Article

An Alternative Model to Determine the Financing Structure of PPP-Based Young Graduate Apartments in China: A Case Study of Hangzhou

Yelin Xu [1], Yi Peng [2],*, Queena K. Qian [3] and Albert P. C. Chan [4]

[1] Department of Engineering Management, Zhejiang Sci-Tech University, Hangzhou 310018, China; E-Mail: zjyelinxu@163.com

[2] School of Urban-rural Planning & Management, Zhejiang University of Finance & Economics, Hangzhou 310018, China

[3] OTB Research Institute for the Built Environment, Delft University of Technology, 2628 BL Delft, The Netherlands; E-Mail: k.qian@tudelft.nl

[4] Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong, China; E-Mail: bsachan@polyu.edu.hk

* Author to whom correspondence should be addressed; E-Mail: pengyihz@gmail.com; Tel.: +86-571-8673-5803.

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Abstract: Public-private partnerships (PPP) can be employed to provide public rental housing for young graduates, which has been urgent to achieve social sustainability in China. However, few studies have been conducted to investigate the financing structure of PPPs, particularly the ratio of private investment, which is important in initiating a PPP project. This study develops a robust model to determine the financing structure through considering the uncertainties in operation. A case study in Hangzhou demonstrates the process of the model. The relevant findings provide private investors and the local government with effective references for negotiating the financing structure of a PPP project.

1. Introduction

Although the rapid urbanization in China has resulted in fast economic development, such changes have brought about some urgent challenges in urban areas [1,2]. According to the China Statistical Yearbook, the urban population increased from 191,400,000 in 1980 to 669,780,000 in 2010, whereas the urbanization rate increased from 19.4% to 50% during this period. Rural-urban migration significantly contributes to the growth of the urban population [3]. Nevertheless, rapid urbanization resulted in considerable achievements in the area of housing. The rate of homeownership increased from 20% to 70%, and the per capita living space increased from 4 m^2 to 29 m^2 from 1980 to 2010 [4]. However, the increasing demand for housing, along with the advanced urbanization and slow income growth, results in difficulties in providing affordable housing to all urban households. For example, the demand exceeded supply by about 1.6%, 3.4%, and 4.5% per year in Beijing, Hangzhou, and Shenzhen, respectively [5]. Moreover, in the past few years, house price appreciation has outpaced even the rapid growth of income, thereby making middle-to-low-income households harder to obtain quality housing [5].

During the rapid development of the private housing market, China has introduced various affordable housing programs to help middle-to-low-income households settle in cities. Such programs include the Peaceful Living Project (Kang Ju Gong Cheng) program from 1995 to 1998, the Economical and Comfortable Housing (Jing Ji Shi Yong Fang) program from 1994 to the present, the Cheap-Rent Housing (Lian Zu Fang) program from 1998 to the present, the Price-Cap Housing (Xian Jia Fang) program from 2007 to the present, and the Public Rental Housing (PRH) (Gong Zu Fang) program from 2010 to the present [6]. Although these programs have different requirements, their focus is primarily middle-to-low-income households with urban residence certificates (Hu Kou). However, without reasonable management, these programs have several negative results, including high construction costs, financial deficit of the local government, and inadequate delivery [7]. Many reasons explain the failure, such as the central government's lack of a precise definition of the mission, heavier fiscal burden on local governments, fragmentation of the inter-governmental structure of China, and loopholes in the allocation mechanism [4,6,8]. More importantly, these programs set an exclusionary policy toward several special groups by implementing strict qualification checks [4].

Young graduates, except from migrant workers, are overlooked by the public rental housing program of China. The informal label "young ant tribe" has been used to refer to the clustering of young graduates who are highly educated but are vulnerable and come from low-income families [9]. Young graduates mainly concentrate in developed cities such as Beijing, Shanghai, Shenzhen, and Guangzhou. Young ant-tribe graduates, which are estimated to be three million in number, allocate more than 70% of their income for rent and basic living [10]. Without considering any affordable housing programs, they usually live in dirty, noisy, and cheap apartments in urban villages or "rural–urban fringes" with low rent [11]. Such poor living conditions contribute to the development of serious psychological problems and other social problems in a large, special group [12]. However, a market should provide suitable housing for such individuals because of the high demand. Young ant-tribe graduates have higher requirements for housing compared with migrant workers, and an increase in their income would allow them to bear the incurred costs of public rental housing. Fortunately, local governments have begun to address this issue. For example, in Beijing, the Tang Jialing Village, where the largest concentration of young ant-tribe

graduates is found, was redeveloped, and public rental housing would then be established for young ant-tribe graduates [13].

Various innovative methods have been suggested for the provision of public rental housing, which include bond-based scheme, land use planning incentive, real estate investment trusts, and public-private partnership (PPP) [14–17]. Among these methods, PPP has been widely employed in the provision of public infrastructure and rental housing, considering its efficiency and effectiveness in providing public services in both developing and developed countries [18–19]. In India, for example, PPP has been one of the major urban housing policies because of its cost and quality [20]. Meanwhile, the Nigerian government has implemented PPP in low-income housing, because the involvement of the private sector would accelerate housing provision [21]. In Malaysia, public agencies have adopted PPP in delivering public housing to enhance organizational reputation [22]. The U.S. Congress promoted PPP in providing affordable housing through the HOPE VI program in 1992 [23]. Canada proposed the Let's Build program to initiate PPP for affordable housing development in 2000 [24]. The Irish government has implemented PPP in social housing regeneration, with positive outcomes since 2000 [17]. In 2001, the Queensland government of Australia implemented a PPP policy that improved "value for money" in public service delivery, which included housing projects [25].

Few studies have investigated the implementation of PPP in PRH and young-graduate apartments in China. Wang and Murie reviewed relevant policy changes in China and reported that a policy involving a hybrid approach should be developed for building affordable housing, rather than relying solely on the government, market, or individuals [26]. Yuan *et al.* identified 16 factors related to strengths, weaknesses, opportunities, and threats (SWOT), for the development of PPP housing in China [27]. Li *et al.* developed a privately owned PRH with a real, option-based valuation model to promote PPP-based PRH in China [7]. Although these provide reliable references in implementing PPP-based young-graduate apartments, these studies have their limitations. First, no survey has been conducted to examine the opinions of young graduates on such kinds of apartments. Therefore, their willingness to pay for these kinds of apartments remains unknown. Second, the Build-Own-Operate model proposed by Li *et al.* is difficult to implement in the context of China, because the general public is reluctant to accept public housing owned by the private sector [7]. Third, few approaches have been developed to determine the financing structure of PPP-based apartments, specifically the investment ratio of private investors in the PPP projects. The financing structure plays a significant function in a PPP project because the private company will usually want to share the initial costs with the government, especially given the related uncertainties and risks in the building and operation stages. A private company is usually reluctant to invest in a PPP project if the ratio is too high, and thus, an investor has to bear most of the uncertainties and risks. Similarly, the government would also reject a PPP proposal if the ratio is too low, which implies that the program is still led by the government.

This research investigates the financing structure of PPP-based young-graduate apartments in China. The next section introduces the research methodology, in which a robustly logical process is developed. The results from the questionnaire survey and secondary data are collected for further analysis. Monte Carlo simulation (MCS) is used to develop the decision model by considering the risk factors during the construction and operation period of young-graduate apartments. Decision criteria are established for the decision model. Afterward, a discussion on the implementation of the model and the results of the case study conducted in Hangzhou is presented. The feasibility of the model integrated with the case

study was validated through an interview. Finally, the conclusion and recommendations for future research directions are presented.

2. Research Methodology

The appropriate methodology for investigating the financing structure of a PPP project was determined by carefully examining existing PPP models in popular journals, such as Journal of Construction Engineering and Management, Journal of Management in Engineering, Journal of Computing in Civil Engineering, Automation in Construction, Construction Management and Economics, Habitat International, and International Journal of Project Management. Table 1 summarizes the existing studies that focus on identifying financing structure for PPPs, particularly the suitable concession pricing and concession period. Net present value (NPV) is usually the foundation for decisions in previous studies. The optional scheme can be selected if it generates the NPV that satisfies the requirements of the government and private companies during the period being studied [28–30]. Moreover, MCS was introduced to simulate NPV computation that will alleviate the problem of risks and uncertainties [30–32].

Table 1. A summary of existing studies related to determining financing structure.

No	Author(s)	Year	Objective	Key Methods
1	Ngee *et al.* [33]	1997	Concession pricing	Multiple linear regression
2	Shen *et al.* [28]	2002	Concession period	NPV
3	Yeo and Tiong [29]	2003	Concession period	NPV, Monte Carlo Simulation
4	Cheng and Tiong [34]	2005	Tariff design	NPV, Risk analysis
5	Shen and Wu [30]	2005	Concession period	NPV, Monte Carlo Simulation
6	Huang and Chou [35]	2006	Minimum revenue guarantee	Real option theory
7	Zhang and AbouRizk [31]	2006	Concession period	NPV, Critical path method, Monte Carlo Simulation
8	Ng *et al.* [31]	2007	Concession price and period	NPV, Monte Carlo Simulation, Fuzzy set theory
9	Shen *et al.* [36]	2007	Concession period	NPV, Bargaining game theory
10	Subprasom and Chen [37]	2007	Concession price	Genetic algorithm, Case study
11	Zhang [38]	2011	Concession period	Web-based concession period analysis system
12	Khanzadi *et al.* [39]	2012	Concession period	NPV, Fuzzy set theory, System dynamics
13	Hanaoka and Palapus [40]	2012	Concession period	NPV, Monte Carlo Simulation, Bargaining game theory
14	Yu and Lam [41]	2013	Concession period	NPV, Principal Component Analysis, Monte Carlo Simulation
15	Bao *et al.* [42]	2015	Concession period	NPV, incomplete information game theory

This study investigated the financing structure of PPP-based young-graduate apartments using NPV and MCS, considering that risks and uncertainties are major concerns in the decision-making process. A confidence level was introduced in the model as a decision criterion. The logical process of the study is illustrated in Figure 1.
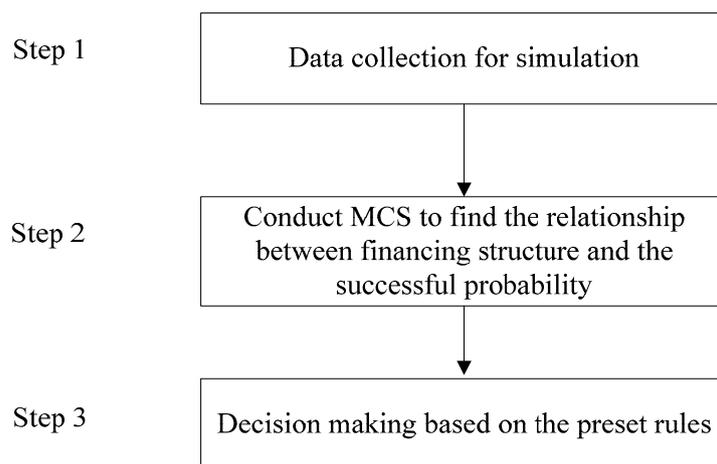
Figure 1. The analytical process of this research.

2.1. Step 1 Data Collection for Simulation

According to Shen *et al.* [28], calculating the accumulated NPV during the concession period is shown in Equation (1).

$$NPV(T_c) = \sum_{t=1}^{T_c} \frac{NCF_t}{(1+r)^t} = \sum_{t=1}^{T_c} \frac{(I_t - C_t)}{(1+r)^t} \tag{1}$$

In Equation (1), NCF_t is the net cash flow in year t, I_t is the income in year t, C_t is the cost (or expense) in year t, r is the discounted rate considering the effects of interest and inflation rates, T_c is the concession period, and $NPV(T_c)$ is the accumulated net present value during the concession period.

Assuming financing structure as K, which is the ratio of the private investment to the total investment, Equation (1) can be further rewritten as Equation (2).

$$NPV(T_c) = \sum_{t=1}^{T_c} \frac{NCF_t}{(1+r)^t} = \sum_{t=1}^{T_c} \frac{(I_t - C_t)K}{(1+r)^t} \tag{2}$$

Efforts should be made in finding the specific income, cost, and discounted rate for the concerned PPP-based young-graduate apartments. Existing practices indicate that the project cost primarily include costs on land, preparation, building and installation engineering, public works, management, reserve funds during the construction stage, as well as the cost of building maintenance, labor, taxes, and other costs at the operation stage. Income, on the other hand, is derived from the rental of young graduates, which is determined by the rental and occupancy rates, and of businesses. Secondary data from local statistics publications were examined to collect existing data for analysis. If no data (e.g., on the rentals of young graduates) are available, then survey questionnaires should be distributed to collect relevant data.

Furthermore, the probability distribution of the involved factors should be specified as a requirement of MCS. If the factors have a large sample of data, then statistics can be used to find the probability distribution that best fits the existing data. Otherwise, a reasonable assumption of the probability distribution should be provided based on other studies and existing practices. Moreover, interviews with relevant experts can limit inaccurate assumptions. As a result of this step, relevant data specified by the probability distribution should be ready for the further MCS.

2.2. Conduct MCS to Determine the Relationship between Financing Structure and the Successful Probability

According to Equation (2) and the results of Step 1, a *K* value specified using MCS can calculate the successful probability of the preset financing structure, which obtains the IRR baseline. The algorithm of MCS based on the work of Yuan *et al.* [43] is shown in Figure 2.
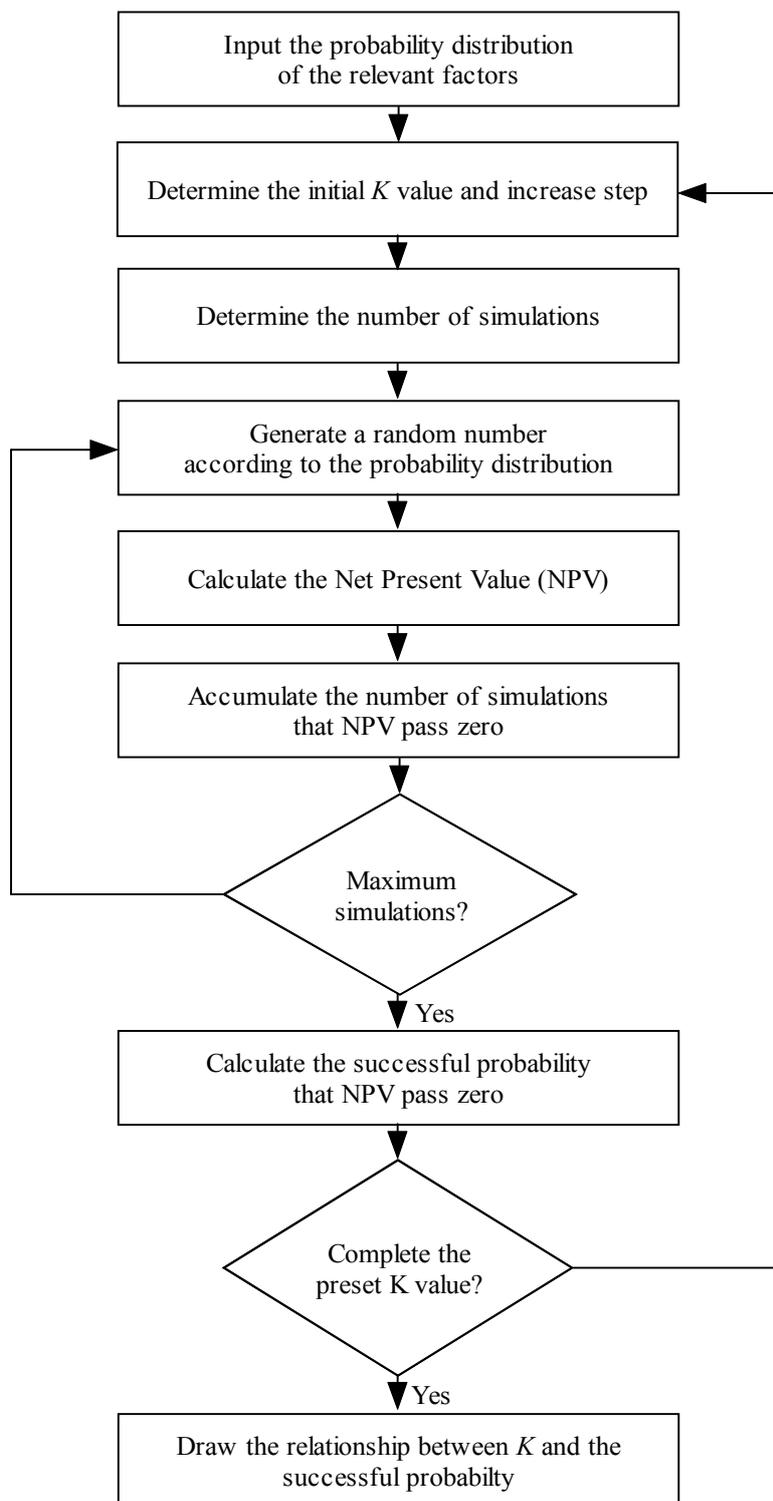
Figure 2. The algorithm for the Monte Carlo Simulation (MCS) in this research.

The *K* value varies from 0 to 1, and the increment can be determined by the decision maker; a small increment results in a fine-tuned relational curve. Likewise, the number of simulations is determined by the decision maker. Having few simulations will result in convergence through MCS, which implies that MCS is ineffective [44]. According to common practice, 10,000 simulations are enough to produce an effective MCS. This means that for each preset *K* value, there would be 10,000 simulations. In each simulation, the variables, except for *K* and *t*, in Equation (2) would be assigned a random value according to its probability distribution. NPV was calculated with these values according to Equation (2). Furthermore, for each *K* value, the percentage that NPV passes zero during the 10,000 simulations would be calculated as successful probability. The successful probability represents the probability that the private investor obtains the expected return rate under the preset financing structure by considering the risk and uncertainties in future. The relationship between *K* and the corresponding successful probability can be generated through the described simulations. Matlab© was used to develop a program that automatically implements MCS and draw the relationship curve between *K* and the successful probability. Consequently, a relationship curve is obtained for further decision-making.

2.3. Step 3 Decision Making Based on the Pre-Set Rules

As a criterion for decision-making, a confidence level should be established. Such level usually depends on personal characteristics. If a decision maker is risk-averse, the confidence level should be high; otherwise, the confidence level should be as low as possible. According to the relationship curve, all financing structures with successful probabilities over the confidence level are accepted. The determined financing structure scope provides a bargaining space for the government and the private investor.
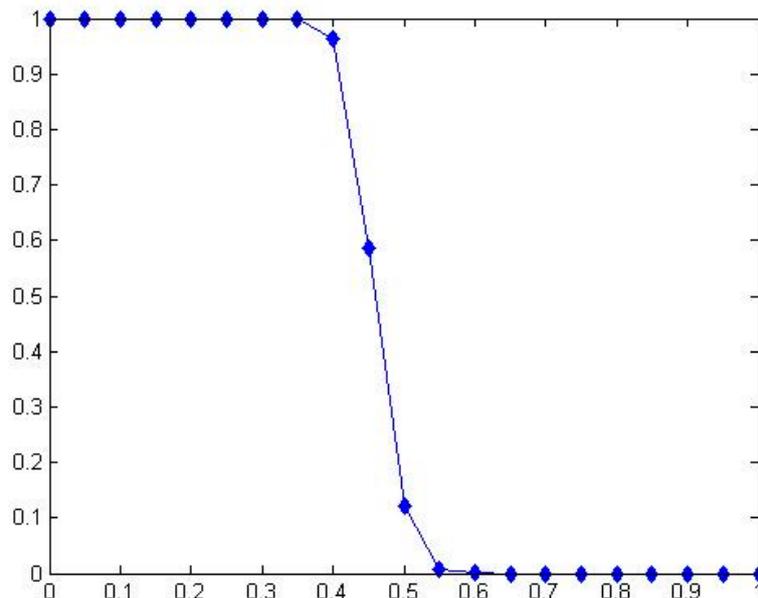
3. Semi-Hypothetical Case Study

A case study was conducted in Hangzhou. However, given that no young-graduate apartments were implemented in the city during the period of the study, a random questionnaire-based survey was conducted to obtain relevant information from November to December 2013. The target population is the young graduates working in Xiasha Higher Education Park, Hangzhou City. After a systematic training, the volunteers distributed the questionnaires to the interviewees working in the randomly selected companies in Xiasha Higher Education Park. After a simple introduction of the survey, the interviewees were firstly asked about their background information including education, age, monthly income, and disposable monthly income. Furthermore, the interviewees were invited to describe their preferences of the young-graduate apartments including the room area and the monthly rent. After excluding the questionnaires with incomplete answers, a total of 530 valid questionnaires were received. In terms of monthly income, about 31.1% of the respondents earned less than RMB 3000 yuan, 36.8% earned RMB 3000 yuan to 5000 yuan, 17.8% earned RMB 5000 yuan to 8000 yuan, and only 14.3% earned more than RMB 8000 yuan. Moreover, 90.2% of the respondents reported a disposable income below RMB 3000 yuan. The ideal monthly average rent for young graduates is RMB 1012 yuan, with a median of RMB 900 yuan and a standard deviation of RMB 739 yuan. Provided that the rental is proportionate to the room area, the ideal size of public rental housing ranges from 16 m^2 to 20 m^2. Approximately 70% of the respondents chose this interval.

According to the survey, the PPP-based young-graduate apartment project was assumed as a complex with an area of 50,000 m^2, which will be constructed along Metro Line One in Xiasha Higher Education Park, Hangzhou City, Zhejiang Province. The PPP public rental housing complex includes 45,000 m^2 of single apartments with gross floor area of 25 m^2. A total of 1800 apartments (with separate toilets), 2000 m^2 of public space (e.g., drawing rooms, table tennis rooms, and reading rooms), 2000 m^2 of supporting commercial facilities (e.g., fast food restaurants and laundries), and 1000 m^2 of management space (e.g., security rooms) comprise the entire complex. The target tenants are unmarried, new graduates, whereas the apartment occupancy rate is approximately 85%. The concession period is 30 years (which is the maximum concession period according to Chinese law) that include one year of construction and 29 years of operation. The public rental housing is about 30 min away from downtown Hangzhou City by public transit.

Construction cost is required to estimate other expenses, such as land cost, preliminary project cost, installation cost, and public facilities cost. Appropriate estimation methods were performed to calculate the management fees, reserve funds, and financial costs, and then the data are consolidated to form the total construction cost [19]. Land cost is estimated through market comparison, in which the transfer prices of recently sold lands that are similar. Three adjacent plots surrounding the proposed public rental housing are selected: Plot 45, 46, and 47 in Xiasha, Hangzhou. According to the price average of the three plots, the estimated land cost for the public rental housing (floor price) is approximately RMB 10,157 yuan/m^2. Construction cost can be jointly evaluated by unit project cost and engineering quantity. Detailed information on the cost estimation is summarized in Table A1. The construction cost is assumed to be fixed given that the construction stage is supposed to be completed in one year. The operational cost and income of the young-graduate apartments were estimated according to the project design and market operation. The growth rate of the involved cost and income were set based on the professional view of the housing market experts. In order to keep the paper concise and informative, the detailed estimation was present in the Appendix.

Based on the preceding assumptions, MCS was conducted to draw the relationship between financing structure (from 0 to 1 and with increments of 0.05 as data points) and the successful probability. The program that runs the algorithm set in the research methodology was developed in Matlab$^{\copyright}$. Setting the number of simulations to 10,000, the confidence level to 0.85, the investment return rate to 10%, and the concession period to 30 years, we obtain the relationship between financing structure and the successful probability (Figure 3).

The method developed in this research is useful in determining an appropriate financing structure. As shown in Figure 3, a private company can definitely secure its profits if the private financing structure is below 0.35. Nevertheless, the Chinese government would not agree to such a financing structure, because it would have to bear most of the risks, and thus, little financial burden can be solved in such a condition. Conversely, projects with financing structures above 0.6 are not preferred by private companies because the probability of successfully gaining profits is nearly zero. Therefore, the bargaining interval of the financing structure for private companies and the government ranges from 0.35 to 0.6, which depends on the confidence level (particularly the risk acceptance level) of a private company. Thus, the suitable financing structure is the arrangement in which the successful probability exceeds the confidence level. Using this principle, we find that the suitable financing structure for this case study is 0.4.

Figure 3. The relationship between the financing structure and successful probability in the case study.

4. Model Validation

The model was demonstrated using a semi-hypothetical case study, as only a few PPP-based young-graduate apartments have been developed. Interviews with experts validated the developed model and ensured its applicability. These experts include scholars and government officials specializing in affordable housing and PPP.

Expert interview was conducted in May 2014. Selection of the interviewees depended on two criteria. First, the experts have professional knowledge of affordable housing and PPP. Second, the experts have certain knowledge of MCS and relevant simulation techniques. Five experts were finally identified from friends of the research team. The developed model was presented to the five experts. As shown in Table 2, these experts were qualified to comment on the model. The experts were acquainted with the development process, and the semi-hypothetical case study, and were then asked several questions concerning its usage, benefits, and shortcomings. The first question asked whether the model was understandable (including the objectives, assumptions, activities, and processes). An expert who could not follow the presented logic implies the failure of the model to meet the key performance objective. Subsequently, the experts were asked on the application of the model in determining the financing structure in practice. The third question asked the experts whether the model was better than their experiences. Finally, the experts were asked to identify the advantages and disadvantages of the use of the proposed model.

Overall, the experts had positive impressions on the developed model. All the experts affirmed that they understood the model. The logic flow was clear, and the semi-hypothetical case study was reasonable. The experts agreed that the model provided specific guidelines to determine the financing structure of PPP-based young-graduate apartments. As the practice mostly depends on the bargaining power of each party, most experts thought that it was an improvement over existing practices.

Although the model is well-designed, potential problems may arise in its implementation, given the difficulty of identifying the probability distribution of relevant factors owing to the insufficient data for

decision making. This limitation, however, is somehow offset by the fact that in reality, decisions usually depend on some reasonable assumptions or forecasts. Reasonable assumptions on the probability distribution, such as in the semi-hypothetical case study, can be provided to use this model and obtain results for reference.

Table 2. Background information of the interviewees in model validation.

Interviewee	Work Unit	Years of Relevant Work Experience	Education Level	Major Responsibility	Time	Venue
Int 1	University	15	Ph.D.	Research in affordable housing	13 May 2014	office
Int 2	University	8	Ph.D.	Research in PPP	13 May 2014	office
Int 3	University	4	Ph.D.	Research in affordable housing	13 May 2014	office
Int 4	Government departments	6	Ph.D.	Attracting investment	14 May 2014	office
Int 5	Government departments	10	Master	Policy-making of affordable housing	14 May 2014	office

Source: from interviews.

Experts consider the model to be a beneficial decision tool. Using this model, both the private investor and the government can identify their preferred financing structure based on the collected information and confidence level under the table. The corresponding results may be used as the parties' bottom line for bargaining, which would make the bargain process considerably easier than when it is performed without any reference.

5. Conclusions

The housing problem of young ant-tribe graduates is a social concern, for which PPP has been presented as a suggested solution. Nevertheless, few approaches have been developed to determine the financing structure, specifically the investment ratio of private investors in PPP projects. A private company is usually reluctant to invest if the ratio is exceedingly high, which means that the company has to bear most of the uncertainties and risks. Similarly, the government would reject PPP if the ratio is too low, which implies that the program is still led by the government. This research introduces a robust, logical process for identifying the financing structure of PPP-based young-graduate apartments through the use of NPV and MCS. The case study shows that this model is effective as designed.

Both government and private companies who aim to develop PPP-based young-graduate apartments can use this model to identify the appropriate financing structure according to their own confidence level. The overlap in the financing structure can be used by both public and private companies to bargain and reach a consensus. Based on this research, future studies can formulate a comprehensive policy framework for the development of PPP-based young-graduate apartments.

Acknowledgments

Author Contributions

The individual contribution and responsibilities of the authors are listed as follows: Yelin Xu designed the research, collected the data, and analyzed the data; Yi Peng developed the model, conducted model validation and wrote the paper; Queena K. Qian revised the manuscript; Albert P. C. Chan gave some comments and helped edit the manuscript. All authors reviewed and approved the final manuscript.

Appendix: Cost and Income Estimation in This Study

Construction cost (investment): includes land cost, preliminary project cost, installation cost, and public facilities cost. The construction cost was estimated according to the research conducted by Xu *et al.* [19] (2012) and the market operation when conducted this research. The details of the estimation can be found in Table A1.

Operational cost: refers to the day-to-day expenses incurred in operating public rental housing. This cost includes the maintenance cost, the wages of the janitorial services and security staff, other expenses incurred (e.g., costs for elevators and the replacement of water and electrical appliances in public areas), and taxes. The operation cost is estimated as follows:

(1) The housing maintenance cost is about 20,000 yuan per year, with an annual growth of 10%. The growth rate is assumed to follow normal distribution, with a mean value of 10% and a variance of 5%.

(2) Public rental housing requires four security personnel (2500 yuan/month/person) and six cleaning staff members (1800 yuan/month/person), with an annual growth of about 5%. The growth rate is assumed to follow normal distribution, with a mean value of 5% and a variance of 3%.

(3) The operating cost of the four elevators is 48,000 yuan per year, and the cost for water and electrical appliance replacement is 2000 yuan per year, with an annual growth of 5%. The growth rate is assumed to follow normal distribution with a mean value of 5% and a variance of 3%.

(4) Business tax and surcharges are incorporated in the operating cost according to 5.5% of the business revenue. The tax rate is assumed to be fixed, considering that China may maintain such a rate to promote market economy.

Operational income: includes rentals of public rental housing and ancillary housing for business purposes, which was estimated as follows:

(1) Income from rentals of public rental housing = 1800 apartments × 1012 yuan/apartment/month × 12 months × 85% = 18,580,320 per year. The growth rate is assumed to follow normal distribution with a mean value of 6% and a variance of 3%.

(2) Income from rentals of ancillary housing for business purposes is equal to 200,000 yuan per year. The growth rate is assumed to follow normal distribution with a mean value of 6% and a variance of 3%.

Table A1. Estimation of total construction investment.

No.	Items	Definition	Cost
1	Land cost	● Land cost refers to the land transfer fees paid by land users to the government to obtain land use rights for a certain period. ● For the construction of public rental housing projects, the government supplies land by allocation (*i.e.*, supply of land for free). Therefore, the land cost can be considered governmental investment in PPP public rental housing projects for calculating financing structure.	10,157 Yuan/m^2 × 50,000 m^2 = 507.85 million Yuan
2	Preliminary project cost	● Preliminary project cost consists of two parts. The first part mainly includes project planning and design cost (geological exploration cost, planning and design cost, shop drawing design cost, and feasibility study cost). The second part refers to the cost of access to water and electricity at the construction site, the construction of construction roads, and site leveling.	5 million Yuan +10 million Yuan = 15 million Yuan
3	Construction and installation cost	● Construction and installation cost refers to the cost directly used for the construction of public rental housing, including construction cost, equipment cost, and installation cost (water supply and drainage, electrical lighting, weak current, elevators, gas pipeline, fire fighting, and lightning prevention). ● Construction and installation cost is estimated by unit project investment estimation, namely, by multiplying the cost of unit quantity by the total quantity.	1600 Yuan/m^2 × 50,000 m^2 = 80 million Yuan
4	Public facilities cost	● Public facilities cost includes infrastructure cost and public facilities cost. ● The infrastructure cost is also called the planning red-line project cost, including those of water supply (pumping stations and water pressure), power supply (distribution cabinets), gas pipelines, roads, landscaping, sewage, drainage, telecommunications, and sanitation. It is usually calculated by unit index estimation. ● Public facilities cost mainly includes expenditure for public facilities in communities that cannot be transferred by compensation, such as the cost of civil air defense works.	220 Yuan/m^2 × 50,000 m^2 = 110 million Yuan 1800 Yuan/m^2 × 2500 + 80 Yuan/m^2 × 50,000 = 8.5 million Yuan
5	Management fees	● Management fees include the owner's management fees and supervision fees paid by the owner to the supervision unit.	100 Yuan/m^2 × 50,000= 5 million Yuan
6	Reserve fund	● The reserve fund includes the basic reserve fund and price contingencies. The basic reserve fund refers to project cost that is difficult to predict in the preliminary design and budget. Price contingencies refer to the reserve fund for changes in project cost caused by price change during project construction. These changes include labor cost, equipment, materials, construction machinery spread, rate, exchange rate, and other adjustments.	100 × 50,000 =5 million Yuan
7	Financial cost	● Interest on bank loans: [(1) + (2) + (3) + (4) + (5) + (6)] × 0.5 × 0.7 × 6.32%	13.9875 million Yuan
	Total investment cost		646.3375 million Yuan

Conflicts of Interest

The authors declare no conflict of interest.

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