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Property Rights, Village Political System, and Forestry Investment: Evidence from China's Collective Forest Tenure Reform

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Abstract: To investigate the effect of improved property rights and, in particular, village democracy under China's Collective Forest Tenure Reform (Tenure Reform) on household forestry investments, we estimate both tobit models and the more general Cragg models for farmers' labor and monetary inputs into forestry, using survey data of 652 households from the southern collective forest region of China. The results reveal that the improved forestland use and disposition rights had a significant effect on household investments in forestry, while the beneficiary right did not. In addition, the results suggest that village democracy had a positive effect on households' forestry investments. More importantly, we find that village democracy was able to significantly strengthen the investment incentive effect of the improved property rights under the Tenure Reform. These effects may be explained by the fact that village democracy improved households' perception, cognition, and, subsequently, confidence toward, in particular, the use and disposition rights of the forests entitled to them. Therefore, the findings suggest that to increase the investment incentives of the Tenure Reform further, governments could strengthen the bundle of households' use and disposition rights, as well as their related policies. Also, our findings indicate that governments could significantly improve the performance of public policies by effectively employing democratic procedures in the process of policy implementation.

Keywords: village democracy; property rights; investment; forest tenure reform; China

1. Introduction

In China, the local agricultural and forest collectives own 62% of all the forests [1]. Since the founding of the People's Republic of China in 1949, Chinese tenure institutions of forestland have experienced a series of fundamental changes [2]. The radical and frequent institutional reversals in property rights induced by these changes have severely dampened households' forestry investment incentives [2,3]. Thus, beginning in the late 1990s and continuing into the early twenty-first century, to motivate households to conduct forestry investments, the Chinese central government initiated a new round of collective forest tenure reforms (collectively referred to as Tenure Reform), including the 1998 *Land Management Law*, the 2002 *Rural Land Contract Law*, the 2003 *Resolution on the Development of Forestry*, and the 2007 *Property Law* [4]. Generally, the Tenure Reform can be partitioned into two parts: the main reform and the supplementary reform. The main reform is about devolving the use right of collective forests by issuing households with legal certificates. After the main reform was

finished by 2012, 180.64 million hectares of collective forests, which account for 99% of China's total collective forest area and 60.02% of China's total forest area, was devolved to households by use right transfer [1,5]. These forests accommodate 71% of domestic timber production. In the supplementary reform, the disposition right, beneficiary right, and corresponding property right policies of forests became more intact and secure [2]. Since 90% of China's forests are located in mountainous areas and 86% of rural households in poverty live in the same areas, China's government places high expectations on the investment incentive and poverty alleviation effects of the Tenure Reform [1,3].

The Tenure Reform has substantially improved the property rights of household forests [6]. Secure property rights can enhance the profitability and exclusivity of assets, reduce investment risk, and increase the efficiency of factor allocation. Therefore, it is anticipated that the Tenure Reform will motivate households' forestry investments and, subsequently, enhance household forestry income [7]. However, conclusions regarding the effects of the Tenure Reform on forestry investments are ambiguous. Some studies have indicated that the investment incentive effect exists by comparing household forestry investments before and after the Tenure Reform [8,9], and others have even indicated that the Tenure Reform has enhanced household forestry income because of the increase in their forestry investments [10,11]. On the other hand, some studies have concluded that the Tenure Reform does not achieve its desired effects [12–14]; many papers argue that the Tenure Reform has caused serious fragmentation of forestland and had an adverse effect on the efficiency of forestry production [12]. The redistribution of forests to households has ostensibly promoted equality and production, but the management costs have been increased significantly [13]. Consequently, households' forestry investment incentives are still at a relatively low level. For example, Yu et al. [14] observed that only 44% of the farmers living in collective forest regions under the Tenure Reform would be likely to reinvest in forestry production.

China's government started to construct democratic village institutions in December 1982, when the new constitution legally approved that the village committee is the essential rural grassroots mass autonomous organization and has the right to elect the village leaders and villagers' representatives by villager voting. The legalization of village-level democratic elections is acknowledged as a vital improvement, which is a significant starting point of China's democratization. During the last thirty years, China's government has gradually developed village-level democratic decision-making, democratic management and democratic supervision mechanisms. This has improved rural welfare and self-governance dramatically [15]. To guarantee policy fairness and efficiency, national regulations of the Tenure Reform stipulate that every village should democratically vote for their own decision on whether to conduct the Tenure Reform. Also, each village committee that decides to enforce the Tenure Reform should draw up its reform scheme and formulate corresponding policies through village-level democratic procedures [16]. In this study, we define village self-governance activities and household political participation as village democracy, which includes democratic election, decision-making, management, and supervision processes.

Although China's democratic system has attributes that differ to those of Western developed countries' democracies [17,18], village democracy can be expected to strengthen the investment incentive effect of the improved property rights under the Tenure Reform in at least two ways. First, if village democracy were sound, farmers' perception and cognition of the benefits of the improved property rights would be boosted through the democratic procedures of publicity, discussion, decision, and supervision under the reform. Second, farmers would have more confidence that the improved property rights structure would be stable and the production benefits from the Tenure Reform would not be taken away coercively if they have participated in designing the policies and voted for them [17]. In general, farmers would have more positive expectations and incentives for engaging in forestry production. However, empirical evidence on whether village democracy has affected households' use of labor and monetary expenditure in forestry is weak. Furthermore, the way that village democracy works in the Tenure Reform remains unclear. Thus, our inquiry in China will especially seek further evidence of the role of village democracy in the investment incentive effect of the Tenure Reform.

Although a plethora of papers have investigated the consequences of the Tenure Reform [19,20], research that investigates the effects of village democracy on the performance of the Tenure Reform is rare. Village democratization in rural China has been found to have profound impacts on many socio-economic developments. Existing studies on the subject can be classified into two groups. One group of studies describes the development of Chinese village democratization, such as the Chinese villages' path to democracy [21], determinants of village democracy [22], and factors impeding democratic rules [21]. The other group of studies identifies the consequences of the democratization, including how village democratization affects household agricultural production [23], rural self-governance [24], and household welfare [25]. Despite this, to date and to the best of our knowledge, only one study by Zhang et al. [26] has investigated the difference in the investment incentive performance of the Tenure Reform between the villages that conducted democratic procedures and those that did not. They [26] found that the Tenure Reform could motivate households to conduct further forestry investments, but the effect was only found in the villages that democratically implemented the Tenure Reform. However, they [26] did not systematically measure the improved forest property rights and the village democracy involved in the process of the Tenure Reform implementation. Specifically, Zhang et al. [26] used dummy variables to measure village democracy and the Tenure Reform. These issues may thus limit the usefulness of conclusions of this initial study. In our study, we will try to fill these research gaps.

The purpose of the present study is to investigate the effect of improved property rights and, in particular, the effects of village democracy under the Tenure Reform on household forestry investments. Based on a conceptual framework, we hypothesize that improved property rights and village democracy both have direct positive effects on household forestry investments under the Tenure Reform. In addition, we hypothesize that the higher the level of the village democracy, the stronger the effect of property rights on the farmers' investment incentives. A survey data collected for the purpose of this study and econometric methods of discrete and limited dependent variables are used to investigate these hypotheses empirically.

2. Conceptual Framework and Econometric Specification

2.1. Conceptual Framework

2.1.1. Basic Economic Model: Market Factors

A representative household's primary incentives in production factor allocation are relative prices if reasonably well-functioning market conditions can be assumed. Specifically, input and output prices of forestry investments and those of alternative investments [27] affect factor allocation to forestry [28]. This is because relative prices influence households' expectations regarding revenues [29] and risks [30]. Therefore, attractive forest returns and favorable market conditions for forestry production are significant factors in motivating households to invest in forestry [31,32]. Thus, as a starting point, we assume that market factors influence household investments in forestry.

2.1.2. The Effects of Institutional Arrangements

In the real world, household investments in forestry are not only influenced by market factors but also by regulatory policies. In other words, since forestry is a long-term investment, institutional arrangements, such as forestland tenure, property right market rules, and financial incentive policies, are vital for affecting household investments [33]. Property rights is one of the most widely discussed topics in global forest policy today because it is the key underlying issue in the institutional arrangements that influence tenure holders' benefits and the costs of forestry production. Earlier research provides the preliminary arguments for the general impacts of forest property rights on stakeholders' input decisions [34]. For example, Zhang and Pearse [35], and Laarman and Gregersen [36], conclude that integrated property rights are essential factors in the stimulation

of private forestry investments, while, in some other empirical investigations on the deterioration of property rights, Bohn and Deacon [37], and Deacon [38], show that restricted property rights have an adverse effect on private forestry resource allocation. Therefore, although the effect of property rights might depend on the specific circumstances, the Tenure Reform and its supporting measures could be identified as a crucial factor that affects household forestry investment decisions.

Theoretically, democratic decision-making, democratic management, and democratic supervision mechanisms in the process of the Tenure Reform implementation could stimulate households' perception, cognition, and, subsequently, confidence toward the benefits and security of the Tenure Reform. Consequently, households might adjust their factor allocation strategies according to their experience regarding the democratic procedures. Specifically, households with a better experience and impression would have a higher expectation of the Tenure Reform and forestry production, and they would have a greater probability of conducting forestry investments and investing more. Besides, democratization could also create opportunities for local collective action by connecting farmers and rural grassroots mass autonomous organizations [39], which could be a separate mechanism for promoting investment. In addition, the Tenure Reform is a carrier of the incentive effect of village democracy on household forestry investments. To put it another way, the effect of village democracy works through the implementation process of the Tenure Reform. Thus, we hypothesize that village democracy may have a strengthening effect on households' forestry investment incentives caused by the Tenure Reform, which is measured in estimable Equation (1) below by the interaction term.

2.1.3. The Effects of Social Factors

Generally, social factors have effects on forestry investments [4]. Some studies have suggested that household social factors (i.e., household characteristics) can be used to predict farmers' propensity to invest in forestry or to react to public policies and programs [40], because household characteristics, such as labor force, financial capital, and social capital, could affect household direct-production cost and opportunity cost. For example, budget and labor constraints have been identified as critical factors in determining the use of inputs into forestry [41].

2.1.4. The Effects of Ecological Factors

In addition, there has been some debate as to whether ecological factors are primary factors affecting small-scale forest owners' investment incentives. Some studies find that forest attributes are positively correlated with household inputs into forestry [18,42], while several other studies have questioned the impact in the developing countries [2,43]. Since the geographic factors and size and quality of household forests vary to a large extent in China's southern collective forest regions and could affect the benefits and costs of household forestry production [44], we also use ecological factors to explain household forestry investment decisions.

2.2. Empirical Approach

Based on the discussion above, we hypothesize that representative household forestry investments are explained by market factors, property rights, village democracy, social factors, ecological factors and household living regions. Note that, since village democracy could be assumed to strengthen the investment incentive effect of the improved property rights under the Tenure Reform, we include an interaction term of property rights and village democracy to test this strengthening effect. The reduced-form behavioral equation for household forestry investment can be written as Equation (1):

$$I_i = aPRs_i + bVD_i + cPRs_i \times VD_i + dMF_i + eSF_i + fEF_i + gRG_i + \varepsilon_i \quad (1)$$

where I_i means household i 's forestry investments; PRs_i represents property rights; VD_i represents village democracy; MF_i represents market factors; SF_i and EF_i denote household social and ecological

factors; RG_i represents household living regions; ε_i is a random disturbance term; and a–g represent the estimated coefficients.

2.3. Econometric Approach

The factors affecting households' decisions to invest labor and purchased monetary inputs in forestry are investigated using cross-sectional survey data available for the study. This data set contains information on the quantity of resources invested in forestry, and information on prices, costs and owner and forest characteristics. Because not all forest owners have invested in forestry production since the Tenure Reform, the data is censored at zero [45]. This type of data is typically analyzed by using a limited dependent variables model, the tobit model and the maximum likelihood method [46]. The standard tobit model assuming a corner solution implies a true zero investments decisions. Considering the time elapsed since the implementation of the Tenure Reform, this is a reasonable assumption in our data. Thus, we initially estimate tobit models for households' own labor inputs and monetary investments into forestry since the Tenure Reform.

In the tobit model, each independent variable is assumed and in estimating the basic tobit models is actually forced to affect the probability and the quantity of the dependent variables similarly. However, this is not necessarily the case in the data, and the tobit model can possibly overlook some policy-relevant information in the data [47]. Therefore, the tobit model should always be tested by estimating a more general Cragg model [48]. The Cragg model is a combination of a probit model for the probability of taking action on investments estimated using the whole sample, and a truncated regression model for the quantity of the investments estimated using nonlimit observations [47,49]. Here, a Decision Equation (2) is specified as:

$$\begin{aligned} \text{Prob}[y_i^* > 0] &= \Phi(\gamma' x_i), & z_i &= 1 \text{ if } y_i^* > 0, \\ \text{Prob}[y_i^* \leq 0] &= 1 - \Phi(\gamma' x_i), & z_i &= 0 \text{ if } y_i^* \leq 0, \end{aligned} \quad (2)$$

and a Regression Equation for nonlimit observations (3) is specified as:

$$E[y_i | z_i = 1] = \beta' x_i + \sigma \lambda, \quad (3)$$

in Equation (2), y_i^* is the censored dependent variable, Φ is the normal cumulative distribution function, x_i are the independent variables of the model, γ' are the parameters estimated using a probit model, and z_i is the indicator variable for positive observations of y_i^* , i.e., the dependent variable of the probit model. In Equation (3), β' are the regression coefficients of the quantity equation for nonlimit observations, σ is the standard error, and λ the so-called Mills ratio, accounting for the effect of truncation of the sample. A tobit model arises if $\gamma = \beta/\sigma$ [47]. Whether a tobit model or a Cragg model is a better representation of the decision process described by the data can be tested using a likelihood ratio test [47].

Therefore, after estimating the tobit models explaining forestry investments, we also estimate and report the results of the probit models on households' probability to invest in forestry [45] and the truncated regression models for the subsample of households that have invested labor and monetary inputs into forestry since the Tenure Reform [49]. It turns out that the tobit model assumption cannot actually be accepted for the models explaining forest owners' decisions to use labor and monetary inputs into forestry. In what follows, we therefore report and discuss the results of the probit models and the truncated regression models first. However, the results of the tobit models are also of interest as they indicate whether the overall average (unconditional) effect of the independent variables in the whole sample are statistically significant. The estimation of the aforementioned models was carried out using Stata version 12.

3. Data and Empirical Measurements

3.1. The Study Area and Data Collection

In China, 300.97 million hectares of the nation's total forestland can be divided into two categories of ownership—collective or state-owned [3]. Collective forestland accounts for 62% of the nation's total forestland, while the other 38% is owned by the national, provincial, and local governments [1,3]. Nevertheless, the stocking levels of collective forests are low. Specifically, the collective forests only contribute 45% of the total forest volume ($15.13 \text{ billion m}^3$) [5]. The stocking level of most counties of the southern collective forest region is in the range of $30\text{--}50 \text{ m}^3/\text{ha}$ [5], which is far below international average standards of $131 \text{ m}^3/\text{ha}$ [50]. Figure 1 graphically shows the distribution of China's forestry resources and data collection areas.

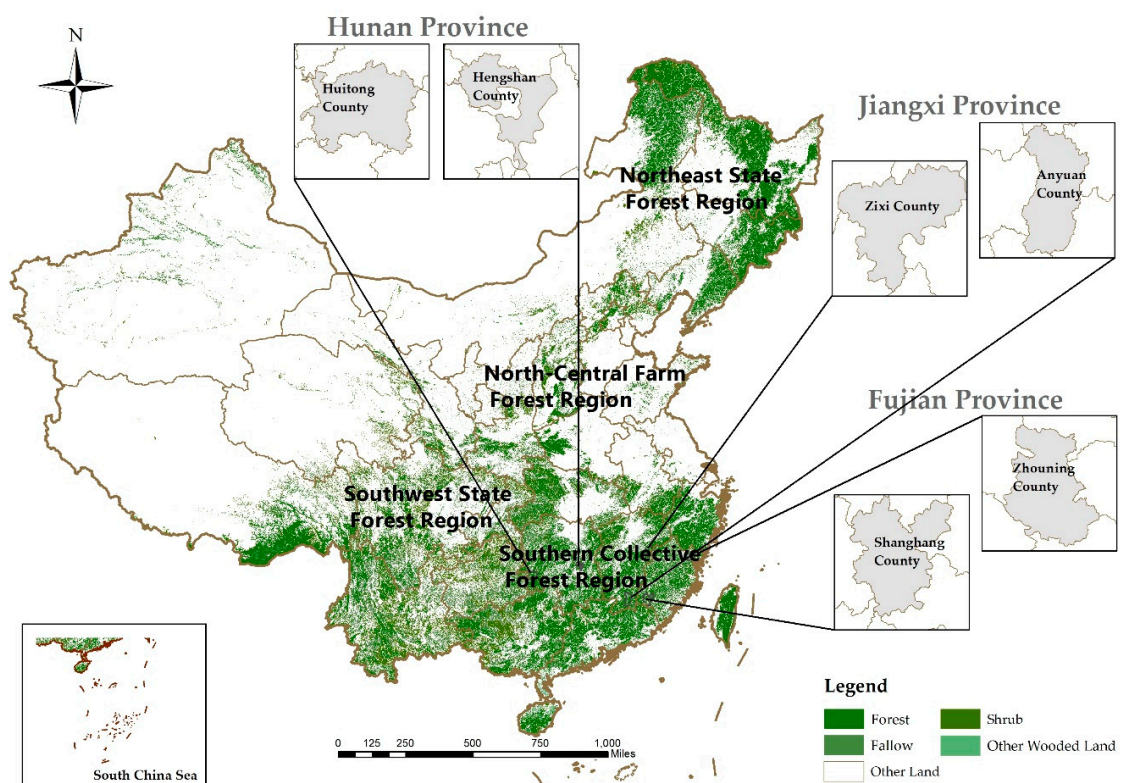


Figure 1. Forest distribution of China and data collection areas.

To represent a broad spectrum of different characteristics of China's major southern collective forest region, we chose Fujian, Jiangxi, and Hunan provinces, which were the first ones to conduct the Tenure Reform in the collective forest regions, as the research area based on the disparities of their economic development, forest endowment, geographical distributions, and the Tenure Reform implementation. (For example, among these three provinces, with regard to the economic development, the annual disposable income of rural households per capita ranged from 13,242.21 to 27,360.28 yuan (100 yuan = 15.75 USD) in 2017. The forest cover ranged from 57.34% to 66.12%, and the area ratio of collective-owned forests to total forests was between 68% and 92% before the Tenure Reform). Specifically, we performed a simple random sampling method to draw two counties from each province, as depicted in Figure 1, and eight towns from each county. All the sampled counties and towns were selected disregarding order and without replacement. Since the principle of simple random sampling is that every object has the same probability of being chosen, we believe that the sampled counties and towns are representative of China's southern collective forest region. Then, in every sampled township, we divided villages into three groups based on the level of the proportion of collective forest area to

the total forest area, then randomly chose one village from each group. In each village, we randomly chose five households for the interview. A total of 720 households were investigated using in-person interviews during January and February of 2018.

During the interviews, a structured questionnaire was given to households. The questionnaire included questions on the Tenure Reform, the village democracy involved in the whole process of the Tenure Reform implementation, market attributes, household production and demographic characteristics, and ecological characteristics. The enumerators talked to the household heads, who usually make forestry production decisions in China, to ensure that the interviewees were sufficiently knowledgeable to give in-depth replies to the set questions. If the respondents seemed hesitant, the enumerators were told to emphasize the confidentiality of the answers. After the interview, with the interviewees still present, the enumerators reviewed the answers to check for incorrect entries. In addition, after arriving at the sampled villages, we discussed with village leaders, asked for basic information on each village, and obtained the necessary official documents. These documents contained the basic information on village economy, the Tenure Reform, and village democracy. After the survey stage, we assigned enumerators to check the rationality of the responses in the questionnaires. The enumerators compared the information provided in questionnaires with general information in the official documents. For unreasonable responses, we called the household heads and asked them to check the responses. Questionnaires from household heads who still could not provide valid answers were excluded from the analysis. Ultimately, there were 652 valid responses.

3.2. Variables Used

3.2.1. Dependent Variables

Forestland, labor, and capital are essential production factors for forestry activities. Nevertheless, since the Tenure Reform, most households' forestland area has been fixed and only a small percentage of the households have rented in or out forestlands [51]. Thus, we took the forestland area as a given explanatory variable and chose forestry labor and monetary production expenditure as our dependent variables in each of our empirical equations. As we focus on the effects of village democracy on households' probability of investing, as well as on the quantity invested in the case of nonlimit observations, we chose to ignore the possible simultaneity between labor and monetary inputs. For this reason, only the reduced-form equations for the two dependent factors, labor and monetary production expenditure, are estimated.

Specifically, since forestry production has a relatively long-term investment cycle and investments are usually concentrated in the early stages of production, we measure forestry labor input by the cumulative labor person-days that household members have spent on forestry production since the Tenure Reform. Similarly, we measure monetary production expenditure by the cumulative expenditure in ten thousand yuan in household forestry production since the Tenure Reform. The expenditure includes the cost of forestry labor hiring, fertilization, and seedlings.

In the tobit models, the dependent variables were limited ones ($I \geq 0$). The dependent variables were qualitative (*there were investments* = 1; *otherwise* = 0) when estimating bivariate probit models. The truncated models were estimated for the subsample with strictly positive and continuous dependent variables.

3.2.2. Measuring Property Rights

In order to be able to measure the effects of property rights, we need to first define the components of the property rights that could affect household forestry production. The property right components generally include ownership, use right, disposition right, and beneficiary right [52]. Every component consists of a bundle of specific rights, and there are corresponding specific property right policies to define what kind of authority farmers could really enjoy in China. Since forestlands are declared as collective property in China, farmers do not own forestland. Thus, use right, disposition right,

beneficiary right, and corresponding property right policies are able to regulate almost all types of household behaviors related to forestry production [53]. Note that it is also these three property right components that have been improved under the Tenure Reform.

The investment incentive effect of improved property rights on household forestry production decisions are mainly based on households' cognition of the property right components and, more specifically, the corresponding right policies they face [54]. Thus, the present study used the forestry property right policies to measure the improved property rights under the Tenure Reform. Table A1 presents the indicator system and the descriptive statistics of each disaggregated property right policy.

To assess the property rights precisely, we created three property right indexes for each property right component, representing the strength of the bundle of property rights that farmers own, by using weighted sums of the scores of corresponding property right policies of each property right component [7]. To avoid the ambiguity of employing subjective weights, as in the Delphi method, we used the entropy method instead to calculate the weight of each right policy of each property right component [55,56]. The specific calculation method is as follows: (1) Build a matrix as $R = (r_{ij})_{m \times n}$, where r_{ij} is the right policy j of household i , m is the number of observations in the sample, and n is the number of right policies of each property right component; (2) Calculate the entropy of each right policy, $H_j = -k \sum_{i=1}^m f_{ij} \ln f_{ij}$, where $f_{ij} = \frac{r_{ij}}{\sum_{i=1}^m r_{ij}}$ and $k = \frac{1}{\ln m}$; (3) Calculate the entropy weight of each right policy, $g_j = \frac{1-H_j}{m-\sum_{j=1}^n H_j}$, and then standardize it. Based on the entropy weight, we calculated the property right index of the use right, disposition right and beneficiary right respectively for each household. Property right indexes are summarized in Table 1.

Table 1. Descriptive statistics of the data. (whole sample, $N = 652$).

Variable	Definition	Unit	Mean	Std. Dev.
Household Forestry Investment				
Forestry Labor	Cumulative household own labor force input into forestry production undertaken after Tenure Reform	Person-days	1387.37	2416.84
Forestry Labor, Nonlimit Households	Cumulative household own labor force input into forestry production undertaken after Tenure Reform, nonlimit households	Person-days	1644.66	2191.16
Forestry Production Expenditure	Cumulative monetary cost in forestry production undertaken after Tenure Reform	Ten Thousand Yuan	5.91	2.67
Forestry Production Expenditure, Nonlimit Households	Cumulative monetary cost in forestry production undertaken after Tenure Reform, nonlimit households	Ten Thousand Yuan	7.01	2.29
Property Rights				
Use Right	Use right index	/	0.63	0.31
Disposition Right	Disposition right index	/	0.57	0.39
Beneficiary Right	Beneficiary right index	/	0.37	0.26
Village Democracy				
Village Democracy	Village democracy index	/	0.48	0.77
Market Factors				
Timber Price	The available timber price for household	Yuan/m ³	391.68	141.82
Market Interest Rate	Annual interest rate of household borrowing money from non-financial units ¹	%	5.64	0.49
Wage of Forestry Labor Force	Employment wage of forestry labor force	Yuan/day	151.61	31.01
Social Factors				
Non-farm Income Proportion	Proportion of non-farm income to total household income	%	43.81	81.94
Labor Force	Number of persons in work in household	Persons	2.79	0.37
Education	Education level of household head	Years	6.61	3.88
Leadership	Family members' experience of village leaders and cadre	0/1	0.29	0.31
Ecological Factors				
Average Stand Age	Weighted average stand age of household forests	Years	9.34	6.27
Total Forestland Area ²	Forestland(s) area managed by household since the Tenure Reform	Ha	7.59	11.43
Forestland Quality	Interviewee's general subjective evaluation of forestland conditions and fertility	5-point Likert Scale	3.09	1.97

Table 1. Cont.

Variable	Definition	Unit	Mean	Std. Dev.
Region				
Fujian	Whether household's registered permanent residence is in Fujian province	0/1	0.27	0.49
Jiangxi	Whether household's registered permanent residence is in Jiangxi province	0/1	0.31	0.47

¹ In rural China, most farmers borrow money from non-financial units, such as parents, relatives, and rural usurious loan suppliers instead of formal financial institutions because of their low accessibility. ² The total forest area managed by any household is the sum of its family forestland, and rent-in forestland area deducted from the rent-out forestland since the Tenure Reform. The family forestland was the product of fundamental reforms in the early 1980s. The renting between households is a more recent activity permitted only since the Tenure Reform.

3.2.3. Measuring Village Democracy

The level of village democracy was also measured using an index. This index was created to measure the village democracy involved in the whole process of the Tenure Reform implementation. The reason for this dimensionality reduction by creating an index is that using a democracy index is a conventional method for assessing regional democracy and the index can comprehensively incorporate multidimensional information about regional democracy [57].

The Freedom House Democracy Indicators [58], the Polity IV Index [59], Vanhanen's Democracy Index [60], and the Economist Intelligence Unit's Index of Democracy [61] are widely used to measure regional democracy. However, Chinese democracy has some unique features in comparison to Western developed countries' democracies [17,18,62], which makes the above indexes not entirely suitable for measuring Chinese village democracy [63]. In the present study, based on the above indexes, we created a new index through the following steps. First, we divided village democracy into four components: democratic election, democratic decision-making, democratic management, and democratic supervision [64]. Second, we divided these four components into nine secondary indicators characterizing the corresponding democratic procedures involved in the process of implementing the Tenure Reform [65]. Table A2 presents the indicator system and the descriptive statistics of the secondary indicators of the disaggregated village democracy components.

Finally, we calculated the village democracy index for each household as $VD_i = \sum_{j=1}^9 p_{ij}/9$, where p_{ij} denotes the value of secondary indicator j of household i and VD_i is the village democracy index of household i . The general results are summarized in Table 1.

4. Results

4.1. Descriptive Statistics

In our sample observations, 56.81% of the households mainly rely on agricultural income for living and the sample households' average ratio of forestry income to total household income is 13.32%. In addition, 81.36% of the sample households only have one or two household member(s) working in agriculture and the education level of 84.43% of the household members is junior high. According to the data, 13.36% of the interviewees did not know the primary aim and content of the property rights policies and some of them were even not aware of the Tenure Reform. In addition, with regard to the interviewees who know the Tenure Reform to a certain extent, 12.21% of them believe that there was no democratic procedure at all in the entire process of the Tenure Reform implementation. This suggests that some village committees did not implement the Tenure Reform in accordance with the policy requirements. For example, some village committees did not publicize the Tenure Reform and some of them did not conduct democratic voting on the forestland reallocation scheme; some village committees even compulsively and/or unjustly entitled the collective forests to households without reasonable fairness and efficiency.

Table 1 illustrates the specific definitions and descriptive statistics of all the variables incorporated in our empirical models.

4.2. Estimation Results

As stated above, we initially estimated tobit models using the whole sample, as this specification can simultaneously model both households' probability of entering the market and the quantity of resources invested when the decision to use inputs has been made. Tobit specification may, however, hide policy-relevant differences in the effects of independent variables on the probability of investing in forestry and the quantity of inputs for those who actually decide to invest in forestry. Therefore, in order to obtain more information on the effects of independent variables on the decision to invest and on the quantity of inputs used by nonlimit forest owners, the Cragg [48] specification was used. Thus, probit models were estimated for the probability of investments and truncated models for the subsample of positive investments [47]. The results for the tobit, probit and truncated regression models are all presented below in Tables 2 and 3.

Table 2. Estimation results: Tobit and Cragg models for the probability and quantity of labor investment.

Independent Variable	Tobit Model		Probit Model		Truncated Regression Model	
	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio
Use Right	539.998 **	1.93	1.008 **	2.58	4276.678	0.86
Disposition Right	127.036 ***	3.42	0.126 ***	3.61	1024.693 *	1.83
Beneficiary Right	76.493 *	1.68	0.113 **	2.43	726.980	1.00
Village Democracy	814.183 *	1.76	0.392	0.54	13,035.940 **	2.13
Use Right × Village Democracy	468.076 **	2.44	0.134 ***	3.71	1352.707 **	2.21
Disposition Right × Village Democracy	51.815 *	1.75	0.064	1.14	742.442 *	1.89
Beneficiary Right × Village Democracy	38.507	0.91	−0.006	−0.08	40.293	0.11
Timber Price	2094.361 ***	5.96	1.187 **	2.15	20,418.160 ***	2.80
Market Interest Rate	−923.616	−0.72	−0.545	−0.93	−3560.203	−0.51
Wage of Forestry Labor Force	1.964	0.61	0.001	0.31	51.852	1.10
Non-farm Income Proportion	−161.937	−0.82	0.276	1.38	−4303.782	−1.51
Labor Force	0.829 ***	6.24	0.051 ***	6.74	3.269 ***	3.32
Education	2.312 ***	10.49	−0.010 ***	−6.51	5.439 ***	3.18
Leadership	489.906 ***	2.60	0.205	1.10	7820.804 **	2.25
Average Stand Age	125.742	0.99	0.063	0.86	678.079	0.84
Total Forestland Area	5.267 *	1.88	0.050 ***	6.42	117.031 **	2.02
Forestland Quality	411.299 **	2.35	0.032	0.18	9083.495 **	2.31
Fujian	512.596 **	2.59	0.150	0.77	11,915.420 **	2.27
Jiangxi	442.618 **	1.99	0.122	0.53	12,033.360 **	2.21
Constant	−134.817	−0.12	−1.086	−0.91	−48,555.260 **	−1.98
Statistics Diagnosis						
Chi-squared	371.02		242.86		24.74	
Log Lik.	−5010.98		−158.77		−4520.02	
Pseudo R ²	0.036		0.433			
N	652		652		550	

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Table 3. Estimation results: Tobit and Cragg models for the probability and quantity of capital investment.

Independent Variable	Tobit Model		Probit Model		Truncated Regression Model	
	Coefficient	t-Ratio	Coefficient	t-Ratio	Coefficient	t-Ratio
Use Right	1.342 **	2.55	1.061 **	2.31	0.565 **	2.28
Disposition Right	0.306 ***	6.04	0.237 ***	3.85	0.062 **	2.32
Beneficiary Right	0.284 ***	4.54	0.097 **	2.53	0.046	1.46
Village Democracy	2.609 ***	4.06	0.843 *	1.90	0.707 **	2.28
Use Right × Village Democracy	0.334 ***	2.73	0.236 ***	3.79	0.077 **	2.36
Disposition Right × Village Democracy	0.124 ***	2.67	0.092 *	1.71	0.039 ***	2.75
Beneficiary Right × Village Democracy	0.060	1.02	0.019	0.26	0.040	1.44
Timber Price	1.770 ***	3.42	1.187 **	2.29	0.735 ***	2.79
Market Interest Rate	−1.454	−1.00	−0.648	−0.68	−0.324	−0.90
Wage of Forestry Labor Force	0.001	0.19	0.003	0.36	−0.0006	−0.30
Non-farm Income Proportion	0.936	0.34	0.361	1.42	−0.227 *	−1.69
Labor Force	0.0007 ***	3.86	0.081 **	2.44	0.0004 ***	4.80
Education	0.0004	1.40	−0.006 **	−2.56	0.0006 ***	4.09
Leadership	0.535 **	2.07	0.304	1.07	0.338 **	2.58
Average Stand Age	0.183	0.38	0.091	0.69	0.063	1.47
Total Forestland Area	0.005 **	1.92	0.008 **	2.46	0.004 *	1.87
Forestland Quality	0.304	1.26	0.267	0.85	0.129	1.08
Fujian	0.739 ***	2.72	0.218	0.87	0.314 **	2.30
Jiangxi	0.595	0.94	0.184	1.53	0.144	0.94
Constant	2.123	1.37	−2.948	−1.12	5.307 ***	6.79
Statistics Diagnosis						
Chi-squared	202.07		219.64		226.36	
Log Lik.	−1447.70		−519.29		−894.86	
Pseudo R ²	0.065		0.206			
N	652		652		550	

Note: *, **, and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

The likelihood ratio test statistics for labor and capital investments are respectively 664.38 and 67.10 with the same 20 degrees of freedom. The statistics for both labor and capital investments exceed the critical value of chi-square distribution at a significance of 1% (which is 37.57). The test suggests that the Cragg models are actually preferable to the tobit models for the analysis. Therefore, we discuss the results of the Cragg models, as it is interesting to see whether the effects on the dependent variables are due to the decision to act or due to the effect of the independent variables on the quantity (or both). However, the results of the tobit models are also of interest, as they indicate whether the unconditional total effects of the probability and quantity decisions sum up to a statistically significant unconditional average effect for the whole sample.

4.2.1. The Effects of Property Rights

As shown in Table 2, forest property right components, which include use right, disposition right, and beneficiary right, all had significant positive effects on the probability of households allocating labor to forestry production. The use right had the strongest effect, while the effect of the beneficiary right was the weakest. Interestingly, contrary to our expectation, the results of the truncated regression model suggest that only the disposition right statistically and significantly motivated the quantity of household labor investment.

Similarly, as the results of the probit model show in Table 3, all the forest property rights had a positive effect on households' probability of investing capital in forestry production. Also, the results of the truncated regression model indicate that both the use and disposition rights positively affected households' quantity of capital investment in forestry production, while the beneficiary right did not have statistically significant effect on it. The property rights variables are statistically significant in the tobit models in both Tables 2 and 3, thus indicating that the unconditional effects of the property rights for the whole sample on households' labor and capital investment are positive.

4.2.2. The Effects of Village Democracy

The results of the probit model in Table 2 reveal that village democracy did not directly increase households' probability of investing labor in forestry production. However, village democracy strengthened the incentive effect of use right on households' probability of investing labor significantly, as indicated by the statistically significant positive coefficient of the interaction term of use right and village democracy. However, village democracy did not affect the investment incentive effect of disposition right and beneficiary right on households' probability of investing labor. On the other hand, according to the results of the truncated regression model, not only did village democracy positively stimulate households' quantity of labor investment, but it also strengthened the investment incentive effect of use and disposition rights on households' person-days spent in forestry. However, the insignificant coefficient of the corresponding interaction term indicates that village democracy did not strengthen the incentive effect of beneficiary right on the amount of labor used by households in forestry work either.

In Table 3, the estimation results of the probit model and the truncated regression model suggest that village democracy motivated both households' probability of investing capital and the quantity thereof. Furthermore, village democracy strengthened the incentive effect of use right and disposition right on households' probability and the quantity of capital investment. Another key observation is that village democracy did not strengthen the incentive effect of beneficiary right on households' probability and the quantity of capital investment, as indicated by the insignificant coefficients of the corresponding interaction terms. The statistically significant coefficients of the first and second interaction terms in the tobit models in both Tables 2 and 3 indicate that the unconditional overall average strengthening effects of village democracy on the investment incentive effect of the improved use and disposition rights induced by Tenure Reform do indeed exist, which is generally in line with the results of the Cragg specification.

4.2.3. Other Determinants of Investments

The regression results in the probit model in Table 2 show that timber price, labor force, and total forestland area had statistically significant impacts on households' probability of investing labor in forestry production. Factors that had significant effects on the labor investment intensity in the truncated regression model include the timber price, labor force, education, leadership, total forestland area, and forestland quality. Note that the education level of the household heads was significantly and negatively related to households' probability of investing in labor, but positively related to the quantity of labor investment for those who decided to invest. The other factors included in the tobit, probit, and truncated regression models—the market interest rate, wage of forestry labor force, non-farm income proportion, and average stand age—had no significant impact on the probability of households conducting labor input and the quantity thereof.

Based on the probit model results in Table 3, similarly, we find that the timber price, labor force, and total forestland area had a statistically significant effect on households' probability of investing capital investment in forestry production. Then again, the regression results of the truncated regression model suggest that the timber price, labor force, education, leadership, and total forestland area were significantly and positively related to households' quantity of capital investment. Similarly to the effect of the education level of the household heads on the probability and quantity of labor investment, it had a significant negative effect on households' probability of investing capital, but it had a significant positive effect on the size of capital investment. However, interestingly, the coefficient of the education in the tobit model in Table 3 is not statistically significant. This suggests that the unconditional overall average effects of the education level of household heads on households' capital investment are not significant. Another interesting result is that households' non-farm income proportion had a significant negative effect on the quantity of capital investment. Likewise, the market interest rate, wage of forestry labor force, average stand age, and forestland quality did not have a statistically significant impact on the probability of households investing capital and the quantity thereof.

5. Discussion

Our results on the effects of property rights on investments are mainly in line with earlier research on the effect of Tenure Reform [4,7,12]. However, one of our extensions upon Zhang et al.'s [26] study is that we actually measured the household property rights using the right components, which are use right, disposition right, and beneficiary right. Based on this, an unexpected finding was that, for those households that invested in forestry production, the improved beneficiary right did not have a significant effect on households' quantity of either labor or capital investments.

The results of our study also reflect the significant role of village democracy in the implementation of the Tenure Reform. The results indicate that the higher the level of the village democracy, the stronger the effect of property rights on the farmers' investment incentives. The interpretation of this result may be that the implementation of the democratic procedures increased households' perception, cognition, and, subsequently, their confidence toward the benefits and security of, in particular, forestland use and disposition rights. The result is in accordance with the study by Zhang et al. [26], which used dummy variables to measure village democracy and the Tenure Reform, and concluded that the Tenure Reform only improved farmers' incentives to invest in forestry only if the villages conducted the Tenure Reform democratically.

In line with earlier findings [53], our results also indicate that the bigger the total household forestland, the stronger their investment incentives are. This might be because the bigger total forestland area enables households to achieve economies of scale more efficiently. Another interesting finding is that the education level of household heads was significantly and negatively affecting their probability of conducting investments but positively related to the quantity of their investments. In spite of this, the unconditional total effect of education on forestry labor was positive and significant in the tobit model for own labor investment, but not significant in the model for monetary investments. One possible explanation for this finding is that household heads with a better educational

background are usually likely to find non-farm employment and will allocate fewer resources to forestry. Nevertheless, those households that decide to invest in forestry, usually tend to invest more because their relatively better education level enables them to manage the forestry production more efficiently and profitably.

Our results suggest that governments could improve the performance of public policies by effectively enforcing democratic procedures in the process of policy implementation. Therefore, there is impetus for China's government to further carry the construction of a village democracy system forward. For instance, government could strengthen farmers' discourse power in the decision-making of public affairs and then more deeply manifest grassroots policy needs by strictly employing village democratic procedures.

Another critical aspect is that to increase the investment incentive effect of the Tenure Reform further, governments should strengthen households' use and disposition rights bundles and related policies. In addition, our results show that household beneficiary rights had no positive effect on farmers' forestry investments, which might presumably suggest that the beneficiary rights have not been adequately improved. Moreover, to enhance households' confidence in the property rights of the forests in the future, related administrative departments could further guide households to correctly and fully understand their rights concerning the forests entitled to them.

Institutions take a long time to become fully developed and incorporated as part of peoples' habitual thoughts and actions [4,66]. As a shortcoming, our findings were only based on cross-sectional data from selected regions. This may limit the generalizability of our conclusions. Future research for enriching the understanding of the effect of village democracy in the process of other public policy implementation could potentially proceed with larger-scale and long-term empirical research designs to test the robustness of our findings and, furthermore, capture the dynamic change of the relationship between village democracy and the performance of public policies. In addition, future studies could also take the possible simultaneity between forestry labor and monetary inputs into account.

6. Conclusions

In this study, we tested the effects of property rights and village democracy on household forestry investments. Moreover, we were interested in particular in the effects of the interaction terms that investigate the strengthening effect of village democracy on the investment incentive effect of the improved property rights induced by the Tenure Reform. We estimated three different models, the tobit model for limited dependent variable ($investments \geq 0$), the binary probit model for the qualitative decision to invest or not ($there\ were\ investments = 1; otherwise = 0$), and a truncated regression model for those households that had invested in forestry after the Tenure Reform. As the tobit model assumption was rejected by the likelihood ratio tests, both in the case of households' own labor and monetary forestry investments, the results of the tobit model should be considered with caution. Therefore, we discuss the empirical results mainly based on the binary probit models for the whole sample and truncated regression models for nonlimit households.

The empirical results reveal that the improved use right and disposition right had a significant positive effect on both the probability and quantity of households investing labor and capital in forestry. However, the beneficiary right only increased the probability of households conducting labor and capital investments without a statistically significant effect on the size of the investments. In spite of this, the total unconditional effect of the beneficiary right on both households' own labor and monetary inputs into forestry was statistically significant, although for the labor input only at the 10% risk level. In addition, the results suggest that village democracy had a positive effect on households' forestry investments. Furthermore, the results are consistent with the hypothesis that village democracy also strengthened the investment incentive effect of the improved property rights, which could be seen from the statistically significant coefficients of the interaction terms of village democracy and households' forestland use and disposition rights.

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Appendix A

Table A1. Operationalization of variables in the measurement of forest property rights and its descriptive statistics.

Property Right Component	Property Right Policy		Property Right Assessment Based on Farmer’s Response	Mean	Std. Dev.
	Secondary Indicator	Third-Level Indicator			
Use Right	Right to Use Forestland	Scale	According to household forestland area from small to large (five levels: less than 1 ha; 1–3 ha; 3–5 ha; 5–7 ha; more than 7 ha), 0.2, 0.4, 0.6, 0.8, and 1 respectively	0.58	0.19
		Tenure	According to household forestland tenure from short to long (five levels: less than 10 years; 10–30 years; 30–50 years; 50–70 years; more than 70 years), 0.2, 0.4, 0.6, 0.8, and 1 respectively	0.51	0.14
		Right to select the ways to use forestland	According to the accumulative number of rights to select the ways to use forestland (including rights to transfer forestland to farmland or nonforestry land, to select tree species, and to conduct under-forest economy) from small to large, 0.25, 0.5, 0.75, and 1 respectively	0.71	0.22
		Right to own ground attachment ¹	Does not have the right, 0; Has the right, 1	0.83	0.10
Disposition Right	Right to Mortgage Forests	Required minimum stand age	According to the required minimum stand age from old to young (three levels: without requirement; more than 1 year; more than 5 years), 0.2, 0.6, and 1 respectively	0.39	0.51
		Required minimum collateral area of mortgaged forests	According to the required minimum collateral area of mortgaged forests from large to small (four levels: more than 30 Ha; more than 10 Ha; more than 5 Ha; without requirement), 0.25, 0.5, 0.75, and 1 respectively	0.48	0.22
		Constraint of loan limit	With constraint, 0; without constraint, 1	0.02	0.13
	Rules of mortgage loans	Collateral rate ²	According to collateral rate of timber forest from low to high (five levels: 40%; 50%; 60%; 70%; 80%), 0.2, 0.4, 0.6, 0.8, and 1 respectively	0.62	0.42
		Loan period	According to loan period from short to long (four levels: 3 years; 5 years; 8 years; 10 years), 0.25, 0.5, 0.75, and 1 respectively	0.39	0.25
		Loan interest rate ³	According to loan interest rate from high to low (five levels: 60%, 50%, 46%, 30% and 0% higher than benchmark interest rate), 0.2, 0.4, 0.6, 0.8, and 1 respectively	0.41	0.36
	Right to Harvest Timber	Allocation of harvest quota ⁴	If harvest quota is allocated to township government, 0.2; if harvest quota is allocated to villager committee, 0.6; if harvest quota is directly allocated to household, 1	0.32	0.29

Table A1. Cont.

Property Right Component		Property Right Policy		Property Right Assessment Based on Farmer's Response	Mean	Std. Dev.
		Secondary Indicator	Third-Level Indicator			
Beneficiary Right	Right to Transfer Forestland	Right to transfer forestland		Does not have the right, 0; has the right, 1	0.87	0.22
		Maturity of forest rights market		According to the degree of subjective convenience of treading from low to high (five levels: very inconvenient; inconvenient; normal; fairly convenient; very convenient), 0.2, 0.4, 0.6, 0.8, and 1 respectively	0.34	0.28
		Right to inherit ground attachment	Right to inherit ground attachment	Does not have the right, 0; has the right, 1	0.88	0.06
	Right to market forestry products		Constraint of sales targets ⁵	Can only sell forestry products to designated purchasers, 0; without constraint, 1	0.59	0.40
			Constraint of marketing area ⁵	According to available marketing area from small to large (three levels: should not sell products outside local county; can sell products outside local counties if pay more taxes; without requirement), 0.2, 0.6, and 1 respectively	0.72	0.24
	Right to Benefit from Forestry Production	Forestry taxes and fees	Timber tax and fee burden	According to level of timber tax and fee burden from high to low (three levels: 0–100 yuan/m ³ ; 100–160 yuan/m ³ ; above 160 yuan/m ³), 0.2, 0.6, and 1 respectively	0.39	0.19
			Taxes and fees on bamboo and non-timber forests	With taxes and fees, 0; without taxes and fees, 1	0.41	0.27
		Forestry subsidy	Subsidy for afforestation	According to level of subsidy for afforestation from low to high (five levels: without subsidy; 0–300 yuan/ha; 300–450 yuan/ha; 450–900 yuan/ha; 900–1500 yuan/ha), 0.2, 0.4, 0.6, 0.8, and 1 respectively	0.28	0.32
			Subsidy for road construction in forestry area	Without subsidy, 0; with subsidy 1	0.02	0.12

¹ According to the provisions of Tenure Reform, farmers should get the ground attachment, which includes trees and other plantations on the forestland, after they were titled use right of the forestland. ² Collateral rate refers to the ratio of available mortgage loans to the economic value of the mortgaged timber forests. For example, if one household's timber forest is worth 100,000 yuan and the collateral rate is 80%, the household can get a mortgage loan of 80,000 yuan, which is the upper limit of the mortgage loan, when the household uses the timber forest as collateral. ³ Loan interest rate refers to the proportion of loan interest, which a lender charges to the borrower household per year, to total loans. Thus, if the loan interest rate were lower, the borrower households would face less financial burden. ⁴ A timber harvesting quota system is employed to strictly regulate households excessively harvesting in China. Households have to apply for cutting permits for timber harvesting on their contracted forestland. ⁵ Some local governments use a compulsory timber delivery system to control households' sales targets and marketing area. In other words, farmers can only sell forestry products to the local state procurement agencies or designated purchasers within the administrative district.

Table A2. Operationalization of variables in the measurement of village democracy and its descriptive statistics.

Village Democracy Component	Secondary Indicator	Definition	Village Democracy Assessment Based on Farmer's Response	Mean	Std. Dev.
Democratic Election	Election Participation	Degree of household involvement in villager representative election	If households did not get involved, $p_{i1} = 0$; if households participated in election, $p_{i1} = 0.5$; if households participated in nomination and election, $p_{i1} = 1$	0.65	0.34
	Election Method	Method of villager representative election nomination	If only village leaders could nominate, $p_{i2} = 0$; if only previous villager representatives could nominate, $p_{i2} = 0.5$; if everyone could nominate, $p_{i2} = 1$	0.36	0.48
	Voting Method	Voting accessibility of villager representative election	If the method was non-public voting, $p_{i3} = 0$; if the method was semi-public voting, $p_{i3} = 0.5$; if the method was public voting, $p_{i3} = 1$	0.82	0.31

Table A2. Cont.

Village Democracy Component	Secondary Indicator	Definition	Village Democracy Assessment Based on Farmer's Response	Mean	Std. Dev.
Democratic Decision-making	Degree of Competitiveness	Competitiveness extent in villager representative election	If the villager representatives were elected by single-candidate elections, $p_{i4} = 0$; if the villager representatives were elected by two-candidate elections, $p_{i4} = 0.5$; if the villager representatives were elected by multiple-candidate elections, $p_{i4} = 1$	0.68	0.26
	Promotion and Decision-making Meeting ¹	Adequacy of promotion and decision-making meeting	If there was no meeting, $p_{i5} = 0$; if there was/were decision-making meeting(s), $p_{i5} = 0.5$; if there was/were promotion and decision-making meeting(s), $p_{i5} = 1$	0.41	0.39
	Household Discourse Right	Degree of household discourse right in decision-making	If there was no chance for households to give suggestions, $p_{i6} = 0$; if there was/were chance(s) for households to give suggestions and part of them was/were valued, $p_{i6} = 0.5$; if there was/were chance(s) for households to give suggestions and all of them were valued, $p_{i6} = 1$	0.27	0.38
Democratic Management	Administrative Visibility	Degree of household satisfaction with administrative visibility	If households were not satisfied at all, $p_{i7} = 0$; if households were partially satisfied, $p_{i7} = 0.5$; if households were completely satisfied, $p_{i7} = 1$	0.48	0.37
	Financial Management Visibility	Degree of household satisfaction with financial visibility	If households were not satisfied at all, $p_{i8} = 0$; if households were partially satisfied, $p_{i8} = 0.5$; if households were completely satisfied, $p_{i8} = 1$	0.24	0.26
Democratic Supervision	Supervision Mechanism	Existence of supervision mechanism	If there was no supervision mechanism, $p_{i9} = 0$; if there was supervision mechanism, $p_{i9} = 1$	0.21	0.15

¹ Villager meeting or villager representative meeting is the fundamental democratic decision-making institution of Chinese village affairs by law.

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