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ABSTRACT

Globally, green buildings (GBs) are receiving more and more attentions. GBs with it's benefits has been recognized by many governments and promoted as a strategy for reaching Sustainable Development (SD). However, barriers of GBs, such as higher initial cost and lack of awareness, further indicate that proper strategies need to be devised for promoting the wider adoption of GBs in construction industry as well as buildings development. To date, there are limited empirical studies identifying the strategies for promoting GBs in developing countries, especially in Vietnam. This study aims to propose the suitable promoting strategies for GBs in Vietnam conditions by researching on consumer's behaviors on certified green buildings. An empirical study conducted with 308 responses of Vietnamese people to figure out main factors that affects to consumer's behaviors. The econometric analysis results confirmed the importance of 'income', 'environmental awareness', 'knowledge', 'personal benefits' and 'trend' to consumer's behaviors. Then, by combining the results and reviewing comprehensive literature, a series of strategies will propose to promote green building in Vietnamese condition.

Key words: Green buildings, consumer's behaviors, Vietnam, econometric analysis.

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I. Introduction

The world population has now reached to 7.7 billion people with incredible economic growths; the world is facing with natural resource depletion and serious social problems. The question being asked is no longer "Do development and environmental concerns contradict each other?" but "How can sustainable development be achieved?" Solving environmental problems is recognized as approach to adapt to whole three features of SD (Lipu et al., 2013). In line with green building benefits, it has been recognized by many governments and promoted as a strategy for minimizing negative effect of construction industry as well as reaching SD.

The promotion of certified green buildings has been focusing on public infrastructure and some sectors such as factories, offices, and schools, etc. Residential buildings have received less attention. However, globally, residential sector is responsible for 16–50% of national energy consumption by all sectors, and averages approximately 30% worldwide (Saidur et al., 2007). In addition, even in residential sector, the certified green buildings are often limited to luxury buildings. As a result, the overall performance of promoting green buildings are largely discounted.

II. Empirical Study

2.1. The consumer's behaviors structure model and hypotheses to be tested.

2.1.1. Theoretic background and model development.

Nowaday, the consumer’s purchasing choices express not only price and quality preferences but also social norms, values and individual beliefs (Caruana, 2007). Therefore, environment-friendly products have being considerable growth as the results of increasing of consumer's environmental considerations (Hunt & Dorfman, 2009). (Hueber, 1991) pointed out that over 70% of Americans supported environmental protection programs and 49% of them

would reject products that were bad influence to the environmental. (Peattie, 1999) suggests that the clearest way to understand green consumerism is by viewing each individual's consumption behaviors. However, studies of developing countries still is lack of attention, esspecially in Vietnam.

2.1.2. Propose hypotheses.

- Dependent variable, y:

Willingness to buy: assuming at 2% extra cost or at 5% extra cost.

- Control variables: may be correlated with some or all independent variables and also affect to the dependent variable

Group 1: Personal traits.

Individual characteristics normally are used as control variables. However, in this case, we would like to use income, living places ad education level as the independent variables that we are interested.

Hypotheses for group 1:

H1a: Income has a positive impact to willingness to buy, in another word; higher income people will have more willingness to buy.

H1b: Living places has a positive impact to willingness to buy, in another word; people live in bigger city will have more willingness to buy.

H1c: Education level has a positive impact to willingness to buy, in another word; higher education level people will have more willingness to buy.

- Independent variables:

Group 2: Rational traits.

H2a: Environmental_awareness has a positive impact to willingness to buy, in another word; people have higher environmental concern will have more willingness to buy.

H2b: Knowledge has a positive impact to willingness to buy, in another word; people have higher knowledge about green building will have more willingness to buy.

H3c: Personal_benefits has a positive impact to willingness to buy, in another word; people who think green building offer higher benefits for them will have more willingness to buy.

H4d: Environ_benefits has a positive impact to willingness to buy, in another word; people who think green building offer higher benefits for environment will have more willingness to buy.

Group 3: Mental/Social traits.

H3a: Trend has a positive impact to willingness to buy, in another word; people who think green building will be a trend in the future will have more willingness to buy.

H3b: Honor has a positive impact to willingness to buy, in another word; people who feel honor when own green building will have more willingness to buy.

2.2. Model design and method.

2.2.1. Econometric model for testing hypotheses.

Ordinary least-squares (OLS) multiple linear regression analysis is used to test the hypotheses. OLS estimators are the best linear unbiased estimators (BLUEs) (Wooldridge, 2015). To ensure that basic assumptions for OLS regression are satisfied, a White test (White, 1980) is performed to ensure that the sample met the homoscedasticity assumption of the OLS regression. An regression specification error test (RESET) test (Ramsey, 1969) is performed to test specification errors such as omitted variables and nonlinearity of functional form. Econometric model:

Willingness to buy =

$$\beta_0 + \beta_1 Gender + \beta_2 Log(age) + \delta_1 Area\_special + \delta_2 Area\_small + \beta_3 Log(income) + \delta_3 Above\_college + \delta_4 Under\_college + \beta_4 Environmental\_awareness + \beta_5 Knowledge + \beta_6 Pesonal\_benefits + \beta_7 Environ\_benefits + \beta_8 Trend + \beta_9 Honor + u$$

In the models, β_0 is the constant, β_1- β_9 and δ_1 - δ_4 are the regression coefficients and u is a random disturbance. To test each hypothesis, we examine the data against the null hypothesis that the hypothesized variable has no significant impact, positive or negative, on the 'willingness to buy'. Two-tailed significance level is used because it gives a more conservative or stringent criterion. The empirical model is depicted as shown in Figure 1.

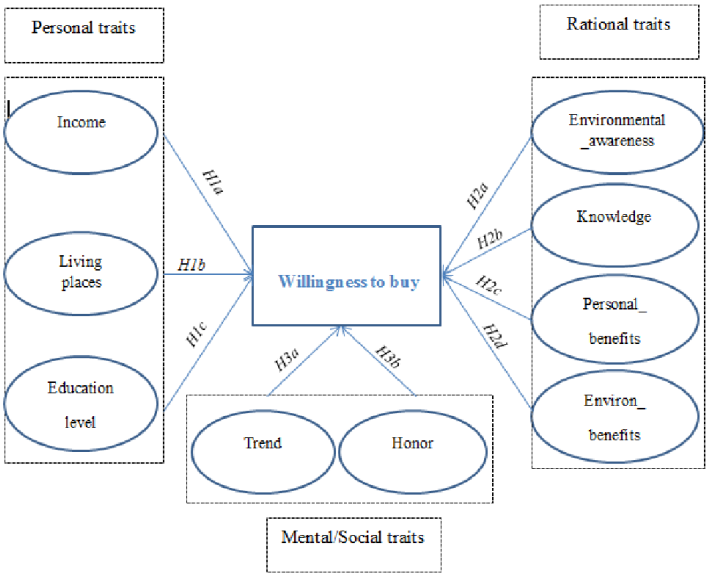

Fig.1. The diagram of the econometric model

2.2.2. Data

To obtain the necessary data for the analysis, we conducted a questionnaire survey with Vietnamese response. The age of observations is mainly focus on 30 to 40 (67%) because people of this age are those who have highly demand and practicality for buying a house. After reviewing literature, a questionnaire was created. The questionnaire format consists of three components: basic information of the interviewee; questions for rational traits variables such as, environmental awareness, knowledge, etc.; and mental/social traits variables such as, trend, and honor. This sample size is 308 collected from questionnaire replies.

2.2.3. Measures of regression variables.

Dependent variable: Willingness to buy.

The limited of higher initial cost of green buildings was used to examine the willingness to buy of customers. Level 'silver' of LOTUS certification was used as a standard to calculate. Using six-point Likert scales. In this case, the score is ranging from 1 (strongly disagree) to 6 (strongly agree).

Control variables:

- Gender:

This variable is control variable, which is designed by dummy variable. ‘Gender’ equals zero, which means the audience is female, and the audience is male if ‘gender’ equals one.

- Age:

This variable is control variable, which represent for age of audiences. It may be related preferences.

- Income:

This variable represent for purchasing power so it is concerned as independent variable and

it is used to test *H1a.* In this case, audiences were asked about family income instead of personal income because in Vietnam case, to date, it is still common when Vietnamese people received financial support from their parent or their family when they want to buy a house.

- Living places:

Three groups and two dummy variables are used to represent for this variable. In detail, people were asked about the city, which they live in and following Vietnam urban center system classification the respondent will classify in respective group. Three groups are group 1 (people live in special urban center), group 2 (people live in grade-I urban center), group 3 (people live in grade-II and grade-III urban center). In which, group 2 is chosen as base group, group 1 is represented by 'area_special' dummy variable, group 3 is represented by 'area_small' dummy variable. *H1b* is examined by this variable.

- Education level:

Same idea with living places, three group and two dummy variables are used for this variables. In which, three group are group 1 (education level of audience is higher college, such as, master degree or PHD degree), group 2 (people finish college degree), group 3 (under college education level people). Group 2 is chosen as base group, 'above_collge' is dummy variable, which represent for group 1, 'under_colege' is for group 3.

Independent variables:

- Environmental_awareness:

This variable was used to test the impact of 'Environmental_awareness' on the willingness to buy, as specified in *H2a*. 'Environmental_awareness' includes respondent concern about environment and their actions to protect environment. It is collected by take average of three

questions. The first question is proposed to see how audiences concern and support to policy protects environmental. The second and third questions asked about the audiences actions such as, garbage sorting and using power equipment properly and reduce water consumption.

- Knowledge:

This variable represents for audience's knowledge about green buildings. It is defined by two questions. The first question is used for respondents to evaluate themself, in their opinion, how much they think they know about green buildings. The second question is proposed as a confirmation or a test for the first question. It is mentioned about main components of green buildings. Several choices are proposed and audiences have to pick all correct features, the score was counted by count the correct features they picked. After all, 'knowledge' equals average of two questions. If a respondent think he or she knows about green buildings a lot in the first question but the score of second question is low that it will lead to the valuable of 'knowledge' is lower than when only use the first question to collect dataset. It is a good way to ensure the accuracy of data.

- Personal_benefits:

This variable represents for audience's opinion about how much green buildings benefits effect to them. It is used to test the correlation between green buildings personal benefits and the acceptance of the audiences.

- Environ_benefits:

Same idea with ‘Personal_benefits’ variable, this variable talk about environment benefits due to green building.

- Trend:

This variable belongs to Mental/Social variable group. This group have no clearly explanations compare to Rational variable group, variables in this group mostly based on actor guess and experiences. 'Trend' used to test the correlation between the thinking green buildings will be the trend in the future and customer willingness to buy.

- Honor:

This variable represents for reputation achieved when own a green buildings. To ensure the quality of database, two questions are asked in indirect way. The first question mentioned about own a green building will give people a good reputation. The second question talks about own a green buildings will make people different.

2.3.Results of econometric analysis and discussions.

2.3.1. Robustness of OLS regression analyses**.**

Several regression diagnostics were taken to ensure that major OLS assumptions were satisfied. Specifically, we tested whether there were specification errors and heteroskedasticity. First, the Ramsey RESET test was performed to test the linearity assumption for OLS. The F-statistic of the RESET test of the full model at 2% extra cost and 5% extra cost were 0.674 with a p-value of 0.413 and 1.73 with a p-value of 0.19, respectively. The test statistics indicated that the functional form problem were not significant in both full models; i.e., linear regression were a proper empirical method for our study. Second, a White test was performed to test the homoskedasticity assumption for OLS. The F-statistic of the White test of the full model at 2% extra cost and 5% extra cost were 2.073 with a p-value of 0.0156 and 3.591 with a p-value of 0.000, respectively. Thus, we rejected the homoskedasticity assumption. Owing to the heteroskedasticity concern, we calculated the more stringent hetero-robust standard errors to

determine the significance of regression coefficients through OLS regression.

2.3.2. Empirical results of hypothesis tests.

Table 1 summarizes the empirical results from the regression analysis. In the first step, we built the 'model 1' shown in Table 1, by including only the control variables as regressors. Both *H1b* and *H1c* are not supported which means 'living places' and 'education level' have not significant impacts on the 'willingness to buy'. Only *H1a* is supported in both 'willingness to buy' at 2% extra cost and 5% extra cost. In another word, people who have higher income will have more acceptances in buying a green house, it is reasonable but it may have not much meaning because it seem to be a fact that easy to understand. In addition, the adjusted R-squares (adj.R^2) in both models are very low which are 6.70% and 5.63% at 2% and 5% extra cost models, respectively. It indicates that the control variables together have not much impact on dependent variable. Thus, the inclusion of group 2 variables in model 2 (basic model) will contribute to the adj.R^2 of model 2.

In model 2, at 2% extra cost basic model, these variables explain 16.09% of 'willingness to buy', group 2 variables contribute 9.39% of explanation compare to model 1. Same situation with model 1, *H1a* is supported but *H1b* and *H1c* are not supported. *H2b* and *H2c* are supported but surprisingly *H2a* and *H2d* are not. It is contrast to several previous studies. For example, in Taiwan, 'environmental_awareness' is very significant on 'willingness to buy'. (Suki, 2013) and (Kim & Choi, 2005) also emphasize the importance of environmental awareness on green purchase behaviors. At 5% extra cost basic model, the adj.R^2 is 19.43% which higher than model 1 is 13.8%. Compare to basic model at 2% extra cost, everything is the same, only 'environmental_awareness' become significant. It can be explained that at higher cost, people

may see the cost difference between green building and conventional building so they need more proof to justify the purchase; in this case, the proof is 'environmental_awareness'. To summarize, when we do not use mental/social traits variables, income, knowledge, personal_benefits and environmental_awareness are importance variables, which have significant effect to willingness to buy.

Most important, the result of full model is shown in table 1. At 2% extra cost full model, the dependent variable is explained by 17.36%, in which, mental/social traits variables contribute only 1.27% of willingness to buy. *H3b* is not supported; only 'trend' is significant so 1.27% additional is come from 'trend' effect. Compare to basic model at 2% extra cost, income, personal_benifits are still significant but knowledge become insignificant. So knowledge is not importance anymore or when we add 'trend' in the basic model, somehow it effect to this insignificant of knowledge? It calls for further investigation of 'trend' which we will discuss after examining full model at 5% extra cost. At 5% extra cost full model, adj.R^2 is 26.26 – increasing 6.83% compare to basic model. The same situation with full model at 2% extra cost, *H3b* also is not supported; 'trend' is significant and contributing 6.83% of explanation – much higher than 1.27% in 2% full model. Compare to 2% full model, 'knowledge' is significant and the reason can be the same with situation in basic model, which is at higher cost, people need more proof to justify the purchase. An interesting thing is 'environmental_awareness' become insignificant when comparing basic model, so the reason may be the same with 'knowledge' in 2% full model. Table 1 also shows a model where 'trend' become dependent variable to see the correlation between trend and others which may explains why when we used mental/social traits variable, some variables become insignificant.

As the result in 'trend' model, knowledge is significant with positive effect to trend, in

another word; trend includes influent of knowledge inside. It may explain why when we add 'trend' in full model, knowledge in 2% full model become insignificant. Another way to explain, 2% extra cost may be not too high; people do not see the cost different between green building and conventional building so they decided to follow the trend because trend has included knowledge inside already. The explanation is the same with environmental_awareness in 5% full model. In addition, 'honor' is not significant in both 2% and 5% full model. It is contrast to study of Taiwan. In Taiwan, honor is very significant and the explanation is about 12% of willingness to buy. The reason may be due to only 8 years of LOTUS certification system compare to 20 years in Taiwan so in Vietnam green building may not offer enough reputation for owner.

Table 1. Results of OLS Regression Analysis.

	Model 3 (full model)		Model 2 (basic model)		Model 1	
Xi \ Y	Willingness to buy at 2%	Willingness to buy at 5%	Willingness to buy at 2%	Willingness to buy at 5%	Willingness to buy at 2%	Willingness to buy at 5%
Gender	0.148159 (p-value: 0.1299)	-0.074491 (0.5838)	0.147240 (0.1384)	-0.078260 (0.5811)	0.100221 (0.3395)	-0.160234 (0.3016)
Log(age)	0.461456 (0.1552)	0.248892 (0.6119)	0.475162 (0.1360)	0.313306 (0.5498)	0.421974 (0.1995)	0.105135 (0.8432)
Area_special	0.119320 (0.3181)	0.059571 (0.7150)	0.087760 (0.4662)	-0.031627 (0.8485)	0.141581 (0.2604)	0.023105 (0.8955)
Area_small	0.126614 (0.4058)	0.190329 (0.4581)	0.076256 (0.6392)	0.042919 (0.8704)	0.112362 (0.5280)	0.105305 (0.7039)
Log(Income)	**0.243157 (0.0028)*****	**0.346794 (0.0012)*****	**0.216249 (0.0069)*****	**0.264844 (0.0199)****	**0.318403 (0.0000)*****	**0.426814 (0.0002)*****
Above_college	-0.118915 (0.2520)	0.148526 (0.2940)	-0.130703 (0.2043)	0.116536 (0.4296)	-0.066389 (0.5398)	0.252195 (0.1225)
Under_college	0.078733 (0.6989)	0.368650 (0.1914)	0.072572 (0.7332)	0.346062 (0.2412)	0.145120 (0.5016)	0.399937 (0.1722)
Environmental awareness	0.066817 (0.2843)	0.096372 (0.2691)	0.095302 (0.1178)	**0.180033 (0.0446)****		
Knowledge	0.074825 (0.2004)	**0.191863 (0.0167)****	**0.108485 (0.0686)***	**0.292221 (0.0009)*****		
Personal benefits	**0.159726 (0.0005)*****	**0.219062 (0.004)*****	**0.166290 (0.0004)*****	**0.238146 (0.0032)*****		
Environ_benefits	0.008176 (0.8532)	-0.031741 (0.6273)	0.014958 (0.7279)	-0.009512 (0.8933)		
Trend	**0.117145 (0.0485)****	**0.357908 (0.0000)*****				
Honor	0.023095 (0.5083)	0.053801 (0.3676)				
Adjusted R-squared	**17.36%**	**26.26%**	**16.09%**	**19.43%**	**6.70%**	**5.63%**

Xi \ Y	Trend
Gender	-0.029565 (p-value: 0.7849)
Log(age)	**0.627185 (0.0712)***
Area_special	-0.151149 (0.2358)
Area_small	-0.283936 (0.1208)
Log(Income)	**-0.223841 (0.0025)*****
Above_college	-0.009506 (0.9396)
Under_college	-0.125674 (0.5253)
Environmental awareness	**0.166928 (0.0119)****
Knowledge	**0.231137 (0.0007)*****
Personal benefits	0.034042 (0.4362)
Environ_benefits	**0.092034 (0.0317)****
Honor	**0.182238 (0.000)*****
Adjusted R-squared	**20.06%**

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III. Conclusion

The regression results confirm the significant impacts of knowledge, environmental_awareness, personal_benefits and trend on willingness to buy. However, we have considered almost all variables that we can think of, the full model only explains 26.26% of buying willingness. It indicates that currently the buying willingness may still largely depend on “personal taste or preference” which cannot be effectively stimulated. We suggest that more education for knowing green buildings and shows the actual benefits of green buildings to both environment and households may be the key for future success of promoting green building. In summarize, to promoting green building in Vietnam condition, ‘GBTs-related educational and training programs for developers, contractors, and policy makers’, ‘availability of institutional framework for effective GBTs implementation’, ‘availability of better information on cost and benefits of GBTs’, ‘public environmental awareness creation through workshops, seminars, and conferences’ and ‘more publicity through media (e.g., print media, radio, television, and internet)(Chan et al., 2017) are most effective strategies.

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