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Differences and influencing factors for Chinese urban resident willingness to pay for green housings: Evidence from five first-tier cities in China

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HIGHLIGHTS

- Constructed a theoretical model of willingness to pay for green housings.
- Identified three independent willingness to pay dimensions.
- Discussed differences for different regions and demographic characteristics.
- Divided willingness to pay obstacles into internal and external risks.
- Educational background regulates between anchoring price and willingness to pay.

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ABSTRACT

Promotion and use of green buildings is a fundamental way to improve living environments, reduce building energy consumption, and solve energy problems. A theoretical and quantitative research model of urban resident willingness to pay for green housing is constructed using China's five first-tier cities as examples, analyzing 2937 valid questionnaires. Five clear effects were identified as follows. (1) Purchase purpose was split in three dimensions: willingness to pay for economical and practical, willingness to pay for investment, and willingness to pay for comfort and pleasure. willingness to pay obstacles were divided into internal (security/functional) and external (economic/policy) risks. (2) There was no significant difference in willingness to pay for economical and practical between gender and income levels, willingness to pay for investment between marital status and family resident population, and willingness to pay for comfort between and pleasure between education, housing type, and family resident population. The willingness to pay dimension distributions varied by region and demographic characteristics, with female residents showing highest willingness to pay in all five first-tier cities, junior high school and below education status showing lowest willingness to pay. Middle income and middle managers showed the highest willingness to pay, rather than higher income or higher employment level. (3) Educational background regulates between anchoring price and resident willingness to pay. Highly educated people are not easily affected by price anchoring, and decide whether to purchase based on their understanding of the product, whereas lower educated people are more likely to be anchored and more dependent on external information when making purchasing decisions. (4) Order and effect (positive (+) or negative (−)) for significant WTP influencing factors were: group pressure (+) > functional risk (−) > individual attitude (+) > perceived behavioral control (+) > egoistic values (−) > security risk (−) > ecological values (+). (5) Residents were most willing to purchase three-star green housings when there was a government subsidy; in the absence of a subsidy, maximum incremental cost residents were willing to pay was 51–100 yuan/m^2. Relevant policy implications are presented based on these findings.

1. Introduction

Energy shortage and environmental degradation have become the great global economic development challenges in the 21st century. The traditional construction industry urgently needs a green transformation and upgrading due to its high energy consumption and large pollution. In China, construction accounts for more than 50% of steel consumption and 60–70% of total cement production; housing construction accounts for ~50% of urban construction land, and building life cycle energy consumption (including building materials energy consumption)

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accounts for 40–50% of national energy consumption [1].

If building energy consumption is not reduced, China's energy production will be unable to meet long term high energy consumption building requirements, and may cause more serious energy waste and environmental pollution. Energy conservation in the construction sector is also essential to reducing China's carbon emissions. Under low-carbon scenarios, the potential for building carbon emission reductions by the year 2050 is as high as 74% [2].

Green buildings are buildings that provide people with healthy and comfortable living spaces, fully utilizing natural resources while minimally effecting the environment. Willingness to pay (WTP) is the consumer's personal valuation of a particular item or service and includes a strong subjective evaluation component [3].

Green buildings account for just 6% of new construction in China, which is somewhat lagging that of developed countries. Several misunderstandings continue among consumers, who often think that green buildings are only those with high green rate, expensive, smart, and/or constant temperature and humidity. However, real energy and material conserving buildings are specifically built to reduce investment and operating expenses. In the construction stage, reducing land or building material use has great opportunity to reduce costs. Operationally, green buildings should reduce energy and water usage compared with conventional buildings, hence significantly reducing operating costs. i.e., less expensive.

Supply was limited during early green housing development, and the supplier dominates the transaction price in the seller's market. Hence, it was difficult to reflect the true market equilibrium level only by transaction price. Green housing supply will markedly increase with further market development and improvement. Thus, consumer WTP for green housing will play an increasingly important role in determining green housing pricing in the future.

This raises the following questions:

(1) Are consumers willing to buy green housing, i.e., is WTP strong?
(2) What factors effect consumers WTP for green housing?
(3) What are the payment differences and commonalities among consumers with different regional and demographic characteristics?
(4) What is the incremental cost consumers are willing to pay when buying green housing compared with traditional houses?
(5) Are higher income groups more willing to buy green housing?
(6) Do government subsidies increase WTP for green housing?

Therefore, the innovations of this study are as follows.

(1) Constructed a theoretical and quantitative model of urban resident WTP for green housing combining grounded theory, planned behavior theory, and anchoring effect in behavioral economics.
(2) Conducted a large empirical survey probing resident executive perspectives, and discusses WTP commonalities and differences for different regions and demographic characteristics.
(3) Identified three independent WTP dimensions: WTP for economical and practical, WTP for investment, and WTP for comfort and pleasure, depending on the purchase purpose.
(4) Divided WTP obstacles into internal (security/functional) and external (economic/policy) risks.
(5) Introduced an anchoring effect from behavioral economics into the model, to verify that educational background has a regulating role between anchoring price and resident WTP.

This study provides several major contributions. (1) We explored the impact of the residents' internal psychological and external environmental factors on their WTP for green housings and provided new insights. (2) Our conclusions may be of interest to policy makers and green residential developers and may help to develop more effective policy support and outreach strategies for green housings. (3) The conclusions for green houses WTP will contribute to future related research and provide an empirical reference for green housing promotion.

The theoretical model for resident WTP influencing factors for green housing was constructed based on planned behavior and behavioral economics theories. Model validity was analyzed using a large empirical survey.

Practically, green housing production processes and marketing can be modified to correspond to consumer green housing concepts, increasing developers benefits. Governmental policy effects can be assessed by comparing consumer WTP with national policy expectations. Comparing consumer perspectives regarding increased green housing price provides a reference to formulate green housing price policies and real estate market regulations.

2. Literature review

2.1. Green building definition

In the 1960s, Paul merged the words ecology and architecture into “Arology” and proposed the ecological architecture (green building) concept. The 18th congress of International Union of Architects (UIA) in 1993 was a landmark meeting in the history of international green building. In October 1998, 14 major western industrial countries attended the Green Building Challenge 98 (GBC98) international conference in Vancouver, Canada. The subsequent international conference Sustainable Building 2000 (GBC2000) was held in Maastricht, Netherlands, marking comprehensive development of the international green building movement. In 1999, at the 20th UIA congress in Beijing, Architecture and Environment in the 21st Century was one of the important topics. The Beijing Charter published by UIA emphasizes that we must face the ecological dilemma to strengthen ecological awareness and called upon architects all over the world to regard environmental and societal sustainable development as the core of their profession and responsibilities [4].

China's green building definition includes private and public green housing buildings [5]. Therefore, green housing is a subset of green buildings, with all the general characteristics of green building, some additional attributes. Green housing strongly emphasizes residence health, comfort, and safety in the context of livable space for people. It is an architectural concept to meet modern development requirements, but does not require a specific housing type, nor does it distinguish between regions. A green house building efficiently and reasonably utilizes resources and energy throughout its full life cycle, and is friendly to, and harmonious with, the environment.

2.2. Green building research

The British BREEAM, USA LEED, Japan CASBEE, Germany DGNB, Canada GBTOOL, Australia NABERS and Singapore Green Mark standards are mature evaluation systems [6], specific to national conditions and characteristics. BREEAM and LEED have been widely used around the world, and although the Green Mark standard is relatively recent, it has achieved great success in Singapore.

Transaction prices for green buildings are 12–13% higher comparable traditional commercial and residential buildings [7]. Tatari and Kucukvar [8] applied neural network methods to predict the cost premium for LEED certified green buildings. Although cost was a major consideration for residents, the benefits of reduced energy and other operating costs emerge in the long term [9]. The extra cost of building a green apartment is quite low compared with the inflated sales price, and operating costs have been estimated as 40%–50% lower than traditional buildings, mainly due to reduced energy consumption [10].

Horowitz and El-Sharif [11] and Amstalden et al. [12] showed that government incentive policies can significantly affect WTP for green housing. Chau et al. [13] used selective experiments to show that consumers had higher WTP increased costs for energy conservation, but