huh, S. and S.J. Kwak. The Choice of Functional Form and Variables in the Hedonic Price Model in Seoul. *Urban Studies*, 1997, 34:7, 989–98.

Kain, J.F. and J.M. Quigley. Measuring the Value of House Quality. *Journal of the American Statistical Association*, 1970, 65:330, 532–48.

Kats, G. The Costs and Financial Benefits of Green Buildings—A Report to California's Sustainable Building Task Force. Capital E, 2003.

Kutner, M. *Applied Linear Regression Models*. Fourth edition. McGraw-Hill Irwin, 2004.

Linneman, P. Some Empirical Results on the Nature of the Hedonic Price Function of the Urban Housing Market. *Journal of Urban Economics*, 1980, 8:1, 47–68.

Miller, N., J. Spivey, and A. Florance. Does Green Pay Off? *Journal of Real Estate Portfolio Management,* 2008, 14:4, 385–99.

Miller, N.G., D. Progue, Q.D. Gough, and S.M. Davis. Green Buildings and Productivity. *Journal of Sustainable Real Estate,* 2009, 1:1, 65–90.

Mok, H.M.K., P.P.K. Chan, and Y-S. Cho. A Hedonic Price Model for Private Properties in Hong Kong. *Journal of Real Estate Finance and Economics*, 1995, 10, 37–48.

Nicholls, S. and J.L. Crompton. The Impact of Greenways on Property Values: Evidence from Austin, Texas. *Journal of Leisure Research*, 2005, 37:3, 321–41.

Orlitzky, M., F.L. Schmodt, and S.L. Rynes. Corporate Social and Financial Performance: A Meta-analysis. *Organization Studies,* 2003, 24:3, 403–41.

Reichardt, A., F. Fuerst, N.B. Rottke, and J. Zietz. Sustainable Building Certification and the Rent Premium: A Panel Data Approach. *Journal of Real Estate Research*, 2012, 34, forthcoming.

Sirpal, R. Empirical Modeling of the Relative Impacts of Various Sizes of Shopping Centers on the Values of Surrounding Residential Properties. *Journal of Real Estate Research*, 1994, 9:4, 487–505.

Taylor, L.D. and T.A. Wilson. Three-Pass Least Squares: A Method for Estimating Models with a Lagged Dependent Variable. *The Review of Economics and Statistics,* 1964, 46:4, 329–46.

The Ecologist. *A Blueprint for Survival.* Harmondsworth, Middlesex: Penguin Books Ltd, 1972.

Tse, R.Y.C. and P.E.D. Love. Measuring Residential Property Values in Hong Kong. *Property Management,* 2000, 18:5, 366–74.

Turban, D.B. and D.W. Greening. Corporate Social Performance and Organizational Attractiveness to Prospective Employees. *Academy of Management Journal,* 1997, 40:3, 658–72.

Wiley, J., J. Benefield, and K. Johnson. Green Design and the Market for Commercial Office Space. *Journal of Real Estate Finance and Economics*, 2010, 41:2, 228–43.

Kwame Addae-Dapaah, National University of Singapore, Singapore 117566 or rstka@nus.edu.sg.

Su Jen Chieh, National University of Singapore, Singapore 117566 or anniesu999@gmail.com.