

Article

# Farmers' Intentions to Lease Forestland: Evidence from Rural China

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**Abstract:** In the last decade, despite considerable research developed for the forestland leasing market, little has been published in terms of econometric results on determinants of intentions and behaviors of Chinese farmers. With respect to leasing forestland, this study uses a Bayesian logit model to examine the factors that influence farmers' intentions, using household data collected in one county in 2017. The results show that farmers' past experience of leasing forestlands have significant impacts on their leasing intentions. Once farmers participated in leasing in or leasing out forestland in the last five years, it was shown that they will have stronger intentions of doing so in the future. Farmers will neither lease in or out forestland if the leasing profits are less than the profits originated from forestland management. As such, household head age, household population, proportion of income from nonfarm sources to total income, and security of rights to forestland use are significant factors in influencing farmers' decisions on leasing in forestland. On the other hand, household head age and educational level, proportion of income from nonfarm sources to total income, and importance of forestland in terms of inheritance are significant factors in influencing farmers' decisions on leasing it out. Results imply that institutional and market factors, which have impacts on transaction costs, are important for farmers in making decisions on forestland leases. Policy implications to reduce institutional intervention are discussed.

**Keywords:** land lease market; decision making; forest market factors; rural land rights; China

## 1. Introduction

Since the early 1980s, a series of economic reforms have been launched in China, as well as a number of market-driven mechanisms that have been implemented to improve resource allocation efficiency and productivity—partly designed to promote the development of the land rental market [1–6]. Market-based mechanisms are thought to be able to play an important role in improving the use of input factors and the economies of scale for land management [7–9]. Due to constitutional provisions of land property rights, rural land is collectively owned and managed. In the process of de-collectivization of rural land, collective ownership is not allowed to be changed and use rights of rural land is contracted to the member of the collective, i.e., the farmer, for a period ranging from 30 to 70 years [10]. The rural land market in China is substantially a land lease market with limited usage rights circulated within the market. In this market, leasing in forestland is equivalent as buying forestland usage rights and leasing out is equal to selling it outright. Farmers' intentions of leasing land therefore play a dominant role on the development of the market—forming the basis for this study.

While forestland accounts for more than two thirds of the rural landscapes in southern China, forestland lease markets have received little research attention compared to the considerable amount of attention farmland markets garner [9,11]. This is probably due in part to the fact that reforms in

farmland tenure occurred before forestland tenure. The farmland tenure reform was initiated in 1978 by creating a Household Contract Responsibility System and granting usage rights of farmland to farm households [4]. Following farmland tenure reform, the initial collective forestland tenure reform in 1981 aimed to distribute forestland to individual households and fix three issues pertaining to collective forest tenure, that being: (1) clarification of rights to the forest (i.e., for family plots), (2) delimitation of boundaries of private plots (i.e., responsibility hills), and (3) establishing a forest responsibility system (i.e., collective management system) [10,12–14]. However, the reform was terminated by the central government in 1987 since it was widely believed that large scaled deforestation was taking place as a result [13]. Therefore, before a new round of collective forest tenure reforms would be undertaken in China in 2003 [15], most collective forestlands were collectively managed until 1987. This caused inefficiency to the forest management system resulting in collective forests having a lack of professionals and an inequity of farmers benefitting from the harvest.

These new reforms are regarded as a de-collectivization step [12], aimed at promoting efficiency and equity of the whole collective forest management system. Rural households are granted forestland usage rights through clarification and confirmation of property rights of forests and forestland. It is widely held that farmers have the motivation to enhance forest investment and management when they are convinced greater incentives and security exist in terms of its use in relation to forestland rights. Together with favorable policies, it has been observed that reducing production costs and enhancing profitability of forest production are aftereffects [13,15]. The reforms are still ongoing, with a goal to make forest management more profitable for farmers by eliminating any existing institutional barriers, such as the difficulty for farmers to obtain a loan by mortgaging the usage right of forestland and ownership of stumpages.

More recently, a few studies were undertaken to investigate China's forestland lease market with specific focuses on fundamental issues of development of the forest market (e.g., Kong and Du [16], Nie [17], and Xie et al. [11]). Kong and Du [16] examined whether farmers had the right to participate in the forestland lease market, particularly the right to lease out forestland use rights. They found that transferability of farmers' land was secured by current land tenure system and farmers were free to decide whether to participate in the market or not. Nie [17] found that current market mechanisms lacked efficiency. That is, there were high transaction costs for seeking lease information and contracting agreements. The market prices for leasing forestland were not transparent and farmers had inadequate knowledge about their forestland value, therefore, suffering in terms of economic loss when leasing out forestland at a low price. Xie et al. [11] examined profitability of farmer leasing out forestlands in the market compared to timber benefit by way of self-management. The study showed that, due to the limitation of China's logging quota system, farmers were unable to harvest all mature stands, hence, their timber benefits were lower than the land rent.

The incidence of leased forestland transactions seems much higher than that of farmland [18]. This is explained by several econometric studies at the farm household level. Xu et al. [9] examined forestland transactions, their scope and motivation, and the characteristics of households participating in the market for forestland in eight villages of Lin'An and Anji counties located in Zhejiang Province. Using household survey data collected from 2009, they found that households in Anji were more likely to lease out land and less likely to lease in than households in Lin'An. The age of the household head, social status of the household head (i.e., whether they were a village leader or not), population size, and number of laborers in the household did not seem to have much explanatory power in farmers' decisions to lease in or lease out forestland. The educational level of household heads was not statistically significant for leasing in behaviors but was slightly significant for leasing out. If there were any household member hired by a business or the government, the household would be more likely to lease out forestland. The most apparent and significant factors for a household's likelihood to participate in land leases were household income and ratio of non-agricultural income. It also was apparent the number of parcels of land households owned affected their decisions. The satisfaction with the transaction price was statistically significant in the lease in and lease out model.

Xu et al. [19] reviewed recent econometric studies about factors affecting farmers' decisions to lease land with a focus on research characteristics, including: analytical framework, regression techniques, data features, and findings. Their synthesis of existing literature indicates that a similar analytical framework is employed by different researchers. It confirms four categories of lease determinants: demographic characteristics, policy variables, forestland conditions, and economic variables. These determinants have been widely discussed in terms of farmers' decision making related to forest management [20]. Demographic characteristics are most frequently used by researchers and can be observed in all cited research, while regression coefficients of demographic characteristics and relating variables are not statistically significant. Policy variables consist of farmers' evaluation of the reform, logging quota system, and regulation of the forestland market. Economic variables include forest management costs and revenue. In addition, all research isolates, to some degree, farmers' leasing in and leasing out behaviors by employing two separate models. Similar research findings of factors affecting farmers' participation in forestland transactions have been examined by Hong et al. [21]. Zhang et al. [22] highlighted the effect of off-farm employment on forestland transfers in China using a simultaneous-equation Tobit model estimation verified that off-farm employment is endogenous to farmer' decision to lease their forestland.

On a global-scale, forestland markets signal a large body of literature from countries that exhibit a sound market economy. In parallel, there are increasing studies from other countries experiencing this transition, i.e., from a centralized market to an open market economy, that also indicate this trend [23–25]. Driving forces of forestland markets, such as forestland prices, physical characteristics of the forestland, and buyer perception and intentions, are major research focuses conducted in the countries with sound market economies [26–31]. Comparatively, studies in countries that are going through a transformative state, indicate the emergence of forestland markets and overlook impacts from institutional reform and related remodeling efforts. Though forestland markets are still underdeveloped, forest plantation farm households have started to rent in forestland from familiar local farmers with government support via cost-sharing in Vietnam [32]. As such, governmental support has promoted development of forestland markets in Uganda [33] and Ethiopia [34,35]; however, land speculation is active in both countries and requires further procurement controls. In Romania, large areas of forestland have shifted from public to private ownership [36], promoting forestland market competition [37,38]. Along with the furthering of market-oriented economic development, forestland markets in these countries will need to embrace significant reforms that better understand the varying actors and perceptive roles that support local livelihoods—via subsistence, commercial, and ecological contributions [25].

The objective of this study is to bridge an understanding on farmer' past lease experience and future lease intentions, and then provide references for a predictive element for the development of the future of the forestland lease market. Individuals' past experience has been recognized as a significant influence on their behavior in several studies, e.g., investigating leisure choice [39] and recycling behaviors [40,41]. Past experience has also been regarded as the best predictor of conservation behavior [42]; however, there are limited studies specific to the forestland lease market. As such, farmers performing as dominant actors, in leasing forestland usage rights, focalized on their leasing intentions formulates the practicality and significance of this study. The incorporation of this research with existing studies (i.e., investigating development of the forestland market based on studies of farmers' lease behaviors [19,21,22]) presents a more complete approach in predictive development of the forestland lease market in China. A conceptual model and econometric approach are presented in Section 2. Data collection and descriptive statistics are provided in Section 3. At length, empirical results are illustrated in Section 4, followed by a discussion and conclusion in Section 5.

## 2. Model Design

The derived conceptual model investigates farmers' intentions of leasing forestland. The conceptual model consists of key factors that affect intention and factor in aspects of decision making and economic

viability. Specific empirical specifications, in terms of corresponding variable selection, are integrated and estimated in the model for robustness.

### 2.1. Conceptual Model

We applied a profit-maximization function by utilizing an approach presented by Johansson and Lofgren [43]. The intended examination of leasing forestland, by representative households as well as identifying factors that affect farmers' decisions on leasing, is a core focus of the model. Our interest is focalized on farmers' land leasing decisions in which the conceptual model considers decision-based variables, that being: lease in only, lease out only, both lease in and lease out, and neither lease in or lease out. As such, in reference to a number of studies [15,44] and fieldwork observations, farmers in developing countries also tend to pay little or no attention to the amenity value of forests, hence, we isolated the physical value of the forest and timber yield of forestland in our model. In comparison to other models (i.e., specifically investigating forestland markets in China [22]), our model differs, respectively, in the decomposition of timber profit into terms of revenue and cost. The conceptual model, as representative of households, is assumed to maximize the profit from timber production, as formulated via Equation (1).

$$\begin{aligned} \max \pi &= \pi(A_0, A_b, A_s; Z, L, I) \\ &= R(A_0, A_b, A_s; Z, L, I) - C_t(A_0, A_b, A_s; Z, L, I) - C_b(A_b; Z, L, I) + \pi_s(A_s; Z, L, I) \end{aligned} \quad (1)$$

where:  $R(\cdot)$  is a revenue function of timber production;  $C_t(\cdot)$  is a function to measure cost in planting, managing, and harvesting forest;  $C_b(\cdot)$  is a cost function for leasing in forestland; and  $\pi_s(\cdot)$  is a profit function for leasing out forestland. Moreover,  $A_0$  is a vector of the characteristics of forestland area currently held by one household,  $A_b$  is a vector of the characteristics of forestland leased in, and  $A_s$  is a vector of the characteristics of forestland leased out. In terms of decision-based variables, if a farmer is grouped in lease in only,  $A_b$  is kept and  $A_s$  is removed. If a farmer is grouped in lease out only,  $A_b$  is removed and  $A_s$  is kept. If a farmer is grouped in both lease in and lease out, both  $A_b$  and  $A_s$  are kept. If a farmer is grouped in neither lease in or lease out, both  $A_b$  and  $A_s$  are removed.  $Z$  is a vector of the characteristics of a household, including household head (i.e., denoted as HHC) and household (i.e., denoted as HC).  $L$  is a vector of the characteristics of past leasing experiences of the household.  $I$  is a vector of the characteristics of perceived institutional impacts from the household in terms of the collective forest tenure reform.

Let  $A_b^*$  and  $A_s^*$  denote the optimal decision to lease in and lease out forestland behaviors, respectively. If the farmers are grouped in lease in only, the profit function can be written as  $\pi(A_0, A_b^*; Z)$ , and satisfies the following notation in terms of Equations (2)–(4).

$$\pi(A_0, A_b^*; Z, L, I) \geq \pi(A_0; Z, L, I) \quad (2)$$

$$\pi(A_0, A_b^*; Z, L, I) \geq \pi(A_0, A_s^*; Z, L, I) \quad (3)$$

$$\pi(A_0, A_b^*; Z, L, I) \geq \pi(A_0, A_b^*, A_s^*; Z, L, I) \quad (4)$$

where:  $\pi(A_0; Z, L, I)$  is the profit function for keeping the current management scale,  $\pi(A_0, A_s^*; Z, L, I)$  is the profit function for only leasing out forestland, and  $\pi(A_0, A_b^*, A_s^*; Z, L, I)$  is the profit function for both leasing in and leasing out forestland.

Equation (2) suggests that the farmers' decisions to lease in forestland depends on the following attributes: whether it is currently held, characteristics of the household, timber production costs, cost of leasing in, past leasing experiences, and perceived institutional impact. Equation (3) can be used to provide additional interpretation for leasing in forestland, compared to Equation (2), i.e., the decision to lease in depends on the profit margin of leasing out. Equation (4) can be interpreted similarly to

Equation (2) and Equation (3) with further integrated interpretation from both of these equations. Furthermore, the probability of the decisions grouped in as lease in only is written using Equation (5).

$$P(\pi = \pi(A_0, A_b^*; Z, L, I)) = g(A_0; Z, L, I) \quad (5)$$

where:  $g(\cdot)$  is a probability function which denotes that the probability to be grouped in the lease in only function which has been originally held forestland and characteristics of the household head and household having impacts on cost of timber production and forestland lease in and profit from forestland lease out.

These factors are employed to indicate how the heterogeneity of farmers' characteristics vary in terms of revenue, cost, and profit in timber production as well as farmers' participation in the forestland market. We enumerate the farmers' decisions on land rental using the following number classes: 1 = lease in only, 2 = lease out only, 3 = both lease in and lease out, and 4 = neither lease in or lease out. The number classes are used to differentiate the four groups without any implication that one group would be superior or inferior to another. Hence, the four groups are depicted using Equation (6).

$$P(y = i) = g(A_0, HHC, HC, L, I) \quad (6)$$

where:  $y$  denotes the group of the farmer, and  $i$  is valued 1, 2, 3, or 4.

## 2.2. Empirical Model Specification

We specified our empirical model specifications upon the conceptual model of framing and existing literature to measure the factors that affect farmers' intentions of leasing forestland (Table 1).

**Table 1.** Variables selections and assumed impacts.

Factor	Variable	Assumed impact	References
Heterogeneity of forestland	Forestland area ( <i>area</i> )	Ambiguous impact	[22,45–47]
	Forestland as inherited ( <i>inherited</i> )	Negative impact both on leasing in and leasing out	[22,47]
Characteristics of the household head	Age of the head ( <i>age</i> )	Ambiguous impact	[11,18,19,45–48]
	Educational level of the head ( <i>education</i> )	Ambiguous impact	[18,46,47]
Characteristics of household	Number of laborers in a family ( <i>labor</i> )	Positive impact on leasing in and negative impact on leasing out	[45–47]
	Nonfarm income ( <i>nonfarm</i> )	Ambiguous impact on leasing in and positive impact on leasing out	[45,47,49]
Institutional factor	Security of forestland usage rights ( <i>security</i> )	Positive impact	[13,44,50]
	Whether leased in ( <i>wea_in</i> )	Positive impact	[40–42]
	Whether leased out ( <i>wea_out</i> )	Positive impact	[40–42]
Past experiences of leasing forestlands	Difficulty in leasing in ( <i>easy_in</i> )	Positive impact	[45]
	Difficulty in leasing out ( <i>easy_out</i> )	Positive impact	[45]
	Whether leased in profitable ( <i>profit_in</i> )	Positive impact	[22]
	Whether leased out profitable ( <i>profit_out</i> )	Positive impact	[22]

We used two variables to denote heterogeneity of forestlands based on the reviewed literature. The first variable is forestland area (i.e., denoted as *area*) was used to describe the forestland held and



managed by each household. We assumed that forestland area has an ambiguous impact on farmers' intentions to lease forestland—as such—existing studies reveal competing results from the impacts of forestland area [22,45–47]. The second variable is whether farmers treat forestland as inherited (i.e., denoted as inherited). Once farmers treated forestland as inherited, they usually become less active in forest management [20]. Similarly, these farmers have appeared to be inactive in the leasing of forestland—per se [47]. We, therefore, assume farmers' treatment of forestland as inherited as a negative impact both on their intention of leasing in and leasing out the land.

We employed two variables to denote the characteristics for the household head (i.e., HHC). First, we assume that the impact of the age of the household head (i.e., denoted as age) on leasing in and leasing out of forestland is ambiguous. The age of the household head had been found to have a negative impact both on leasing in [45] and leasing out of forestland [47,48]; however, some studies contested that age had no influence on forestland lease in [16] or lease out behavior [11,19,46]. Second, we assume the educational level of the household head is ambiguous (i.e., denoted as education) due to the majority of previous studies that concluded the effect as not significant [29,31,46] with a few studies showing a positive effect [18].

Household characteristics variables (i.e., HC) include the number of laborers in a family unit (i.e., denoted as labor) and income from nonfarm work (i.e., denoted as nonfarm). The more labor force a household had, the more likely the household would lease in forestland [45,46] and the less likely they were to lease it out [47]. Farmers can get nonfarm income not only by working for others (i.e., a wage income), but also from doing additional business dealings. Nonfarm income is measured by aggregating wage income and business income. A higher nonfarm income implies that the return on aggregate labor and capital input in nonfarm activities as well as opportunity costs of working in forestry is high. We assumed that nonfarm income has a positive impact on leasing out forestland [30,32]; however, the impact of nonfarm income on leasing in forestland was ambiguous since contradicting results exist from previous studies [45,47,49].

Only one institutional variable was used by incorporating security of forestland usage rights (i.e., denoted as security). Previous studies show that insecurity of land property rights resulted in a lack of incentive for farmers to intensify forest investment and expand forest management scale [13,44,50]. Though it can be noted that there are policy incentives for forestland leasing in other areas of China, for example in Zhejiang Province [45], we did not find any such policies in our study area.

Regarding impact of past experience of leasing forestlands, we employed three variables as indicators. The first variable is whether farmers leased in (i.e., denoted as wea\_in) or leased out forestlands (i.e., denoted as wea\_out) in the past five years. Intuitively, farmers who have experiences in leasing forestlands might have a better understanding on how to lease forestland, which could cause variability in intentions between farmers with experience versus not. In order to capture a more detailed impact from past experience, we employed a second variable of whether farmers had difficulty in leasing in (i.e., denoted as easy\_in) or leasing out (i.e., denoted as easy\_out) forest land in the past five years. We assumed that farmers with such difficulty might have less intention of leasing forestland in the future. It has been proved, however, that once transaction costs of leasing forestlands are lowered, the leasing effect becomes more active [45]. A third variable was assigned to whether forestland lease in or lease out profitable existed (i.e., denoted as profit\_in and profit\_out), respectively. The third variable assumed to have a similar impact as the second variable on farmers' leasing intention. The timber price was used as a proxy variable to measure farmers' profit of lease from forestland. When timber prices rose, lease in became more active. Conversely, once timber price lower, lease out became more active—according to Zhang et al. [22].

Noticeably, very few farmers both leased in and leased out forestlands in our observation. Therefore, we specified our focus on farmers' intention of either leasing in or leasing out by utilizing the following two equations (i.e., Equations (7) and (8)) to formulate our reduced empirical models.

$$P(y = 1) = f\left(\begin{array}{c} \text{area, inherited, age, education, labor, non farm,} \\ \text{security, wea\_in, easy\_in, profit\_in} \end{array}\right) \quad (7)$$

$$P(y = 2) = f\left(\begin{array}{c} \text{area, inherited, age, education, labor, non farm,} \\ \text{security, wea\_out, easy\_out, profit\_out} \end{array}\right) \quad (8)$$

Equation (7) is a lease in model where  $y$  is equal to 1 and Equation (8) is a lease out model where  $y$  is equal to 2.

### 2.3. Model Estimation

The specified models were estimated by adopting Bayesian logit regression models in which farmers' responded intention of leasing in or leasing out forestlands were the dependent variables. In the models, farmers who had answered "Yes" indicating that they have intentions of leasing in or leasing out forestland was coded as one. Merged responses of "No" and "I don't know" were placed into a single category and coded as zero by following Sanchez and Morchio's [51] and Groothuis and Whitehead's [52] analyses. Bayesian methods can randomly sample and estimate individual-specific parameters [53] as well as consider model uncertainty by taking into account various combination of models to minimize the subjective judgment [54]. Bayesian analyses provide a robust estimation approach by using not only the data but also existing know-how about model parameters. They also allow one to introduce stochastic conditions in the posterior distribution of parameters to address estimation challenges in the empirical model (e.g., excessive multi-collinearity among explanatory variables as described by Hair et al. [55], Western and Jackman [56], and Willis and Perlack [57]).

According to the Bayesian theorem [58], the posterior density of the parameters of the independent variable is proportional to the likelihood of reported knowledge given model parameters (i.e.,  $\beta$ ), and knowledge of the prior probability distribution. The prior distribution of  $\beta_j$  ( $j = 1, 2, 3, \dots, m$ ) where  $m$  is the number of independent variables was assumed to be normally distributed with  $\beta_j \sim N(\mu_j, \sigma_j^2)$  in respect to Congdon's [59] work. In this study,  $\mu_j$  was set to 0 and  $\sigma$  to 10,000. The random-walk Metropolis-Hastings sampling method, a default setting in the Bayesian calculation provided by Software Stata 15, was used to estimate the posterior distribution [60–62]. Metropolis-Hastings sampling is a general algorithm that releases the assumption in Gibbs sampling that proposed distributions are the posterior conditionals. Random-walk is the most commonly used Metropolis-Hastings algorithm when simulating candidate samples from a Gaussian proposal distribution that randomly perturbs the current state of the chain [63–65]. The coefficients of the explanatory variables were calculated by 10,000 iterations of the sampling based on the Monte Carlo errors with a burn-in of an initial 1,000 iterations [66].

## 3. Methodology

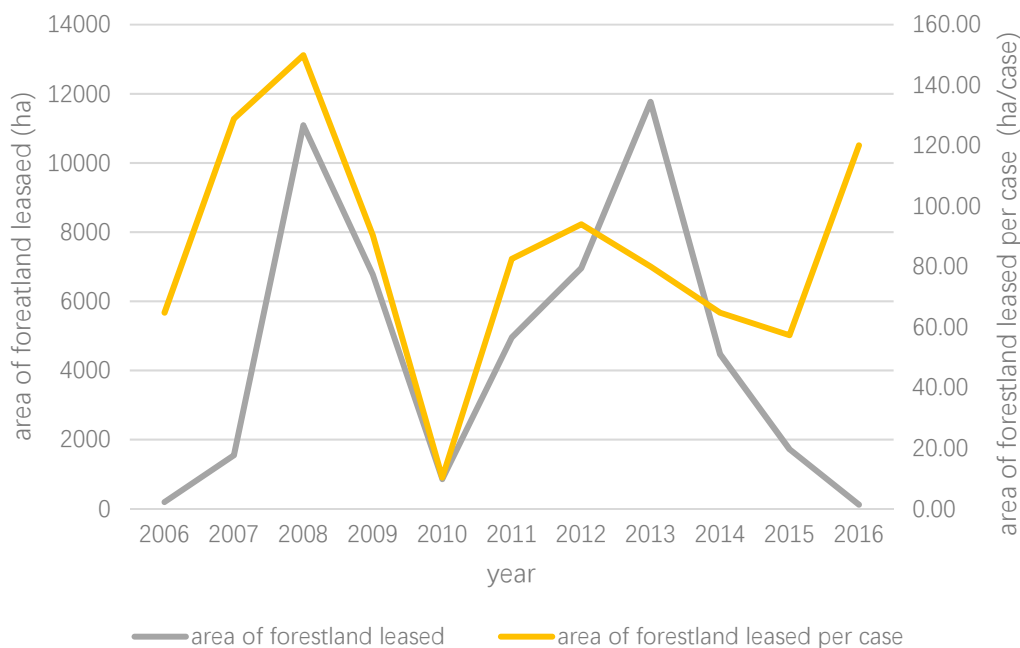
We define the study area where we conducted data collection at the farm household level. A description of the general characteristics of our data are also noted.

### 3.1. Study Area

We conducted data collection in Ningdu County of Jiangxi Province. Jiangxi was one of the four provinces to host pilot projects for the reforms implemented during the collective forest property rights restructuring in 2004 [15]. In consequence, Jiangxi was considered an ideal study area for the research especially since its implementation of collective forest tenure reform and subsequent emergence as a forestland market [11,15,67]. As one of the key forestry counties, Ningdu is ranked fourth in terms of acreage of forestland province-wide. The total forestland is estimated at around 300,000 hectares.

The forest coverage is high at 71.3%, which is 10% higher than the provincial average. Collective forestlands are 280,000 hectares, accounting for 93% of total forestlands while the rest are state-owned. The total standing forest stock is 9.7 million cubic meters. On average, each farmer owns 0.5 hectares of forestlands (i.e., more than 10 times 0.05 hectares of crop land from the county level). Forestlands are crucial resources to local households. As a result of the reform, more than 90% of collective forestlands usage rights and ownership were transferred to farm households. This process was regarded as de-collectivization of collective forestland, generating more secure and beneficial rights to use it at the farmer-level [12,13].

Forestland lease market emerged along with increasing transfer of usage rights of forestland from collective to individual farm households in Ningdu. This provided us with ample local-based evidence to form a sound understanding of development for the ongoing forestland market. The Ningdu Forestry Administration Bureau set up an agency providing services as policy consultation, forestland demand or supply information distribution, auction, bidding, and assistance of the contract signing. This universal practice facilitated development of the lease forestland market throughout Jiangxi Province [11]. The agency started to collect data of forestland leasing based on the transfers of contracts signed in-house from 2006. The data presents leased forestland with an area per case larger than 10 hectares (Figure 1). The data provided the general dynamics of the lease forestland market from 2006 to 2016—note that inadequate information of single cases of leased forestland with a scale of smaller than 10 hectares was not available.



**Figure 1.** Dynamics of leased forestland with areas per case larger than 10 hectares.

As noted in Figure 1, the lease forestland market fluctuated sharply during the period from 2006 to 2016. In isolation, from 2006 to 2008, the leased forestland continued to be more active and reached a summit of 11,091 hectares in 2008, while from 2008 to 2010, the leased forestland kept decreasing and reached a low of 857 hectares in 2010. Noticeably, China State Council announced that the collective forest tenure reform was to be implemented nationwide in 2008—at the same time the lease forestland price reached a summit in Ningdu County. From 2010 to 2013, the lease forestland market experienced recovery and rapid development and reached 11,766 hectares in 2013. We believe that the announcement released by the China State Forestry Administration that all necessary transfer of collective forestland from the collective to the individual farm households were to be completed in 2012 had a positive impact on the development of the lease forestland market. During this period,



China State Forestry endorsed a document encouraging forestland lease and scale management of forests. From 2013 to 2016, the forestland lease continued to decrease and reached a new low of 120.1 hectares in 2016. At this point, China State Council conducted a nationwide inspection on the finished transfer of usage rights of forestlands which aimed to resolve existing conflicts [68].

The fluctuation of leased forestland in our study area implied that the previous forestland leasing will have an impact on the current situation as well as significant impact on the future market. All leased forestland recorded by the agency were rented out by local farmers with similar statistics pointing to most of them being rented in as well. This initially implied that farmers' past experience with leasing forestland should have an impact on their future decision making.

### 3.2. Data Collection

A stratified sampling method was applied to selected interviewed households. Following the administrative system within the county, we selected seven townships from a total of 24 (i.e., one lower level than that of a county). These townships were distributed evenly regarding their geographic location. We randomly selected three villages from each township for a total of 21 sample villages. Next, we randomly selected 20 farm households from each village totaling 420 interviewed household representatives. Noting that a larger sample might provide more accurate results; however, due to financial and time constraints this hampered our time in the field and field-oriented resources.

The interviews were conducted in the selected villages at the end of 2017 when most household heads had returned from outside work places to have the Spring Festival with their families. A two-person group was organized and appointed to conduct the investigation county-wide. All investigators were able to communicate in local dialects and were trained to efficiently ask questions and fill in the questionnaire in 10 minutes. This protocol greatly reduced communication problems caused by the fact that dialects are popular in the study area where most of the population are Hakka people. The questionnaire used in the interviews were collected as primary data—characterized by household head, general situation of the household, forest plot characteristics, and past experience of leasing forestland. From the 420 planned interviews we only concluded 408 households in our sampling—discarding 12 interviews due to incompleteness.

### 3.3. Data Description

Descriptive statistics of the data are presented in Table 2. The intentions given by the farmers on whether they would lease forestland are stated in the Section 4.1. Farmers' intention and past experience of leasing in and leasing out of forestland. Descriptive findings will ensure a complete picture of the past experience and future intention. The data indicates that the average forestland held by one household was 1.83 hectares, a figure that closely resembled the Chinese national average. Moreover, 56% of the households did not indicate that usage rights of the forestland were unchanged—due to previously implemented reforms. In addition, only 14% of the households indicated that they would leave forestland as an expected inheritance for the next generation.

The majority of the household heads were aged between 40 and 60 years old with an average age of 49 years old. As far as the attainment of education was concerned, 206 household heads, i.e., 50.49%, completed high school. There were 150 household heads that completed middle school accounting for 36.76%, 32 households or 7.84% were headed by people who had schooling at the elementary level, and 19 household heads who had university degrees, accounting for 4.66% of the sampled households. In terms of the number of people being employed, the range was from zero to six. Among the households, 216 households had two people working in the household, which accounted for 52.94% of the total. Another 67 (i.e., 16.42%) households had three people working, 55 (i.e., 13.48%) households had four people working, and 42 (i.e., 10.29%) households had one person working. The number of households that had nobody working was 13, accounting for 3.19%. There were five households having more than four people working, accounting for 1.23% of the total. The households differed from one another in terms of nonfarm income relative to the total income. On average, 41.9% of the total income comes

from nonfarm sources. In fact, 127 households reported that they had no income from nonfarm work, while 27 households reported that all of their incomes were from nonfarm work.

**Table 2.** Descriptive statistics of the data.

Variable	Definition	Mean	SD <sup>†</sup>
Dependent variables			
<i>will_in</i>	farmers' intention of leasing in forestland (1 = <i>yes</i> , 0 = otherwise)	0.32	0.47
<i>will_out</i>	farmers' intention of leasing out forestland (1 = <i>yes</i> , 0 = otherwise)	0.21	0.41
Independent variables			
<i>area</i>	forestland area (ha)	1.83	5.05
<i>inherited</i>	whether forestland was inherited (1 = <i>yes</i> , 0 = otherwise)	0.14	0.35
<i>age</i>	age of household head (years)	49.69	11.76
<i>education</i>	education level of household head (1 = primary school or below, 2 = middle school, 3 = high school, 4 = university or above)	2.51	0.72
<i>labor</i>	number of people working in the family (people)	2.39	1.11
<i>nonfarm</i>	proportion of income from nonfarm sources of total income (%)	41.94	37.30
<i>security</i>	forestland usage rights (1 = <i>yes</i> , 0 = otherwise)	0.44	0.49
<i>wea_in</i>	leased in forestland in the past five years (1 = <i>yes</i> , 0 = otherwise)	0.12	0.32
<i>easy_in</i>	easy to lease in forestland (1 = <i>yes</i> , 0 = otherwise)	0.14	0.35
<i>profit_in</i>	not profitable to lease in forestland (1 = <i>yes</i> , 0 = otherwise)	0.25	0.43
<i>wea_out</i>	leased out forestland in the past five years (1 = <i>yes</i> , 0 = otherwise)	0.07	0.25
<i>easy_out</i>	easy to lease out forestland (1 = <i>yes</i> , 0 = otherwise)	0.17	0.38
<i>profit_out</i>	not profitable to lease out forestland (1 = <i>yes</i> , 0 = otherwise)	0.18	0.39

<sup>†</sup> standard deviation.

## 4. Results

The results of the farmers' intentions and past experience of leasing in and leasing out forestland is elucidated. An additional detailed examination of the Bayesian logit model, pinpointing the main factors affecting farmers' intention of leasing out forestland, in terms of the assigned variables, are shown.

### 4.1. Farmers' Intention and Past Experience of Leasing in and Leasing out of Forestland

Results indicate that those farmers that intended to lease in forestland accounted for 32% of the total sample; however, those farmers that intended to lease out forestland were 11% fewer (Table 2). Regarding past experiences of leasing in or leasing out forestland, the results indicated slightly more than 10% of farmers who had experience with leasing in versus only 7% of those leasing out. Comparatively, 14% of farmers' positive responses in terms of ease of leasing in forestlands versus 12% of them for leasing out forestlands. In addition, there are about a quarter of the farmers who did not perceive that lease in of forestlands as profitable, and 18% of them that did not respond to leasing out as profitable.

We grouped all farmers into two categories according to their differing perspectives of experiences of leasing in forestlands. We found the group with experience of leasing in forestland had a significantly higher intention of leasing in forestlands than the other group (i.e., t-test value of  $-5.78$ ). We also found that the group with responses of not being profitable in terms of leasing out had fewer intentions of leasing in forestlands than the other group (i.e., t-test value of  $6.29$ ). In addition, we found significantly different impacts of ease to leasing in forestlands on intention of leasing in between two groups with different responses in term of ease of lease in (i.e., t-test value of  $-5.92$ ).

When we categorized farmers into two groups according to whether they had experiences of leasing out forestlands, we found the group with this type of experience had significantly higher intentions of leasing out forestlands than the other group (i.e., t-test value of  $-2.65$ ). We also found different intention of leasing out forestlands between the group responding to it not being profitability

to lease out versus the other group (i.e., t-test value of 5.88). However, we did not find significantly different impacts of ease in leasing out forestlands on intention of leasing out between two groups with different responses in terms of ease in leasing out (i.e., t-test value of  $-1.35$ ).

#### 4.2. Factors affecting Farmers' Intention of Leasing in Forestland

As illustrated in Table 3, the results of the Bayesian logit model identify the effects of demographic characteristics, characteristics of forestland, and past experiences of leasing in forestland of the respondents on their intention of leasing it in. We tested for correlation between all explanatory variables and found that none of the correlative coefficients exceeded 0.50. Furthermore, all of the variance inflation factors (VIF) were less than two, indicating that our data did not suffer from multi-collinearity issues based on commonly used cut-off values [55,69]. The estimated Monte Carlo errors were all less than 5% of the standard deviation, indicating that random-walk Metropolis-Hastings sampling was appropriate [70].

**Table 3.** Results of factors affecting farmers' intention of leasing forestlands.

	Model 1		Model 2		Model 3		Model 4	
	Mean	SD †	Mean	SD †	Mean	SD †	Mean	SD †
<i>area</i>	−0.003	0.002	−0.002	0.001	−0.002	0.002	−0.003	0.002
<i>inherited</i>	−0.059	0.327	−0.253	0.332	−0.676	0.411	−0.391	0.265
<i>age</i>	−0.479 ***	0.009	−0.045 ***	0.009	−0.045 ***	0.011	−0.045 ***	0.010
<i>education</i>	−0.188	0.136	−0.189	0.162	−0.147	0.197	−0.232	0.152
<i>labor</i>	0.196 **	0.081	0.229 **	0.088	0.227 ***	0.081	0.216 ***	0.073
<i>nonfarm</i>	−1.471 ***	0.0262	−1.449 ***	0.294	−1.589 ***	0.354	−1.575 ***	0.361
<i>security</i>	0.829 ***	0.174	0.669 ***	0.229	0.950 ***	0.234	0.625 **	0.247
<i>wea_in</i>	1.732 ***	0.365					1.589 ***	0.382
<i>esay_in</i>			1.304 ***	0.316			1.351 ***	0.302
<i>pro_in</i>					−3.165 ***	0.387	−3.153 ***	0.279
Constant	1.259 ***	0.423	1.055	0.739	0.882	0.875	0.966	0.637
Model features								
Log likeli.		−280.5		−280.8		−285.7		−282.6
Accept. Rate ‡		21.65		19.89		19.42		20.39
Mean VIF		1.13		1.14		1.15		1.17

† standard deviation; ‡ percentage; \* significant at  $P < 0.10$ ; \*\* significant at  $P < 0.05$ ; \*\*\* significant at  $P < 0.01$ .

In order to check robustness of impacts of farmers' past experiences of leasing in forestland, Table 2 reports on four models and employed each of three indicators of past experiences in the first three and all three indicators in the fourth. The impacts of the indicators of past experiences and other variables are consistent in all four models—which convinced us of its robustness. We conducted the following analysis based on the fourth model. The regression results showed that seven factors have statistically significant impacts on farmers' intentions of leasing in forestland. These factors are the household head age (i.e., age), number of people working in a family (i.e., labor), security of forestland usage rights (i.e., security), lease in of forestland in the past five years (i.e., wea\_in), ease of leasing in forestland (i.e., easy\_in), and not profitable to lease in forestland (i.e., profit\_in).

The coefficient for the age variable is negative and significant at 1%; thus, the intention to lease in forestland decreases as the age of the household head increases. The education level of the household head (i.e., education) also had a negative effect on lease in of forestland, but the effect was not significant. The effect of the number of people working in the household (i.e., labor) is positive and insignificant. The coefficient of the nonfarm variable is negative and significant at 1%. This implied that those households with larger nonfarm income are less likely to lease in forestland.

Regarding impact of characteristics of forestlands on farmers' intention of leasing in forestland, we found that only the coefficient of the security variable is positive and significant at 5%. Those households holding the view that forestland usage rights were secure had a higher probability to lease in forestland. This may have resulted from the fact that farmers are afraid that their right to lease

forestland cannot be well protected if usage rights are not secured. The other two variables, including area and inherited, did not have significant impacts on farmers' intention of leasing in forestland. However, both of these impacts were negative.

In terms of the impact of farmers' past experiences of leasing in forestland, both coefficients of the *wea\_in* and *easy\_in* variables were positive and significant at 1% whereas the *profit\_in* variable was negative and significant at 1%. The results suggested that those households that once participated in leasing in of forestland were perceived to more easily lease in forestland or had a higher intention of doing it in the future. This is in line with the fundamental economic theory that low transaction cost will always facilitate a transaction. This also implied that farmers' past experiences play a significant role and impact on their intention to lease in in the future.

#### 4.3. Factors Affecting Farmers' Intention of Leasing Out Forestland

We presented the results of the Bayesian logit model by identifying the effects of demographic characteristics, characteristics of forestland, and past experiences of leasing out forestland from the respondents' intention to leasing out their land (Table 4). We also reported four models as a check on the robustness of the impacts of farmers' past experiences to leasing in forestland. The consistency of the impacts of farmers' past experiences on farmers' intention to lease out forestland convinced us that the results are robustly conclusive. We also made use of results from the fourth model for further inquiry. The regression results showed that seven factors have statistically significant impacts on farmers' intentions to lease in forestland. These factors are the household head age (i.e., age), educational level of household head (i.e., education), number of people working in the family (i.e., labor), security of forestland usage rights (i.e., security), leasing out of forestland in past five years (i.e., *wea\_out*), and not profitable to lease forestland (i.e., *profit\_out*).

**Table 4.** Results of factors affecting farmers' intention of leasing out forestlands.

	Model 1		Model 2		Model 3		Model 4	
	Mean	SD †	Mean	SD †	Mean	SD †	Mean	SD †
<i>area</i>	0.002	0.002	0.001	0.002	0.002	0.002	0.002	0.002
<i>inherited</i>	−3.258 ***	0.742	−2.644 ***	0.345	−1.758 *	1.005	−1.711 ***	0.419
<i>age</i>	−0.022 ***	−0.008	−0.015 *	0.009	−0.026 **	0.011	−0.026 ***	0.008
<i>education</i>	−0.691 ***	0.175	−0.658 ***	0.131	−0.695 ***	0.157	−0.614 ***	0.179
<i>labor</i>	−0.048	0.086	−0.066	0.079	−0.049	0.092	−0.051	0.087
<i>nonfarm</i>	1.579 ***	0.354	1.679 ***	0.331	1.082 *	0.588	1.717 ***	0.381
<i>security</i>	−0.097	0.251	−0.120	0.219	−0.266	0.239	−0.234	0.267
<i>wea_out</i>	0.837 **	0.421					0.864 *	0.444
<i>easy_out</i>			0.468	0.288			0.237	0.275
<i>pro_out</i>					−3.852 ***	0.402	−3.703 ***	0.547
Constant					2.306 ***	0.692	1.181 ***	0.236
Model features								
Log likeli.		−246.8		−248.4		−240.2		−245.6
Accept. rate ‡		27.42		15.01		17.36		22.64
Mean VIF		1.12		1.11		1.15		1.16

† standard deviation; ‡ percentage; \* significant at  $P < 0.10$ ; \*\* significant at  $P < 0.05$ ; \*\*\* significant at  $P < 0.01$ .

The coefficient for the age variable is negative and significant at 1%. This points to the correlative finding that an intention to lease out forestland decreases as the household head's age increases. The education level of the household head (i.e., education) also has a negative and significant effect on the leasing out of forestland. This implied that once the household head had a higher educational level, they had a smaller intention to lease out their land. The effect of the number of people working in the household (i.e., labor) was negative with an insignificant correlation. The coefficient of the nonfarm variable was positive and significant at 1%. This implied that those households with larger nonfarm income were more likely to lease out their forestland.

Regarding impact of characteristics of forestlands on farmers' intention of leasing in forestland, we found that only the coefficient of the inherited variable was negative and significant at 5%. Those households treating forestland as inherited have a lower probability to lease out their forestland. This result is in line with our expectations. Two variables, i.e., area and security, did not have a significant impact on farmers' intention of leasing out forestland—however both had positive impacts.

In terms of the impact of farmers' past experiences of leasing in forestland, the coefficient of the *wea\_out* variable was positive and significant at 10%, the coefficient of the *easy\_out* variable was positive and insignificant, and the coefficient of the *profit\_out* variable was positive and significant at 1%. These results suggest that those households that participated in leasing out forestland were more likely to do it again. Once farmers did not believe leasing out of forestland was profitable, they have less intention to lease out at all. This also implied that farmers' past experiences played a significant impact on their intention of lease in—in the greater scope of the study.

In terms of the robustness of the results, a Bayesian approach was used as an alternative method to the classical approaches, e.g., logit model and probit model, to avoid biased estimators and misspecifications (i.e., left out variables, errors in variables, and heteroskedastic errors common in traditional models) [71–73]. Zellner and Rossi [74], the first to use a Bayesian analysis for qualitative choice in econometrics, point out that the Bayesian approach exhibits operational capability and provides an avenue for proper analysis of differing scaled samples. A review of recent studies also reveals that Bayesian approaches have been adopted to overcome non-robustness when attached with traditional models (i.e., Caglayan-Akay and Sedefoglu [75] and Cai et al. [70]). As such, low autocorrelation is more efficient in a Markov Chain Monte Carlo simulation procedure designed to fit Bayesian models. The procedures within our study, hence, reported on the existence of autocorrelation automatically and took into consideration any avoidance of it. Moreover, we ignored the spatial factors at the township and village level since they were not found to be significant or have spatial heterogeneity in terms of forestland lease. It should be noted that every approach has a certain level of embedded weakness which may generate non-robustness—something we have attempted to limit and veer away from as best as possible. Finally, poor statistical background may have also curbed our contribution to modify the existing approach, leaving us with causation factors for the affected farmers' intention to lease in or lease out farmland.

## 5. Discussion and Conclusions

In this study, we examined how farmers' past experiences in leasing forestlands affect their future intention to lease it again. The results indicate that farmers do not have strong intentions both of leasing in and leasing out of forestland. Compared to farmers' low participation in leasing in and leasing out in the past five years, strong intentions imply that the forestland market might be on the brink of rapid development. At present, the leasing market of forestlands has become less active for both participation in leasing in and leasing out of forestland—as noted by Xu et al. [19] in Anji County of Zhejiang Province, which is more than two times larger than our study in Ningdu. Notably, Anji has a much stronger market-orientated economy than Ningdu which may play an important role in its brisker development.

Furthermore, it should be noted that farmers' intentions of leasing in forestlands are stronger than their intentions of leasing out forestlands. Similarly, we found farmers' participation in leasing in of forestlands much more active than their participation in leasing it out. However, there is a reversal when compared to farmers' past participation in the forestland market in Zhejiang [19] (i.e., where farmers' participation in leasing out forestland is nearly three times that of their participation in leasing in forestland). If forestlands are only leased in and leased out between local farmers, an unbalanced bias would be a part of our datasets. However, we noted that other actors outside of local farmers participated in the leasing of forestlands. For example, some forestlands are leased out by some forest firms at the village level. The gap between intentions to lease in and lease out of



the forestlands also needs to be closely observed in terms of supply by other actors rather than just local farmers.

Regarding impact of demographic factors of household heads, the results impacted household head age in that intention to lease in forestland is consistent with research findings from Xu and Li [45]. The insignificant effect of educational levels of household heads indicates research finding at par with Wang et al. [48] and Chen et al. [46]. Regarding impacts of demographic factors of the household head in terms of leasing out forestland, negative and significant results of age are consistent with Wang et al. [48] and Ran and Lv [47], while negative and significant results of educational level are consistent with Xu et al. [19].

The significant and positive results regarding farmers' leasing in of forestlands correlate Xu and Li's [45] and Chen et al.'s [46] research, however, the insignificant and negative results regarding farmers leasing out forestlands are not consistent—in terms of significance and negative effects—with Ran and Lv [47]. A possible reason for this discrepancy is that farmers' leasing in practices—to expand their scale of forest management—do not correlated with the total labor workforce but, instead, do not need less labor (i.e., at the moment). Another important variable, denoting demographic characteristics of a household, the nonfarm factor has significant effects on intention of leasing in and leasing out of forestland—however this result is somewhat antipodal to finding by Ran and Lv [47]. Finally, it should be noted that the nonfarm factor has been proven to be endogenous with farmers' leasing behaviors [22]. In this study, farmers' nonfarm work outweighs their intention to lease forestland which convinces us not to ignore the endogeneity effects of this impact.

Among three variables related to forestland held by farmers, our results indicate that security is the only variable having significant impact on farmers' intention to lease in forestland, and inherited is the only variable having significant impact on farmers' intention to lease out forestland. These results identify security as consistent with research finding from Zhang and Pearse [50], Zhang and Owiredu [44], and Xie et al. [13]. We have learned, from our field survey, that some farmers do not have a strong sense of security in terms of usage rights of their forestland to lease in. For example, they cannot obtain harvest permission if they do not get assistance of the original holders proving their legal use and rights to the forestland. The result of the impact of inherited land and the intention to lease it showed that once farmers have an intention to pass on their forestland (i.e., to next generation), they are less active in the forestland market. A similar result is observed by Amacher et al. [20] in which farmers were less likely to be active in forest management as well. In addition, the insignificant impact of forestland held by farmers and their intention of leasing in and leasing out implies that farmers do not treat forestlands solely as a physical asset and that entails a certain amount of know-how in the practice for it to be successful.

Our results about farmers' past experiences of leasing forestland are consistent with existing research findings [19,22]. Farmers' past experiences of participating in lease in and lease out forestland will reduce transaction costs and increase profit for the future leasing agreements. Among these are three different variables that clearly indicate farmers' past experiences, i.e., wea\_in and wea\_out concern farmers' past behavior of leasing in and leasing out of forestlands, and easy\_in, easy\_out, pro\_in, and pro\_out concern farmers' perceptions of past experiences. Their perceptions are either formed by their personal experiences or formed in terms of observation of and communications with their relatives, neighbors, and friends. The correlations between lease behavior, their response to ease, and their response for profitability are smaller than 0.25, i.e., it implies that our employment of these three types of indicators are well captured by farmers' past experiences from three independent perspectives. Clearly, profitability from a previous lease plays a significant role and hardens future decisions and intentions rather than easing and encouraging open participation. This behavioral response pertains to market mechanisms that also provides evidence and support for the employment of the profit-maximization function [43,76–80].

Since farmers are major holders of forestland usage rights in rural of China, their intention of leasing in and leasing out of forestland determine development of the forestland market [13,15,19,67].



We do not compare wellbeing of those farmers having past experiences or with other farmers, in addition, we cannot confirm if there is a need to increase farmers' intention of leasing in or leasing out of forestlands for a rapid development of the area. However, we believe it to be necessary that consideration of what factors affect or restrict farmers' intention (i.e., of leasing in or leasing out) be carefully observed for sounder advancement. Our results indicate household bearing smaller transaction costs and embracing larger profits will be more active in the forestland market. In order to ensure stable development of the forestland market, a policy is needed to reduce transaction costs and promote related profits for farmers who lease in or lease out such land. A more important policy would consider removing restrictions on forestland management and their benefits. Regarding households with elderly heads that have an intention to treat forestland as inherited, a less active forestland market should be expected, forcing policy makers to best coordinate and management these conditions—making countermeasures a priority.

This study explored the causable relationship between farmers' past experiences and future intentions of lease in and lease out of forestland. There is no doubt that this explored causable relationships that show theoretic reference for further future study. However, we note our study was conducted based on survey data from one county which, respectively, is a narrow representation of results. Another limitation is our lack of comparative research of forestland markets between China and other countries in terms of a farmer's perspective. We also note that our indicators, used to measure farmers' past experience, carried limited information reflecting heterogeneity of that experience. We also should state that we differentiate between "forestland market" and "cropland market", and specifically did not incorporate "cropland market" into our study scope. Further study could investigate more details of farmers' past experiences including: area of forestland leased in or leased out and the setting up of a temporal-spatial model (i.e., used to synthesis and compare research finding at different time periods and regions for increased reliability). At length, a follow-up study to this one is suggested to test how many intentions of leasing can be turned into reality.

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