

# Tenure Integrity, Security and Forestland Transfer: Evidence from Jiangxi Province, China

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## Abstract

*The new round of collective forest tenure reform implemented since 2003 has provided farmers with more integrated and secure forestland rights. Drawing on household data collected in Jiangxi province in 2011 and 2013, this paper examines the impacts of households' recognition of tenure integrity and security on forestland transfer activities. Our empirical results show that households with higher perception of their use rights and mortgage right have a lower probability and intensity of transferring-in land, while households with lower expectations of future forestland redistribution or expropriation are more likely to transfer in forestland and more of it. In order to develop a forestland transfer market, the government should strengthen the enforcement mechanisms underlying the forest tenure reform and provide and /or improve supplementary measures, including the establishment of an effective transfer platform and a reliable rural social security system.*

**Key Words:** *forest tenure reform; forestland transfer; tenure integrity; tenure security*

## 1. Introduction

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Forests are recognized as an important resource that not only contribute to combating rural poverty and ensuring food security, but also play a key role in maintaining stable ecological conditions and biodiversity (FAO 2015). Since the early 1980s the State Forestry Administration of China has carried out a series of comprehensive reforms in order to encourage more sustainable use of forest resources and to protect the ecological environment. These measures include the Natural Forest Protection Program, the Sloping Land Conversion Program, and the Collective Forest Tenure Reform (Liu et al. 2014a, Liu et al. 2014b). A new round of collective forest tenure reform, introduced in 2003, has distributed forest management rights from village collectives to individuals. This has enhanced farmers' tenure security, provided incentives for them to do more tree planting and make other forestry-related investments and helped to improve the welfare of rural households living in forested areas (Qin and Xu 2013, Xie et al. 2013).

However, the distribution of forest management rights to individuals has also resulted in fragmentation, decentralization, and a mismatch between forestry resources and other factors, such as the available labor force, management capabilities and capital. This is leading to overexploitation of forestland and sub-optimal forestry production (Che 2009, Xu et al. 2013). Globally about 13 million hectares of the world's forest are lost each year due to deforestation (FAO 2005), and this accounts for approximately 12-15% of global greenhouse gas emissions and reduces global carbon storage capacity (Chaplin-Kramer et al. 2015).

One way solution to reduce forestland fragmentation and increase allocative efficiency is to promote forestland transfer so that forestland can be managed on a larger scale. Despite a series of legal reforms and policy regulations which aim to boost forestland transfers, the level of forestland transfer remains very low in China (Zhu et al. 2014). Studies of land rental markets for farmland provide evidence that insecurity or incompleteness of tenure are the main factors impeding the development of markets (Macours et al. 2004, Feng and Heerink

2008, Zhong and Luo 2013). However, there are few studies that explore the relationship between forest tenure and forestland transfer<sup>2</sup>.

To the best of our knowledge, only Chen et al. (2009), Holden et al.(2011), Kimura et al. (2011), Xu and Li (2012), Zhu et al. (2014) have analyzed the effect of forest tenure factors on forestland transfer in China. Chen et al. (2009) claim that households with formal certificates and logging quota are more willing to transfer forestland than others. Holden et al. (2011) assess the current level of forest tenure security and the effect of tenure security on forestland allocation by using past forestland reallocation experience and the perceived risk of reallocation within the coming five years. Kimura et al. (2011) demonstrate that the perceived tenure insecurity (risk of land reallocation) has discouraged households from participating in land rental market. Xu and Li (2012) argue that farmers' better understanding of forestland mortgage policies induces their forestland transfer activities. Zhu et al.(2014) take a more integrated set of rights, (including ownership rights, transfer rights, mortgage rights, and usufruct rights) into consideration and show that these rights can increase forestland transfer by reducing transaction costs.

These studies provide some important evidence for understanding the effect of land tenure on forestland transfer, although there are other aspects that have received less attention. First, while tenure integrity may be correlated with tenure security, they are not equated. Tenure integrity indicates whether, and to what extent, a household currently possesses a specific right; while tenure security is the (un)certainty that a specific right to forestland will be recognized and protected in the future. The impact of tenure reform on forestland transfer may be underestimated due to either of these factors. Second, the current studies mostly focus on the impact of transaction cost on forestland transfer activities (Kimura et al. 2011, Zhu et al. 2014). They do not consider that forest tenure could also affect forestland transfer decisions by raising the value of forestland.

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<sup>2</sup> A number of studies have examined the factors that contribute to household's forestland transfer activities and most of them emphasis the impacts of household demographic and economic factors, such as age and education of household head, household income, etc.

This could push up potential land rental prices and reduce the incentive to transfer forestland. This value-increasing effect is different from the transaction-cost-reducing effect that is widely discussed in the existing literature. Third, these recent studies do not take into account households' risk of losing forestland as a result of forestland expropriation for ecological forest protection or infrastructure construction, which is another important source of tenure insecurity.

This paper is based on household-level data collected in 2011 and 2013 in Suichuan county and Fengcheng city in Jiangxi province, and aims to examine the impact of forestland tenure integrity (including use rights, mortgage rights, and transfer rights) and tenure security (denoted by expectations of forestland being expropriated or forestland reallocated) on households' decisions to transfer forestland. We identify two channels throughout which forestland tenure integrity and tenure security can affect forestland transfer. These are the transaction-cost-reducing effect, and the value-increasing effect of rising forestland values and transfer prices. These concepts will be elaborated in the following section. In our empirical analysis we control for potential endogeneity<sup>3</sup> by measuring tenure integrity/security at the village level.

The paper is structured as follows. Section 2 briefly reviews the collective forest tenure reforms in China. Section 3 provides a theoretical framework that links tenure integrity and security with forestland transfer decisions. Section 4 introduces the study sites, data collection and the selection of variables. The model specification and estimation strategy are presented in Section 5. Section 6 reports on the empirical results, and the conclusions and policy implications are discussed in Section 7.

## **2. Trajectory of collective forest tenure reform in China**

Since the late 1970s, China started to practice a dramatic land reform known

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<sup>3</sup> It should be noted that forestland transfer behavior may also affect household perceptions on tenure integrity, so there is potential endogeneity between forest tenure perception and transfer decisions (Mullan et al. 2011, Ma et al. 2014).

as the Household Responsibility System (HRS) which has brought about remarkable success in agricultural productivity (Lin 1988). The reform was later extended to the forestry sector. There have been three major forest tenure reforms since the late 1970s: the 'Three Fixes' policy during 1979-1991; the forestry market reform during 1990s, and the new round of forest reform since 2003. These reforms have gradually promoted the development of collective forestry.

## **2.1 First reform: the 'Three Fixes' policy (1979-1991, decentralization)**

Following the success of the HRS, the Chinese government issued the '*Resolution on Issues Concerning Forest Protection and Development*' in March 1981<sup>4</sup>. This policy was also known as the 'Three Fixes', because it aimed to distribute the forestland to individual households and fix three issues pertaining to forest tenure: clarifying rights to forests (family plots), delimiting the boundaries of private plots (responsibility hills), and establishing a forestry production responsibility system (collective management) (Holden et al. 2011, Delang and Wang 2013, Xie et al. 2014). In this way, farmers were granted rights to decide which trees to plant, when to plant and fell, as well as the right to prevent other people from cutting down their trees. In return they bore responsibility for preventing forest fires and were not permitted to convert forestland into farmland or to cut trees "unreasonably" (Delang and Wang 2013).

Farmers' responses to the forest reform were mixed. In the northern region where collective forest only made up 11% of the total forest area, the household forest tenure system was quickly accepted and farmers were allowed to sell the timber at market prices without the need for harvest permits. This led to much afforestation in this region during 1980s as farmers had more rights and fewer restrictions on how they used their forest land (Yin and Xu 2002, Delang and Wang 2013). Here, the granting of property rights, consistent with the theoretical literature, led to an increase in the rate of afforestation.

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<sup>4</sup> See details in the central government document issued in 1981: <http://gjzmqw.forestry.gov.cn/main/4814/content-801605.html>.

In the southern region where forest coverage was high, the story was rather more complex. Local officials initially refused to distribute forestland to individual households but this led to objections from the grassroots. The local governments then made some compromises, contracting forestland to individual households. Although the 'Three Fixes' policy did provide rural households with some rights, the state still retained the usufruct right and right of disposal. Farmers perceived a high degree of tenure insecurity under the uncertain policy environment, where there were frequent policy changes, restrictions on logging permits, control of the timber market, and high forest taxes and fees. This inhibited the planting of new trees in southern China and in some regions, the distribution of forestland led to widespread deforestation in the 1980s (Yin and Xu 2002, Holden et al. 2011, Delang and Wang 2013, Xie et al. 2014), a process that closely followed the script of the 'Tragedy of the Commons' (Hardin 1968).

## **2.2 Second reform: forestry market reform experiment (1992-1998, centralization)**

Following China's pronouncement to establish a market economy in 1992, the central government issued *'The General Outline of Forestry Economic System Reform'*<sup>5</sup> in 1995. This granted forestland use rights to individual rural households, forestry cooperative organizations, and other investors. Due to the lack of investment capacity and access to credit, many farmers transferred their contracted forestland to large holders with more capital. However, the concentration of forestland among large holders did not achieve the anticipated benefits of economy of scale. A heavy tax burden imposed on forest operators and difficulties in obtaining harvest permits inhibited them from investing in forestland and the productivity of collective forests decreased. Although forest operators were granted more complete rights forestry during this period the country faced a dilemma: importing huge quantities of timber while vast tracts of forestland inland lay unused (Xie et al. 2014).

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<sup>5</sup> See details in the government document issued in 1995:  
<https://www.gdf.gov.cn/index.php?controller=front&action=view&id=3114>.

### 2.3 Third reform: marketization and forestland certification (2003-now, decentralization)

Against this background, a new round of forest tenure reform named '*Resolutions on Forestry Development*'<sup>6</sup> was introduced in 2003 to provide more forest management incentives to farmers. It was supported by a series of mechanisms, such as providing households with more secure forestland use rights, loosening commercial-forest logging restrictions, and reducing taxes and fees on harvesting (Yin et al. 2013), in the hope of enhancing rights that were already clearly legally stipulated (i.e., the use rights, transfer rights, mortgage rights and logging right) and other rights that had not been explicitly regulated (such as the right to abandon forestland).

These reform policies have strengthened farmers' control of forest tenure rights and reduced interventions from the government and village committee on management and revenue distribution. At the same time the new round of reforms has increased farmers' ability to mitigate against potential risks of losing forestland and indirectly increase their forest tenure security (Holden et al. 2011, Yi et al. 2013). In addition, the new round of reform also involved issuing forestland certificates and made the contract period explicit (30-70 years)<sup>7</sup>, both actions enhancing farmers' perceptions of tenure security. In sum, the new forest tenure reform has enhanced the integrity and security of forestland tenure.

With respect to forest property rights, forestland use rights were allocated to farmers in the first reform in the 1980s, and the use rights were permitted to be *transferred* during the 1990s. However, the overall forest tenure, including ownership, use rights and disposal rights, were ambiguous due to excessive intervention by local governments and the changing policies. Farmers, who ought to be at the center of the collectives, have few incentives to participate in forest management. In consequence, the reforms did not solve the problems of

<sup>6</sup> See details in the central government documents issued in 2003: (<http://www.forestry.gov.cn/portal/hdy/s/1773/content-273318.html>)

<sup>7</sup> See details in the central government documents: 'The Decisions Concerning the Comprehensive Implementation of Reforming the Tenure System of Collective Forests' in 2008 ([http://www.gov.cn/gongbao/content/2008/content\\_1057276.htm](http://www.gov.cn/gongbao/content/2008/content_1057276.htm)).

forest tenure insecurity and incompleteness. The new, third, round of reform sought to combine and improve the reform policies adopted in the 1980s and 1990s: long-term use rights of collectively owned forestland were granted to member households of the collectives, and the use rights of forestland can be traded in the open market or transferred in other ways. This evolution of tenure integrity and security may alter farmers' forest management behavior.

### **3. Conceptual framework**

Forestland shares a lot of similarities with farmland and existing studies of farmland market development may shed light on the mechanism of forestland transfer activities. Drawing on this literature we can argue that the changes in forest tenure integrity and security<sup>8</sup> brought about by the most recent round of reforms could affect forestland transfer through two mechanisms: a transaction-cost-reducing effect and a value-increasing effect. These are both described more fully below.

#### **3.1 Transaction-cost reducing effect**

Programs aiming to provide a higher level of tenure security and a wider range of land rights are often justified as having the beneficial impact of lowering transaction costs in land markets (Ali et al. 2015). Transaction costs are incurred when buyers and suppliers procure goods or services through the market. Their level depends on: 1) asset specificity, 2) the disturbances to which transactions are subject, and 3) the frequency with which transactions recur (Williamson 2008, p.47). From an institutional economics perspective, typical transaction costs include: 1) information costs, such as searching for information about products, prices, inputs, buyers and sellers, and their reputation, 2) the bargaining and negotiation costs associated with reaching a mutually acceptable agreement and drawing up a contract to support the agreement, and 3) monitoring costs which are needed to oversee the behavior of a trading partner and the quality of what they deliver (Pejovich 2000, pp.43-45).

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<sup>8</sup> See the detailed definitions of tenure integrity and security in Section 4.2.

A large amount of research on farmland tenure has confirmed that transaction costs of land transfers can be reduced when farmers are provided with more integrated land rights including use, transfer, and mortgage rights (Brasselle et al. 2002, Holden and Yohannes 2002, Xu and Guo 2011, Xu et al. 2011, Hu et al. 2013, Xu 2013) and more secure farmland rights (Holden et al. 2007, Kimura et al. 2011, Ma 2013). This, it is argued will increase farmers' participation in the farmland transfer market. In a similar vein, the high transaction cost stemmed from information failure was identified as one of the major obstacles of the underdeveloped forestland transfer market before 2003, and the new round forest tenure reform has contributed to reducing the transaction cost by providing more guarantees at the legal and policy levels (Collective Forest Land Tenure Reform Research Group 2012, p.199, p.244).

The mechanisms of how forest tenure integrity and security affect forestland transfer through reducing transaction costs and increasing forestland value are shown in Figure 1.

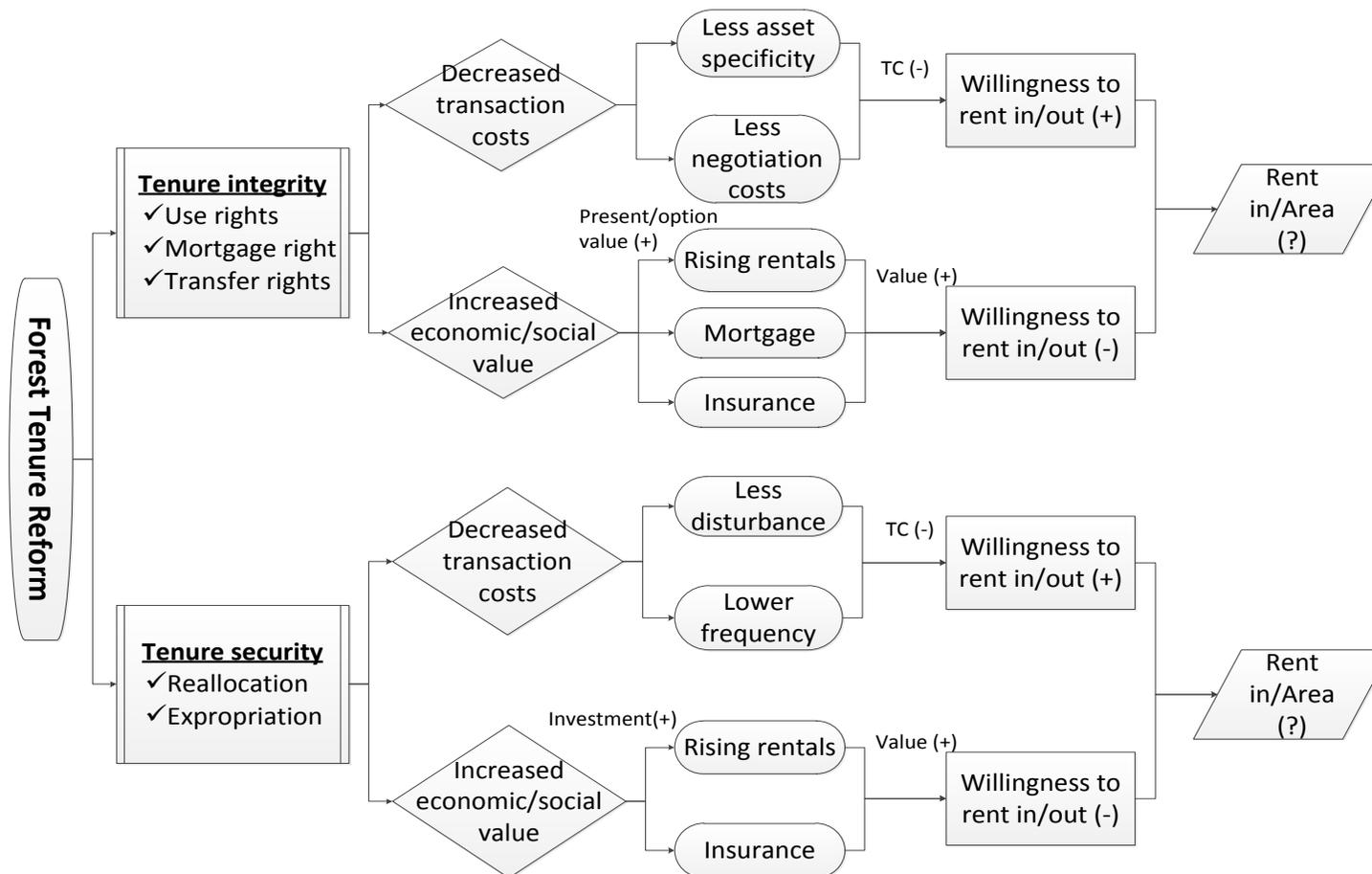


Figure 1 Forest tenure reform, tenure integrity, security and forestland market development

Tenure integrity can reduce transaction costs by lowering the level of asset specificity and strengthening households' negotiating abilities. More complete rights, (i.e. transfer, logging and mortgage rights, the existence of the right to convert forestland into farmland and the rights to change forest type, to decide which tree species to plant and to plant non-wood forest products) have all contributed to diversifying the management of forestland and reduced the degree of asset specificity. Transaction costs tend to decrease in line with a reduction in asset specificity (Williamson 2008, p.49). Second, the possession of more complete and clearer forestland rights also implies that potential landlords and tenants may both need to spend less time/money on searching, bargaining and negotiating in order to reach an acceptable agreement. Hence, the search and negotiation costs will also decrease when more forestland rights are granted to households. The reduction in asset specificity and negotiation costs will decrease transaction costs, which should boost both supply and demand for forestland transfers, and thus raise allocative efficiency (Ma et al. 2015b).

Tenure security can also reduce transaction costs by mitigating against the disturbance of forestland transactions, and the frequency of transactions. First, a large amount of forestland has been expropriated at below 'market prices' to feed up land for urbanization or for ecological forest protection. In some villages forestland has been reallocated due to population trends, following the similar logic of farmland readjustment<sup>9</sup>. The short-term forestland contracts and the uncertainties associated with expropriation and reallocation increased the risks of losing forestland and of claiming profits *when transferring out* forestland (Deininger and Jin 2005). They also impact on those who wish to transfer in forestland as there is a risk of investment interruption: losing the forestland before the expiry of the contracts (Ma et al. 2015a). This increases the transaction costs on both the supply and the demand sides. The aim of the new

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<sup>9</sup> In the late 1990s, as the first 15-year land contract was coming to an end, local governments in China were encouraged to organize village leaders to reallocate land among households in order to redress imbalances in access to cultivated land that had arisen from demographic and other factors (Kimura et al. 2011).

forest tenure reform is to reduce expectations of forestland expropriation or reallocation and stimulate both the supply and demand for forestland transfers.

### **3.2 Value-increasing effect**

In the collective forest areas in southern China, forestland plays a dual role as a productive resource and a form of social insurance. Entitling farmers with more rights and securer rights should strengthen the economic value and social security value of forestland, which can be defined as a value-increasing effect.

Tenure integrity may affect both the supply and demand in the forestland transfer market. Granting households more complete use rights (as listed in the previous section) will raise the value of forestland and lead to anticipation of a higher rental price. In terms of option value theory, granting households more complete transfer rights should have an option value effect on long-term land investment and eventually increase land value, leading potential landlords to postpone the decision of land transfer (Ma et al. 2013). The increased land value and rental price might well reduce potential tenants' incentives to rent in forestland instantly<sup>10</sup>, while reducing potential landlords' incentives to rent out forestland (assuming that the tenants' willingness to pay (WTP) is lower than the landlords' willingness to accept (WTA)) (Zhong and Luo 2013). In other words, more complete use and transfer rights may make the matching of partners in the forestland market more difficult if the extra value anticipated by potential landlords is not realized by potential tenants.

Granting households mortgage right and transfer rights has same effects as granting use rights. Households with a mortgage right are more likely to use forestland as collateral than to transfer out their forestland, which may also reduce the supply of forestland on the market (Zhu et al. 2014). In consequence the extra value effect of more tenure integrity can reduce incentives to offer forestland on the market. Finally, in the absence of a reliable rural assurance

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<sup>10</sup> Because long-term contracts are widely used for forestland transfer activities, potential landlords prefer to delay forestland transactions until they can find tenants that can afford the landlords' expected forestland price, rather than transfer the forestland instantly at a lower price .

system, land is the last resort for providing employment and income when rural households cannot find jobs in cities or other sources of income (Xu and Tao 2004). As a result, the increased value of forestland as an insurance becomes more important for potential landlords and thus may inhibit their interest in transferring out their forestland (Zhong and Luo 2013).

Tenure security might also induce a value-increasing effect by stimulating forestland investment and enhancing the insurance function of forestland. Studies on farmland tenure have indicated that secured land rights may stimulate farmers to invest in land, raise land values (Besley 1995, Brasselle et al. 2002, Beekman and Bulte 2012), and create anticipation of a higher rental price (Ma et al. 2015b). Tenure security may also enhance the insurance function, as tenure integrity does, in the absence of a reliance rural assurance system. As with tenure integrity, the increased economic and social security values of forestland will reduce the incentives for forestland transfers.

As Figure 1 shows, a household's decision to transfer in forestland and the size of the transfer-in are dependent on the cumulative effects of tenure integrity and security. The combination of the transaction-cost-reducing effect and the value-increasing effect that occur as a result of granting more integrated and secure property rights to forestland is expected to increase the reallocation efficiency of factors (land, labor, and capital) through the rental market. This eventually may bring about broader economic benefits including improved access to credit, better allocation of household resources, and more sustainable use of forestland rather than excessive deforestation for short-term benefit. However, the extent to which these economic benefits can be achieved depends on the development of forestland market.

Tenure integrity and security are measured by a series of property rights-related indexes (see details in Table 1). These indexes reflect different levels for the transaction-cost-reducing effects and value-increasing effects. However, the single effect of a specific index cannot be directly identified in the

econometric model, so the combined effects need to be discussed together (see Section 5). The estimation of the combined effects can also help to us to understand how forest tenure affects famers' transfer decisions in the current context.

#### **4. Study sites and data set**

##### **4.1 Study sites and data collection**

As one of the provinces with richest forestry resources in China, Jiangxi holds 158 million *mu*<sup>11</sup> of forestry. The forest cover rate is around 63%, much higher than the national average of 21.63%<sup>12</sup>. In order to stimulate collective forestry production, Jiangxi implemented the 'Three Fixes' policy in 1981 and the new round of forest reform to clarify property rights in 2004. It was a common practice for clarifying property rights to distribute forestland use rights to each household according to household size, but this led to severe fragmentation and abandonment of forestland. The forestland transfer market is growing in Jiangxi, although it is still small in size and regionally segmented. We selected two study areas, Suichuan and Fengcheng, which typify the management styles of collective forestland in southern China. The economic development status, geographical location, forestry development and forest tenure reform status in the two areas are comprehensively taken into account.

The village- and household-level data used in this study were collected in 2011 under the project entitled '*Sustainable Natural Resource Use in Rural China (SURE)*', which was jointly funded by the Dutch Royal Academy of Sciences and Ministry of Science and Technology of China. In order to get an in-depth insight into the determinants of forestland transfers, we conducted a follow-up survey in 2013. Using a stratified random sampling method, we selected 14 villages in Suichuan county and 15 from Fengcheng city. Around 10 households from each village were randomly selected, according to the village

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<sup>11</sup> 1 hectare = 15 *mu*.

<sup>12</sup> Data source: The 8th National Forest Survey 2009-2013, <http://www.forestry.gov.cn/main/65/content-659670.html>.

size<sup>13</sup> and a total of 289 households were surveyed. The structured questionnaire provided information on the characteristics of the villages interviewed households, forestland, and the status of forestland tenure and transfers.

## 4.2 Variables used in the analysis

Table 1 presents the variables used in the regression analysis, their descriptive statistics and the signs of the expected effects. The variables are categorized as forestland market participation, tenure integrity and tenure security, while the control variables are grouped to give the characteristics of the household, forestland, village and region. The control variables are selected on the basis of previous studies of land markets in China (e.g., Deininger and Jin 2005, Feng and Heerink 2008, Jin and Deininger 2009, Mullan et al. 2011, Xu et al. 2013, Ma et al. 2014).

**Table 1 Variable Definition, Descriptive Statistics and Expected signs**

<b>Variables</b>	<b>Definition</b>	<b>Mean</b>	<b>SD</b>	<b>Expected signs</b>
<b><i>Participation in forestland market variables</i></b>				
Renting in dummy	1= if the household transferred in forestland in 2010; 0= otherwise	0.18	0.38	
Rented land	Total area of land rented in by renting household (mu)	66.30	135.44	
<b><i>Forest tenure integrity</i></b>				
Village perception of use rights	Average perception of use rights <sup>a</sup> in the village based on the other sampled households that live in the same village as the surveyed household	2.18	0.39	+/-
Village perception of mortgage rights	Average perception of mortgage rights in the village based on the other sampled households that live in the same village as the surveyed household	1.29	0.44	+/-

<sup>13</sup> In eight villages, more than ten households were interviewed, and in five villages, less than ten households.

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Village perception of transfer rights	Average perception of transfer rights <sup>b</sup> in the village based on the other sampled households that live in the same village as the surveyed household	2.36	0.39	+/-
<b>Forest tenure security</b>				
Village perception of land reallocation	Average perception of land reallocations in the village based on the other sampled households that live in the same village as the surveyed household	1.13	0.31	+/-
Village perception of land expropriation	Average perception of land expropriations in the village based on the other sampled households that live in the same village as the surveyed household	1.19	0.24	+/-
<b>Household characteristics</b>				
Head age	Age of the household head (years)	52.67	10.47	+/-
Head education	Education of the household head (years)	6.75	3.06	+/-
Leader or party member	1= household head is a party member or village leader, 0= otherwise	0.32	0.47	+
Head gender	1= household head is a male, 0= female	0.97	0.18	+
Head occupation	1= household head engaged in forest sector in 2008, 0= otherwise	0.66	0.47	+
Household size	Size of the household population in 2008 (persons)	4.75	1.83	+
Labor share	Share of labor to population in 2008	0.78	0.19	+
Female/male ratio	Ratio of female to male labor force	0.92	0.48	-
Average education	Average education level of the household laborers (years)	7.15	2.20	+/-
Off-farm employment share	Share of off-farm employment labor to household labor in 2008 (%)	0.11	0.20	-
Family wealth	Value of agricultural devices, livestock, electronic instruments, house, furniture and transportation	57627.85	73246.17	+

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vehicle (RMB)

***Forestland characteristics***

Plot number	Initial number of forestland plots in 2008	2.64	2.08	-
Forestland area	Total area of forestland contracted by a household in 2008 (mu)	18.75	27.16	+/-

***Village characteristics***

Distance to town	Distance from village center to nearest town (km)	4.86	2.99	+
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***Regional characteristics***

Region dummy	0 – Suichuan, 1 - Fengcheng	0.48	0.50	+/-
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**Note:** Data based on the village and household level surveys.

a Use rights is a combined weighted average based on six kinds of rights: a) the right to convert forestland for agricultural use; b) the right to change forest type; c) the right to decide on tree species; d) the right to plant non-wood forest product; e) the right to log the forest, and; f) the right to abandon forestland.

b Transfer rights is a weighted average based on rights to transfer in (out) within the village, and rights to transfer in (out)/ from (to) outsiders

**Participation in the forestland rental market**

The two dependent variables in our analysis consist of a forestland renting in dummy and the area of land that is leased. We focus our analysis on the demand side of the forestland rental market. The supply side is usually under-enumerated in rural household surveys, including the survey that we used for this study, as households who are not found at home at the time of survey time are not interviewed. As a result, the households that have migrated elsewhere and rented out their forestland to other households – a common phenomenon in rural China – are excluded from the sample. In our research area, there was evidence that the forestland rental market had already developed to a certain extent: by 2011: 18% of households were renting in forestland, with an average of 66.30 mu of rented-in land. The share of households leasing additional land that we found was much higher than the average rent-in share for Guizhou and Ningxia (7%) found in 2004-2005 by Mullan et al. (2011) and the average level (12%) for Sichuan, Jiangxi, Fujian, and Hunan provinces during 2003-2009 found by the Collective Forest Land

Tenure Reform Research Group (2012, p.246). Hence, our limited evidence suggests that forestland rental market transactions have continued to increase in rural China during the first decade of the 21st century.

### **Forest tenure integrity**

In practice, multiple rights to land can be held by individuals or groups, as part of 'a bundle of rights'. Different rights, such as the right to use, or the right to transfer, can be pictured as 'sticks in the bundle' (FAO 2002). Based on the definitions of tenure integrity in the existing literature (Brasselle et al. 2002, Feng and Heerink 2008, Holden et al. 2011, Yi et al. 2013), we defined tenure integrity in terms of the number of 'sticks' in the bundle that a household holds and the extent to which these sticks can be held by households. Specifically the bundle has three categories and 11 specific rights.

(1) Use rights—the rights to convert forestland into farmland, change forest type, decide tree species, plant non-wood forest product, to abandon forestland and to cut down the forest.

(2) Mortgage rights—the right to use forestland as collateral to obtain credit from formal and informal lenders.

(3) Transfer rights—the right to transfer-in within the village, to transfer out within the village, to transfer in from outside the village, and to transfer out to outside the village.

Both mortgage rights and transfer rights that affect the disposable of land, but they may have different effect on forestland transfers (see the detailed discussion in Section 6). We therefore differentiate between mortgage right and transfer rights, instead of talking of disposable rights as a homogenous whole.

Each kind of right of tenure integrity is assigned a 0 (if a household considers itself not to hold such a right), 1 (if he/she is not sure of having such a right), 2 (if he/she holds the right with village committee's approval), and 3 (if he/she holds the right even without village committee's approval). In order to

mitigate against multicollinearity, the use rights variable is calculated by the weighted mean of the six related rights, and the transfer rights variable is calculated by the weighted mean of the four related rights. In the end, following Holden et al (2011)<sup>14</sup>, we considered three categories of rights indexes in the models: (the weighted average of) use rights, mortgage rights, and (the weighted average of) transfer rights (weighted average).

It should be noted that forestland transfer behavior can also affect household perceptions of tenure integrity, and this could be a potential cause of endogeneity. To overcome this problem we use a method similar to that employed by Mullan et al. (2011) and Ma et al. (2014). Village-level perceived tenure integrity is defined as the average tenure integrity perception of the other survey respondents living within the same village. This variable is used as a proxy for a household's perceived tenure integrity which reduces the potential simultaneity bias. This assumes that tenure integrity perceptions will be very similar for households living within the same village, and that the renting-in decision of one household does not affect the tenure integrity perceptions of the other (surveyed) households in the village. On the other hand, the choice to tent in forestry land will also partly depend on the supply decisions taken by other households living in the same village, and the factors affecting those decisions. The use of a village-level average of perceived tenure integrity is also expected to capture the supply-side effect of tenure integrity perception in the village.

### **Forest tenure security**

Security of tenure is the certainty that a person's rights to land will be recognized by others and protected in cases of specific challenges. Tenure security cannot be measured directly and, to a large extent, it is what people perceive it to be (FAO 2002). We therefore use two perceptual indices to define tenure security: household expectations of forestland reallocations when the

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<sup>14</sup> Holden et al.(2011) defined a bundle of disaggregate rights (the right to convert forest land to cropland, the right to change forest type, the right to decide tree species, the right to intercrop trees and agricultural crops, the right to abandon forest, the right to transfer the plot to other villagers, and the right to transfer the plot to outsiders) and calculated a property rights index by summing all the rights scores from the disaggregate rights.

contract period expires, and household perceptions of forestland expropriation within 10 years. Each kind of tenure security is assigned 0 (if a household perceives that forestland might possibly to be expropriated/reallocated), 1 (if he/she is unsure that forestland might be expropriated/reallocated) and 2 (if he/she perceives that it is impossible that forestland will be expropriated/reallocated). As with tenure integrity, the village-level perceived tenure security is defined as the average tenure security perception of the other survey respondents living within the same village.

### **Household characteristics**

Household characteristics include age, education level, political position (village leadership/party membership), gender, and occupation (specifically forestry management experience) of the household head, household size, share of labor who aged 16-65, ratio of female/male labor force, average education level of the family workforce, share of off-farm employment and family wealth.

The impact of age on transferring-in forestland is unpredictable. On the one hand, physical and energy constraints might mean that older household heads are less likely to engage in large-scale forestry operations and thus will be less likely to transfer in forestland. This may be balanced by older farmers finding it more difficult to obtain off-farm job opportunities, making them less likely to transfer out forestland (which can provide pension insurance) (Xu and Guo 2011, Xu 2013), and more likely to transfer in (more) forestland. The impact of the household head's education level on transfer-in activities is also unclear. Better educated farmers have more chance to find an off -farm job making them less likely to transfer in forestland (Feng and Heerink 2008, Xu et al. 2013, Ma et al. 2014). However, education would also improve farmer's entrepreneurial ability, which may stimulate a household head to transfer in and operate more forestland.

Being a cadre or a CPC (Communist Party of China) member reveals the political power of a household head within the village. We expect political power

and better access to transfer information to have a positive impact on transferring in activities. Females and males have different levels of physical strength and appetites for risk, and male heads of household have been found to be more inclined to transfer in forestland and to operate it on a larger scale (Feng and Heerink 2008). As such, households with a female head and/or a higher ratio of female to male labor force may be less inclined to rent in forest land. The head of household's occupation and specifically a household's experience in the forestry sector may mean that individual households are perceived as better forestry land tenants as they are more familiar with forest management (Deininger and Jin 2005). Larger households who face higher expenditure on food, education and health care, may transfer in more forestland to achieve a higher income to nourish the family (Feng and Heerink 2008).

Land markets tend to facilitate a 'factor equalization effect': transferring land from land-abundant and labor-poor households to land-poor and labor abundant households (Jin and Deininger 2009). Therefore, households with less land and more labor are more likely to transfer in (more) forestland. In addition we need to consider the quality of labor, as denoted by the average educational level of household laborers. Average education will improve a laborer's ability to manage forestry and to find non-farm jobs, which presents an unclear impact on transferring in forestland.

The number of workers employed off-farm may have a negative influence on transferring in forestland, because more off-farm workers indicates less dependence on land (Tian and Jia 2004, Xu et al. 2013). Wealthier households, by contrast, may transfer in more forestland, because they have more capital and capability (Xu et al. 2013).

### **Forestland characteristics**

Forestland characteristics include the initial number of plots and total forestland area. The initial number of plots is a measure of the degree of fragmentation. Evidence from farmland studies shows that households with

more plots are more likely to transfer out their farmland and less likely to transfer in land (Ma et al. 2011, Xu et al. 2013). The forestland area denotes the household's forestland endowment. Findings from farmland studies show that the more land a household initially has the less likely it is to transfer in land (Tian and Jia 2004). Forestland may also have similar features. The difference is that forestry operation makes more demands for large-scale management, therefore, the more the initial allocated forestland area, the stronger the willingness to engage in large-scale operations, and the greater the likelihood of transferring in more forestland (Chen et al. 2009, Yan and Huo 2016). As a result, the influence of initial allocated forestland area is unclear.

### **Village and regional characteristics**

Village characteristics are captured by the distance from town. In relatively remote areas, farmers have limited opportunities for off-farm jobs. They will rely more on land-based income sources and be more inclined to transfer in forestland. A regional dummy (0 - Suichuan, 1 - Fengcheng) is also employed to control for the unobserved region-specific factors that affect forestland transfer.

## **5. Model specification and estimation strategy**

### **5.1 Model specification**

The basic model for examining the joint effect of the two tenure status variables on forestland market decisions is specified as:

$$M_i = c_0 + c_1UR_i + c_2MR_i + c_3TR_i + c_4LR_i + c_5LE_i + \sum c_{6j}X_{ji} + u_{3i} \quad (1)$$

where  $M_i$  denotes the forestland market participation variable for household  $i$ , *i.e.*, either the participation decision (renting in dummy), or the total area of forestland rented in;  $UR_i$ ,  $MR_i$  and  $TR_i$  denote the average village-level expectations for household  $i$  with regard to forestland use rights, mortgage rights and transfer rights, respectively;  $LR_i$  and  $LE_i$  denote the average village-level perceptions for household  $i$  with regard to forestland reallocation and expropriation, respectively;  $X_{ji}$  is a set of control variables for household  $i$ ,

consisting of the village, household, land and regional characteristics (as presented in Section 4.2); and  $u_{1i}$ ,  $u_{2i}$  and  $u_{3i}$  are the random disturbance terms in the three models.

## 5.2 Estimation strategy

We used a Probit model to estimate the equation for the forestland market participation decision. A household will participate in the forestland market if the expected net utility from renting in forestland is positive. Otherwise, forestland market participation is not expected to occur.

Censored Tobit models are used to estimate the equations for the area of land rented in by renting households because the variable is left censored. In our data set, 82% of households are left censored at 0. A censored Tobit model is an appropriate estimation technique for dealing with corner solutions.

It should be noted that unobserved characteristics that influence the probability to participate in forestland market may also influence decisions on the area of land rented in. We used the Heckman selection model to test for possible selection bias. The test results did not show evidence of a significant selection bias for the data set<sup>15</sup>. We therefore used the censored Tobit model instead of the Heckman selection model to estimate the equations for the area of land rented in.

As explained in Section 4.1, a multi-level sample design was used for collecting the data, with 29 villages selected in the first stage and around ten households per village selected in the second stage. To take this specific data structure into account, we applied cluster-adjusted standard errors, adjusted for the 29 villages, in all the regressions.

The Tobit model is known to generate unreliable standard errors in small samples. As a robustness check, we therefore calculated bootstrapped standard

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<sup>15</sup> The two-step estimates in STATA report an inverse Mills ratio of 59.20 (p-value=0.43) in model (1), -51.31 (p-value=0.58) in model (2), and 12.42 (p-value=0.87) in model (3). We thus cannot reject the null hypothesis that there is no selection bias for all these models.

errors for the Tobit models. The results, based on 200 bootstrap replications where bootstrapped standard errors were used to account for the village cluster characteristics of the data, are reported in the appendix.

## **6. Empirical results**

Table 2 reports the regression results for the Probit and Tobit models. From the perspective of tenure integrity, providing farmers with more complete use rights and mortgage right negatively affected the probability and intensity of households renting in forestland. This finding indicates that the value-increasing effect is stronger than the transaction-cost-reducing effect in our sample areas. Diversified forest management and production is quite uncommon in our study region, and thus the asset specificity of forestland may not be significantly reduced. However, the value of forestland and anticipation of a higher rental price may increase significantly as more use rights (i.e. the right to convert forestland for agricultural use, to change forest type, to decide on which tree species to plant, to plant non-wood forest products, to log the forest, and to abandon forestland) and mortgage rights are granted to households. In the absence of a reliable social security system, the value-increasing effect highlights the importance of holding forestland as a form of insurance and the forestland market is stagnant.

Transfer rights are found to have an insignificant effect on transfer decisions. While the transaction-cost-reducing effect increased significantly when full transfer rights are granted to households, in our sample this effect was offset by the value-increasing effect.

In regard to tenure security, both forestland reallocation and expropriation variables had significant positive impacts on transferring-in activities. This is in line with the findings of Kimura et al. (2011), Zhou and Chand (2013), and Ma et al. (2015b) in farmland rental market studies, and those of Chen et al. (2009), and Liao et al. (2010) in forestland transfer studies. It means that, in our sample, the transaction-cost-reducing effect caused by land reallocation and

expropriation is greater than the value-increasing effect stemming from investment improvement. The finding may be related to smallholders' low intensity of investment on in forestland due to high sunk costs (Ji et al. 2015).

**Table 2 Regression results for participation in land rental market**

Variable (Model)	(1) Rent in dummy (Probit)	(2) Rented land area (Tobit)	(3) Rented land area (Tobit)
Variable	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>b</sup>
<b><i>Forest tenure integrity</i></b>			
Village perception of use rights	-2.514*** (0.629)	-190.350*** (70.812)	-190.350** (78.850)
Village perception of mortgage rights	-1.810*** (0.566)	-192.548* (100.757)	-192.548** (91.764)
Village perception of transfer rights	-0.332 (0.448)	22.718 (52.480)	22.718 (78.625)
<b><i>Forest tenure security</i></b>			
Village perception of land reallocation	1.899*** (0.661)	144.049** (66.035)	144.049* (80.512)
Village perception of land expropriation	1.675** (0.833)	226.237* (127.713)	226.237 (164.778)
<b><i>Household characteristics</i></b>			
Head age	-0.339*** (0.055)	-29.717 (18.317)	-29.717 (19.873)
Head age square	0.003*** (0.001)	0.277* (0.163)	0.277 (0.176)
Head education	0.056 (0.056)	12.626 (8.160)	12.626 (10.920)
Leader or party member	0.574* (0.324)	83.895* (45.728)	83.895 (58.734)
Head gender	-2.003*** (0.610)	-177.557** (83.074)	-177.557* (99.448)
Head occupation	0.660** (0.289)	49.314** (24.242)	49.314 (32.006)
Household size	-0.194	-12.273	-12.273

	(0.125)	(12.898)	(13.693)
Labor share	-0.153 (1.027)	-88.568 (98.700)	-88.568 (107.180)
Female/male ratio	-0.305 (0.319)	-23.619 (48.911)	-23.619 (60.762)
Average education	0.106 (0.075)	7.369 (6.116)	7.369 (10.341)
Off-farm employment share	0.244 (0.484)	112.274 (69.840)	112.274 (95.401)
Ln(Family wealth)	0.132** (0.055)	14.560* (7.948)	14.560 (12.407)
<b><i>Forestland characteristics</i></b>			
Plot number	-0.787*** (0.137)	-81.508*** (28.017)	-81.508*** (31.323)
Forestland area	0.002 (0.006)	0.487 (0.586)	0.487 (1.003)
<b><i>Village characteristics</i></b>			
Distance to town	0.284*** (0.069)	28.358*** (10.669)	28.358** (12.453)
<b><i>Regional characteristics</i></b>			
Region dummy	-1.472*** (0.552)	-190.820** (83.253)	-190.820** (92.006)
Observations	289	289	289
Mean VIF <sup>c</sup>	9.39	9.39	9.39
Log pseudolikelihood	-55.49	-364.03	-364.03
% correct prediction	92.04	-	-

\*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels respectively.

<sup>a</sup> Standard errors are adjusted for 29 clusters (villages); <sup>b</sup> Bootstrapped standard errors with 200 replications are reported; <sup>c</sup> Mean VIF tests the degree of multicollinearity among the independent variables, including all interactions.

The control variables relating to household characteristics show that the partial derivative of the head of household's age is negative and significant, after taking the square of age into consideration. This implies that younger household heads are more likely to transfer in forestland.

The head's political power, as represented being by a cadre or a CPC member, facilitates transfer-in activities, but the effect of education level is not significant at the 5 percent level. Contrary to our expectations, households with male heads tend to transfer in less forestland. A reasonable explanation for this is that the returns on investment in forestry are relatively low in our survey areas. As the main labor force in the households, male heads may participate in other sectors that provide higher returns than forestry.

As expected, households' experience in engaging in the forestry sector and family wealth contributed both to their willingness to transfer in and the transferred forestland area, which means more experienced and capital-abundant households are more capable of transferring in.

Forestland fragmentation significantly reduces the possibility and area of transferring in, which supports the findings of Xu et al. (2013) in a forestland study and Ma et al. (2011) in a farmland study. Our results also reveal that households in more remote areas, further from the nearest town, tend to transfer in more forestland. Location is also an important factor in transferring in. Farmers in Suichuan are keener on forestland transfers than those in Fengcheng, which implies that some unobserved differences between the two regions, such as land quality or the institutional environment, may affect land renting decisions.

### **Robustness check**

First, although tenure integrity and tenure security measure tenure status from different perspectives, there are some observed and unobserved factors, i.e. household risk preference, which may influence households' perceptions of both tenure integrity and security. Therefore there is a correlation between tenure integrity and security<sup>16</sup>. To examine the separate impact of the forest tenure integrity and security variables, we estimated two groups of models as a

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<sup>16</sup> We calculated the pairwise correlation coefficients between the two types of tenure variables in the regression model, and found the largest correlation coefficient to be 0.36, between village perception of transfer rights and village perception of forestland reallocation.

robustness check. The first group examined the effect of tenure integrity on forestland market decisions, and the second group examined the effect of tenure security. Table A1, A2 in the appendix reports the estimation results. The conclusions that can be drawn for the main variables of interest (tenure integrity and security) are the same as displayed in Table 2, although in Table A2 the coefficients of tenure security are less significant.

Second, village-level average perceived tenure security is defined as the average tenure security perceptions of the other survey respondents living within the same village, and thus the household's own tenure security perceptions are excluded when calculating the village-level average. It should however be noted that a household's own tenure security perceptions may also affect its forestland renting in decision. In order to deal with this problem, as a robustness check, we use the village-average tenure security perceptions as instruments to calculate the predicted values of individual tenure security perceptions. We assume that apart from village-level characteristics (i.e. village-level tenure environment), individual tenure security perceptions are also affected by individual characteristics, land endowment, and so on (Ma et al. 2015a). In the first step, we regressed individual tenure security perceptions on individual characteristics, land endowment as well as village-level average tenure security perceptions. In the second stage, the resulting predicted values of individual tenure security perceptions were introduced into equation (1)<sup>17</sup>. Table A3 in the appendix reports the estimation results using the IV method. Although there were some changes in the significance level of the coefficients of tenure variables, the results reported in Tables 2 are still robust within the context of the choice of the estimation technique.

## **7. Conclusion and policy implications**

Using household-level data collected over 289 households from Suichuan

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<sup>17</sup> We also tried to introduce both predicted individual tenure perceptions and village-level average tenure perceptions into equation (1) to account for individual tenure and the average tenure of other survey respondents living within the same village. However, we found that all the regressions suffered from severe multicollinearity between individual tenure and village-level average tenure, and so have not reported these results.

and Fengcheng in Jiangxi province in southern China, this study examines the impact of tenure integrity and security on households' decisions to transfer in forestland. Our results show that, granting farmers more secure rights by reducing forestland reallocation and forestland expropriation without appropriate compensation mainly reduces transaction costs, and does contribute to the development of a market for forestland. Granting farmers more use and mortgage rights mainly increases the value of forestland and anticipation of increased rental prices, and makes the matching of potential partners in the forestland market more difficult. This effect inhibits the development of the forestland market.

The policy implications of our findings are twofold.

Firstly, forest tenure reforms should put more emphasis on the enforcement mechanism, and increase household perceptions of tenure integrity and security. The new round of forest tenure reform greatly contributed to improving tenure integrity and security from a legal perspective. However, given the existence of informal institutions such as rural customs, the legal rules for formal tenure cannot be fulfilled at the grassroots level. As a result, the household perceptions of tenure integrity and security are far below the level regulated for by legal provisions. In this context, the enforcement mechanism of forest tenure system at local level should be improved to help develop a forestland transfer market.

Secondly, in order to reduce the difficulty of matching partners in the forestland market, some further measures are needed to supplement forestland tenure reform in China. First, a well-functioning transfer platform is crucial to reduce the matching cost between potential landlords and tenants, in particular, help them to arrive at an appropriate rental price. Second, there is a need for an effective social insurance system in rural areas to reduce peasant's reliance on forestland as a form of social insurance and to encourage potential lessees to transfer out their forestland. Third, the scale of forestry operations could increase forestry production, which is important if rising rental price caused by

the tenure reforms is to be covered. Governmental subsidies for forestland transfer and operation, as well as other facilities are important measures for developing a forestland transfer market.

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## Appendix: robustness checks

**Table A1 Regression results for participation in land rental market  
(with integrity of forestland rights as tenure variables)**

Variable (Model)	(1) Rent in dummy (Probit)	(2) Rented land area (Tobit)	(3) Rented land area (Tobit)
Variable	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>b</sup>
<b><i>Forest tenure integrity</i></b>			
Village perception on use rights	-1.671*** (0.539)	-126.498** (51.885)	-126.498** (59.889)
Village perception on mortgage rights	-1.834*** (0.469)	-200.294** (95.998)	-200.294** (83.485)
Village perception on transfer rights	0.271 (0.429)	55.108 (59.143)	55.108 (67.144)
<b><i>Household characteristics</i></b>			
Head age	-0.303*** (0.053)	-28.022 (17.599)	-28.022 (18.816)
Head age square	0.003*** (0.000)	0.260 (0.158)	0.260 (0.164)
Head education	0.050 (0.043)	11.949 (7.335)	11.949 (9.859)
Leader or party member	0.361 (0.294)	78.622* (42.873)	78.622 (56.654)
Head gender	-2.133*** (0.580)	-183.345** (77.131)	-183.345* (98.250)
Head occupation	0.687*** (0.218)	54.804** (25.499)	54.804* (31.366)
Household size	-0.135 (0.111)	-10.089 (12.230)	-10.089 (12.519)
Labor share	-0.088 (0.868)	-67.000 (88.840)	-67.000 (100.403)
Female/male ratio	-0.224 (0.309)	-14.251 (45.912)	-14.251 (55.922)
Average education	0.092	5.348	5.348

	(0.075)	(6.156)	(9.488)
Off-farm employment share	0.297	116.557*	116.557
	(0.446)	(68.562)	(94.180)
Ln(Family wealth)	0.090*	11.535*	11.535
	(0.046)	(5.992)	(10.915)
<b>Forestland characteristics</b>			
Plot number	-0.673***	-72.650***	-72.650***
	(0.126)	(25.659)	(26.014)
Forestland area	-0.000	0.342	0.342
	(0.006)	(0.639)	(0.962)
<b>Village characteristics</b>			
Distance to town	0.230***	24.071**	24.071**
	(0.067)	(9.605)	(9.836)
<b>Regional characteristics</b>			
Region dummy	-1.303**	-174.483**	-174.483**
	(0.509)	(81.583)	(86.406)
Observations	289	289	289
Mean VIF <sup>c</sup>	10.05	10.05	10.05
Log pseudolikelihood	-62.20	-375.06	-375.06
% correct prediction	92.39	-	-

\*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels respectively.

<sup>a</sup> Standard errors are adjusted for 29 clusters (villages); <sup>b</sup> Bootstrapped standard errors with 200 replications are reported; <sup>c</sup> Mean VIF tests the degree of multicollinearity among the independent variables, including all the interactions.

**Table A2 Regression results for participation in land rental market  
(with security of forestland rights as tenure variables)**

	(1)	(2)	(3)
Variable (Model)	Rent in dummy (Probit)	Rented land area (Tobit)	Rented land area (Tobit)
Variable	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>b</sup>
<b>Forest tenure security</b>			
Village perception of land reallocation	0.374 (0.666)	53.110 (75.379)	53.110 (51.827)
Village perception of land	1.312*	168.901	168.901

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expropriation	(0.708)	(107.163)	(116.039)
<b><i>Household characteristics</i></b>			
Head age	-0.279*** (0.058)	-31.295* (18.069)	-31.295 (19.184)
Head age square	0.003*** (0.001)	0.298* (0.164)	0.298* (0.170)
Head education	0.074* (0.044)	15.689* (8.109)	15.689 (10.454)
Leader or party member	0.384 (0.280)	70.867 (44.404)	70.867 (55.128)
Head gender	-1.646*** (0.534)	-168.525** (80.165)	-168.525* (93.467)
Head occupation	0.557** (0.239)	44.352** (21.810)	44.352 (29.094)
Household size	-0.115 (0.126)	-7.529 (13.523)	-7.529 (13.315)
Labor share	-0.227 (0.837)	-74.788 (90.869)	-74.788 (95.112)
Female/male ratio	-0.248 (0.262)	-25.615 (44.741)	-25.615 (50.695)
Average education	0.045 (0.072)	1.138 (5.783)	1.138 (9.223)
Off-farm employment share	0.386 (0.368)	106.007 (70.523)	106.007 (90.085)
Ln(Family wealth)	0.063 (0.062)	8.989 (7.102)	8.989 (12.133)
<b><i>Forestland characteristics</i></b>			
Plot number	-0.810*** (0.170)	-90.046*** (29.811)	-90.046*** (31.716)
Forestland area	0.003 (0.005)	0.546 (0.551)	0.546 (0.969)
<b><i>Village characteristics</i></b>			
Distance to town	0.121*** (0.046)	13.660*** (5.173)	13.660 (8.679)

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<b>Regional characteristics</b>			
Region dummy	0.369 (0.390)	-11.295 (44.292)	-11.295 (40.125)
Observations	289	289	289
Mean VIF <sup>c</sup>	10.33	10.33	10.33
Log pseudolikelihood	-75.31	-375.06	-375.06
% correct prediction	89.97	-	-

\*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels respectively.

<sup>a</sup> Standard errors are adjusted for 29 clusters (villages); <sup>b</sup> Bootstrapped standard errors with 200 replications are reported; <sup>c</sup> Mean VIF tests the degree of multicollinearity among the independent variables, including all the interactions.

**Table A3 Regression results for participation in land rental market (IV method)**

	(1)	(2)	(3)
Variable (Model)	Rent in dummy (Probit)	Rented land area (Tobit)	Rented land area (Tobit)
Variable	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>a</sup>	Coef. (Std.Err.) <sup>b</sup>
<b>Forest tenure integrity</b>			
Household perception of use rights <sup>c</sup>	-1.019 (0.790)	-95.212** (42.740)	-95.212 (59.691)
Household perception of mortgage rights <sup>c</sup>	-2.390*** (0.508)	-232.461** (93.947)	-232.461** (98.304)
Household perception of transfer rights <sup>c</sup>	0.635 (0.539)	130.540* (78.352)	130.540 (109.027)
<b>Forest tenure security</b>			
Household perception of land reallocation <sup>c</sup>	0.875 (0.744)	92.180 (68.468)	92.180 (76.378)
Household perception of land expropriation <sup>c</sup>	2.124*** (0.803)	224.808** (110.510)	224.808 (155.843)
<b>Household characteristics</b>			
Head age	-0.363*** (0.076)	-28.115 (18.093)	-28.115 (19.793)
Head age square	0.004*** (0.001)	0.300* (0.173)	0.300* (0.179)
Head education	0.175***	22.187**	22.187*

	(0.053)	(9.271)	(12.695)
Leader or party member	1.062***	130.407**	130.407*
	(0.331)	(59.395)	(69.716)
Head gender	-2.845***	-258.095**	-258.095**
	(0.701)	(103.467)	(120.683)
Head occupation	1.243***	100.252**	100.252**
	(0.328)	(39.777)	(40.028)
Household size	-0.167	-11.294	-11.294
	(0.131)	(13.490)	(12.013)
Labor share	-1.318	-191.188**	-191.188*
	(0.936)	(94.900)	(107.334)
Female/male ratio	-0.911**	-84.097	-84.097
	(0.432)	(65.808)	(72.776)
Average education	-0.064	-12.801	-12.801
	(0.086)	(8.275)	(14.019)
Off-farm employment share	1.480**	190.634*	190.634
	(0.593)	(102.811)	(125.618)
Ln(Family wealth)	-0.046	-0.947	-0.947
	(0.056)	(7.825)	(10.838)
<b><i>Forestland characteristics</i></b>			
Plot number	-0.845***	-82.853***	-82.853***
	(0.164)	(29.742)	(29.162)
Forestland area	0.007	0.912	0.912
	(0.008)	(0.753)	(1.110)
<b><i>Village characteristics</i></b>			
Distance to town	0.264***	26.912***	26.912**
	(0.052)	(8.891)	(11.296)
<b><i>Regional characteristics</i></b>			
Region dummy	-0.688	-103.923**	-103.923
	(0.452)	(47.807)	(63.777)
Observations	289	289	289
Mean VIF <sup>d</sup>	11.22	11.22	11.22
Log pseudolikelihood	-60.99	-367.17	-367.17
% correct prediction	91.00	-	-

\*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1% levels respectively.

<sup>a</sup> Standard errors are adjusted for 29 clusters (villages); <sup>b</sup> Bootstrapped standard errors with 200 replications are reported; <sup>c</sup> Household perceptions on tenure integrity and security are predicted values using average values of all household perceptions in a village as instruments; <sup>d</sup> Mean VIF tests the degree of multicollinearity among the independent variables, including all the interactions.