Land titling, land reallocation experience, and investment incentives: Evidence from rural China

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A R T I C L E   I N F O

A B S T R A C T

The impacts of land titling on investment incentives among farmers with different land reallocation experiences are studied in this work. Ordered Probit model and 2SLS are employed to estimate the survey data collected from 2704 households in rural countries in China. We find that, generally, land titling can substantially promote investment incentive among farmers. However, the impacts vary among farmers with different land reallocation experiences. Specifically, land titling positively affects farmers without land reallocation experience, but it negatively affects those farmers who experienced big reallocation. Land titling has an investment incentive effect on China's special agricultural land system, where farmers only have contract rights of land. However, big reallocation should be heavily restricted to guarantee the investment incentive effect of land titling.

1. Introduction

Among the various factors affecting agricultural investment, the farmland system in developing countries continuously attracts the most attention. However, the property rights of agricultural lands in developing countries remain insecure (Janvry et al., 2014). Such rights are controlled by the government or other social powers. China is one of the countries that continue to undergo land system reforms.

The household responsibility system (HRS), the current farmland system in rural China, has been implemented in the early 1980s after the de-collectivization of the people's commune. In contrast to the private ownership of agricultural land in Western countries, the ownership of lands in rural China belongs to villages (collectives). Farmers only have a contractual management right to land (use right). Under HRS, members of collectives can obtain farmland use rights from the villages by virtue of their membership rights. This arrangement of land rights institution leads villages to frequently reallocate farmland due to population changes (Kung, 2002; Yao and Carter, 1999). Such reallocation is a major threat to property rights security. The prohibition of land reallocation is one of the main objectives of China's farmland system reform.

The central government began conducting a new round of land titling pilot work in 2009. The No. 1 Central Document of 2013 clearly states, "Complete the rural land contractual management right and confirm the registration certificate within five years." The government insists on the collective ownership of farmland by endowing land use

rights to households. The government registers the details of the farmland, including location, area, and owner of use rights, in the certifications given to the farmers. This land titling practice has distinctive Chinese characteristics. It differs from the "exclusive" and "independent" private property ownership in Western laws. The security of farmers' land use rights has been emphasized in government policies since the establishment of HRS. However, the reallocation of farmland exists in many villages, which may weaken the anticipation on the land titling of farmer households and become the main land property rights problem of farmers (Brandt et al., 2004; Gao et al., 2017). Therefore, Land reallocation is the important background that must be considered when studying the effect of land titling.

We aim to identify if the investment incentives of land titling will be different under China's special farmland system structure, where the ownership does not belong to the farmers operating the land. We also aim to understand how reallocation will change the relationship between land titling and investment incentive. The study on China's land titling can provide empirical evidence on the relationship between land property rights and investment. It can also help provide insights into farmland rights reform systems in developing countries, such as China, Ethiopia, and Mozambique, where farmers have no land ownership.

2. Literature review

Securing property rights drive economic growth by promoting investments (Jacoby et al., 2002). Farmers invest in land only when they

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anticipate a secure return (Beekman and Bulte, 2012). If land property rights are insecure, then the land and investments on it will have higher risk of loss, thereby resulting in investment loss (Banerjee and Ghatak, 2004). Besley (1995) argued that insecure land rights are like levying a random tax, which reduces the investment incentives of farmers.

Several empirical studies on the land reform experience of other developing countries, such as Alston et al. (1996) in Brazil and Saint-Macary et al. (2010) in Vietnam, have supported the aforementioned claims. However, a consensual conclusion is yet to be achieved. Property rights security may not have substantial impact on farmland investment. It may even have negative effects. Carter and Olinto (2011) found that farmland rights security can only promote the investments of wealthy farmers in Paraguay but does not have substantial effect on poor farmers. Other studies in African countries show that land titling almost has no impact on land investment (Brasselle et al., 2002; Domeher and Abdulai, 2012). Alternately, it may even have negative impacts (De Zeeuw, 2010). Therefore, land titling may have various effects in different social backgrounds.

Farmland tenure security is also one of the core issues in rural China. Under the land rights arrangement of HRS, land reallocation is the top threat to land property rights security (Brandt et al., 2004; Qu et al., 1995; Yang, 1997; Deininger and Jin, 2007). Most studies have focused on the land reallocations or expropriation risk related to land reallocations. Li et al. (1998) found that the slowdown of land reallocation will incentivize farmers to further invest on organic manure in land but has no impact on nitrogen fertilizers, animal traction, or phosphate fertilizers. With household data from Northeast China, Jacoby et al. (2002) found that land tenure insecurity significantly reduces the application of organic fertilizers. Xu and Zhang (2005) argued that land reallocations do not have a significant effect on farm manure but will reduce the purchase of farming machinery. Ma et al. (2013) indicated that farmers' perception on the probability of future land reallocation significantly affects self-governed investments but does not affect individual investments in land quality improvements.

Other studies focused on the legal property rights of land. They estimated the impact of farmland rights certificates, which were delivered in accordance with the *1998 Land Management Law*, on land investment incentives. Ye et al. (2006) found that the issuance of farmland rights certificates will increase the amount of farmers' investments in farmland. Their follow-up survey in 2008 led to a similar conclusion. Farmers who own the required contracts or certificates have 28.2% share of the investments in agricultural land, which is significantly higher than those without any legal document (20%) (Ye et al., 2010). By contrast, Deininger and Jin (2003) found that households with land certificate did not invest more than those without land certificates.

Few studies are on the investment incentives of the new round of land titling project started in 2009. Moreover, existing studies rarely considered the actual operating property rights (land reallocation) as a policy implementation background when discussing the implementation of the legal property rights.

Farmland reallocation has occurred under the prohibition of previous land reform policies, which may influence the trial effect of the new round of land titling. Human action stems from the memory of past knowledge and experience, and people's current and future actions are guided by conditioned reflex and learning (Robinson, 1951). According to Becker (2010), the external environment has a profound impact on the formation of people's preferences and beliefs and their desire and choice. Studies on behavioral economics also found that people subjectively think that their experiences are likely to happen (Tversky and Kahneman, 1973). Carroll et al. (2000) found that the residents of emerging countries who are accustomed to low consumption patterns will continue to maintain such patterns after economic growth, which is an important reason for the high savings rate in emerging countries. Therefore, whether the impact of land titling on the investment is related to farmers' land reallocation experiences should be identified.

Although the law stipulates that cultivated land contract period shall remain unchanged for 30 years, the survey on China' rural farmland system from Ye et al. (2006) and Ye et al. (2010) found that many villages frequently reallocated their farmland in different frequencies. Thus, farmers' experiences of land rights security in different villages may greatly vary. Their perception of farmland property rights may be secure or insecure. When facing the same legal empowerment, farmers with different perceptions on land rights may trust the law and have a secure anticipation of farmland property rights. By contrast, others may not trust the law and have an insecure anticipation of farmland rights, which may lead to different investment incentive. Moreover, farmers who experienced land reallocation may subjectively think that land reallocation is very likely to happen. Such a perception will weaken the anticipated security of farmland rights conferred by the new round of titling, thereby resulting in the belief that farmland property rights remain insecure. Hence, they do not trust the new round of land titling. Farmers who have not undergone reallocation of land rights and have no prior experience of relatively safe property rights may once again strengthen the security of property rights granted by the new round of land titling.

Our study takes land reallocation as the background of land titling. We first estimate the impact of the new round of land titling on farmers' investment incentives in farmland. We then observe the different impacts on the investment incentives of farmers who had various land reallocation experiences when facing the new round of land titling.

Agricultural investments have various classifications, including nitrogen fertilizers, animal traction or phosphate fertilizers, and many other investments. Hence, our survey has covered farmers with different planting structures, which may have different investment requirements. Moreover, the new round of land titling has just been implemented, and the investment behaviors of farmers may still be adjusted. Therefore, we will focus on farmer's willingness to invest.

3. Background

3.1. Farmland system reform in rural China

HRS is the current land rights arrangement in rural China. This arrangement states that the ownership of land in rural China belongs to the villages (collectives). Farmers only have contractual management rights to land (use right). They can obtain farmland use rights from collectives by virtue of their membership rights. A village often reallocates its farmland in accordance with demographic changes to ensure equal access among members (Brandt et al., 2004). Although HRS achieved great success (Lin, 1992), land reallocation frequently happened and was considered the reason for the low efficiency in agriculture. As such, the central government has begun emphasizing the land tenure security.

In 1984, the No. 1 Central Document *Notice of the Central Committee of the Communist Party of China on Rural Work in 1984* stated that "the contract duration of farmland should be at least 15 years. Before the extension of the contracting period, if the masses have the requirement to reallocate the land, they can be allocated in a unified manner based on the principle of 'great stability and small adjustment.'" In 1993, *Policy Measures on the Current Agricultural and Rural Economic Development* extended the contract duration to 30 years after the original contract period expires. Such a policy aims to stabilize land contracting relationship and increase land investment and productivity. It also points out that, "In order to avoid frequent changes in contracted farmland and prevent the farmland management from being subdivided continuously, it is recommended to implement the method of 'no increase when born, no reduction when die' during the contract period." In 1998, the *Land Management Law* required farmers to receive a 30-year land use contract certificate, which aimed to eliminate land reallocations during the contract duration (Deininger and Jin, 2003). In 2002, the *Rural Land Contract Law of the People's Republic of China*

regulates that "During the contract period, the village shall not reallocate the contracted land."

However, surveys show that land reallocation continues to exist in rural China. Rural China has two kinds of farmland reallocation (Gao et al., 2017). The first kind is big reallocation, which refers to the redistribution of land in accordance with population changes within the whole village. The area and location of the farmland will be changed before and after reallocation. The second kind is small reallocation, which allocates part of the land of families with few members to households with new family members, such as newborns or brides. The total area may be different before and after small reallocation, but the location remains still. If the household population remains unchanged, then the location and area of their farmland will not be affected by the small reallocation.

To further stabilize the contracting management rights of farmland, the *2008 Several Major Issues Concerning Promoting Rural Reform and Development* emphasized that farmland contract duration is permanent. China began conducting the land titling project in 2009 to strengthen the contractual management rights by legally ensuring the security of property rights. Each province was ordered by the central government to continue promoting the land titling project.

Based on the *Opinions on conscientiously doing a good job in the registration and certification of rural land contractual management rights*, different levels of governments have a clear division of responsibilities. For the entire land titling project, the provincial government is responsible for organizing and leading, the city-level government is responsible for organizing and coordinating, and the county and township governments are responsible for the implementation. The county government must ensure that the land titling project of each village in its jurisdiction is carried out and completed.

The land titling process is performed as follows. First, government staff measure the specific location and area of each farmer's farmland via field measurement or even drones. Then, they draw the land information of each household in papers and publicize such information to farmers. If farmers have disputes about their own farmland, then the executors must coordinate or remap. These procedures will be repeated until all disputes are solved. The executors will then encode the farmland information and submit it to the provincial government's land system, which will draw the title certificate. The farmers' farmland and their owners' information are printed on the title certificate and then delivered to the farmers by village cadres.

Fig.1 shows the land reallocation in our sample provinces from 2010 to 2014 when the new land titling system was carried out. Farm households in all provinces have experienced land reallocation since the land titling pilot policy was launched in 2009. Farm households in Henan have experienced less land reallocation of only approximately 4.8% in comparison with other provinces. However, more than 20% of farm households in Jiangxi, Ningxia, and Shanxi have experienced land reallocation.

In addition, the proportion of big reallocations is relatively small compared with that of small reallocation, but big reallocations are still happening in different provinces. Land reallocations continue to exist in rural China. Hence, we have to consider land reallocations when investigating the investment incentives of land titling.

3.2. Production and management of farmers in rural China

The increase and kind of investments in agriculture depend on the type of agriculture, the purpose of planting, and the importance of agriculture in the economic status of farmers. As such, we develop a general understanding of the production and operation of today's farmer households in rural China.

China has two main types of crops. One type of crops is food crops, which mainly includes rice, wheat, corn, soybeans, and potatoes. The second type is cash crops, including vegetables, cotton, oilseeds, and fruits. We analyze the purpose of the planting of the two crops in Fig. 2. 38.18% of the farmers plant cash crops for subsistence, 31.12% for commerce, and 30.61% for both purposes. The proportion of farmers planting food crops for commerce is much less than that for subsistence. Only 9.58% of them plant solely for commerce. The purposes of planting the two types of crops are very different.

We visualize the income structure of farmer households in Fig. 3. The results show that wage has become the main source of income for farmers instead of agriculture. However, as shown in Fig. 4, only 37.65% of the workforce is composed of full-time workers and 28.68% of seasonal workers. Agriculture is still their main occupation. From the perspective of occupation, the rural labor force has begun to differentiate. However, farming is still an important occupation for the rural labor force.

Our survey has covered farmers with different planting structures and farmer households with different income structure, making the representation of the agricultural investment of farmers through a
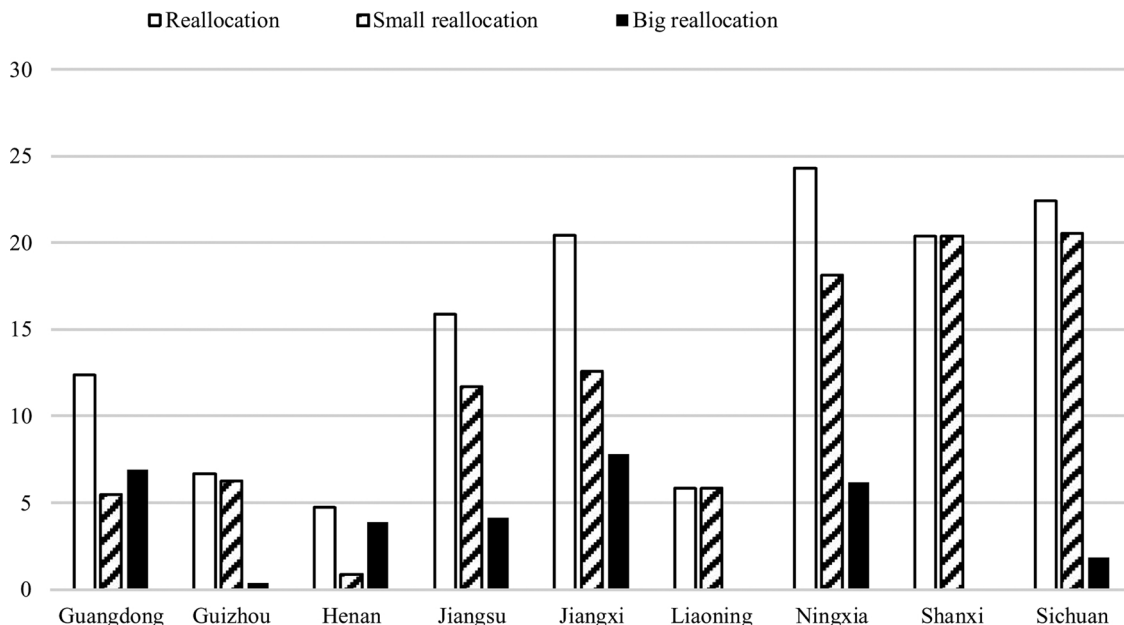

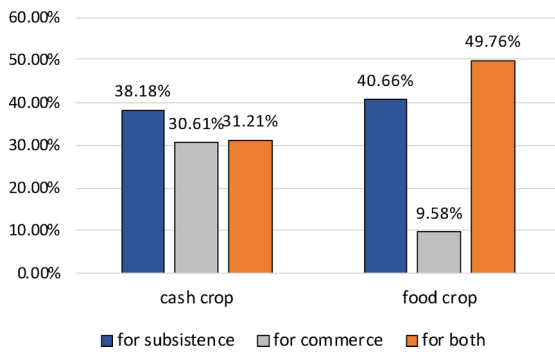**Fig. 1.** Land reallocation in sample provinces.

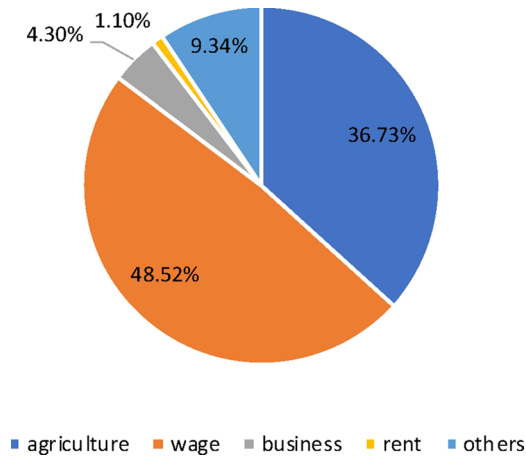**Fig. 2.** Purpose of planting of farmers.

Fig. 3. Income structure of farmer households.
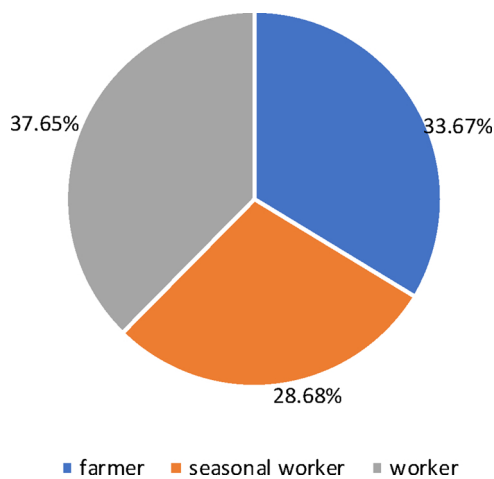

Fig. 4. Occupation structure of farmer households.

specific investment difficult. Therefore, we focus on willingness to invest.

4. Data

4.1. Data source

The dataset was based on a nationwide large-scale household survey conducted by the research team from December 2014 to March 2015. The survey targeted the development of land-related elements of farmers and farmland property rights. To avoid data deviation and gain a representative understanding of the new round of land titling, the

survey was conducted during the Spring Festival when numerous migrant and seasonal workers return to their hometowns. Thus, we obtain comprehensive information of farmers' families. Our interviewers used a face-to-face interview method to visit 2880 households. Finally, 2704 questionnaires satisfied our criteria and were used in our study.

Multilevel stratified random sampling was adopted for this survey. The sample province was first selected. Six social and economic characteristics indicators, namely, total population, per capita GDP, cultivated area, proportion of cultivated land, proportion of agricultural population, and proportion of agricultural output, were used to classify 31 Chinese provinces (cities and districts) into three categories via cluster analysis. Provinces were divided into three major regions of China, namely, eastern, central, and western regions. Three provinces were selected from each of the three regions: the eastern part includes Guangdong, Jiangsu, and Liaoning Provinces; the central part is composed of Henan, Jiangxi, and Shanxi Provinces; and the western part comprises Ningxia, Sichuan, and Guizhou Provinces. Second, the sample counties were selected. In accordance with the aforementioned clustering indicators, all the counties in each sample province were clustered into three categories via cluster analysis. Two randomly selected counties in each category were investigated, ending with a total of 54 counties. Finally, the sample towns, villages, and farmers were identified. Four towns were selected in each county. One village was taken for each town, and 10 rural households were randomly selected for each village. Thus, 2160 households were investigated. In the meantime, the research group conducted an additional survey in Guangdong and Jiangxi, with a sample of 360 farmer households per province following the sampling rules above. Thus, a total of 2880 (2160 + 720) households were included in the final sample. In the choice of survey villages, the selected towns must have the titled and untitled villages. The sample farmers in both types of villages must be in equal proportion to ensure matching in the comparative analysis. To obtain information about farmland confirmation and farmland investment, we chose the family member who is familiar with farming production as the interviewee.

4.2. Land property rights and willingness to invest

The following question was asked to the farmers: "Will you increase your investment in farmland?" The answers ranged from "1 = strongly disagree," "2 = disagree," "3 = neutral," "4 = agree," to "5 = strongly agree." Table 1 shows the average score of farmers' willingness to increase their investment in farmland. The average score is 3.402 in the titled group, which is 0.118 score higher than that in the untitled group. Such difference is significant at the 1% level. Therefore, based on the descriptive statistics, the famers in the titled group have a stronger willingness to invest than those in the untitled group.

Table 2 shows that 15.16% of the sample households have experienced land reallocation. A total of 10.65% have experienced small reallocation, whereas 4.51% have experienced big reallocation. Willingness to invest between the titled and untitled groups is different among households with various reallocation experiences. For farmers without land reallocation experience, the average willingness to invest in the titled group is 3.408. Such value is 0.136 higher than that in the untitled group (3.272) and significant at the 1% level. The average willingness to invest in the titled group for farmers with small

Table 1
Difference of willingness to invest between titled and untitled households.

	Titled	Untitled	Difference
Willingness to invest	3.402	3.284	0.118*** (0.043)
Observations	1456	1248	——
Ratio (%)	53.85	46.15	——

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1, standard errors in parentheses.

Table 2
Land titling, land reallocation, and willingness to invest.

	Without reallocation		Small reallocation		Big reallocation	
	Titled	Untitled	Titled	Untitled	Titled	Untitled
Willingness to invest	3.408	3.272	3.519	3.265	3.000	3.508
Difference between two group	0.136***(0.048)		0.254**(0.122)		−0.508**(0.195)	
Observations	2294		288		122	
Ratio (%)	84.84%		10.65%		4.51%	

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1, standard errors in parentheses.

reallocation experience is also higher than that in the untitled group. However, for farmers with big reallocation experience, the average willingness to invest in the titled group (3.000) is 0.508 significantly lower than that in the untitled group.

5. Econometric

5.1. Econometric framework

The econometric models are as follows:

$$y^* = \alpha_1 + \delta_1 titling_i + X'_i \beta_1 + \mu_i, \tag{1}$$

$$y^* = \alpha_2 + \delta_2 tiling_i + \phi_2 realloc_i + \varphi_2 tiling_i * realloc_i + X'_i \beta_2 + \eta_i, \tag{2}$$

where i is the ith farmer; y^* is the explained variable, representing the investment incentives on farmland; *titling* and *realloc* are the key explanatory variables, representing land titling and land reallocation, respectively; X is the control matrix; α_1, α_2, δ_1, δ_2, β_1, β_2, ϕ_2, and φ_2 are the parameters to be estimated; and μ_i and η_i are the error terms.

Formula (1) is used in Section 5.2 to estimate the impact of land titling on willingness to invest. Formula (2) is used in Section 5.3 to identify if the relationship between land titling and willingness to invest will be different when farmers have different land reallocation experiences. As our explained variable is an ordinal variable, we used an Ordered Probit Regression model (Wooldridge, 2016) for the estimation, except for Model1-ols, where we employ OLS to estimate the average impact of land titling on investment. We also control for some variables to reduce the omitted variables problem. Such variables

Table 4
Impacts of land titling on investment incentives.

VARIABLES	Willingness to invest			
	Model1-Oprobit		Model1-OLS	
	Coefficient	Robust standard errors	Coefficient	Robust standard errors
Land titling	0.130***	0.041	0.135***	0.043
Gender	0.084*	0.043	0.090**	0.045
Age	−0.004***	0.001	−0.005***	0.002
Experience	0.046	0.042	0.046	0.045
Village cadres	0.071**	0.032	0.077**	0.033
Contracted land	0.003**	0.001	0.004***	0.001
Income = 2	0.002	0.065	0.003	0.068
Income = 3	0.019	0.068	0.025	0.072
Income = 4	0.036	0.078	0.041	0.081
Income = 5	0.076	0.104	0.084	0.109
Share of agri-income	0.002***	0.001	0.002***	0.001
Non-farmers' ratio	−0.246***	0.062	−0.256***	0.066
Low education ratio	−0.092	0.090	−0.106	0.094
Aged labor ratio	0.063	0.089	0.073	0.094
Female labor ratio	−0.246*	0.143	−0.252*	0.150
Time to county	−0.020	0.031	−0.018	0.033
Terrain = plain	−0.172***	0.043	−0.183***	0.046
Constant			3.468***	0.137
Observations	2704		2704	
R-squared			0.036	

Note: 1. *** p < 0.01, ** p < 0.05, * p < 0.1.

Table 3
Variable description and summary statistics.

Variable	Definition	Mean	Std. Dev.
Willingness to invest	Want to increase land investment on farmland? 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree	3.348	1.125
Land titling	= 1 if has land title certificate; 0, otherwise	0.538	0.499
Small reallocation	= 1 if experienced small reallocation since 2009; 0, otherwise	0.107	0.309
Big reallocation	= 1 if experienced big reallocation since 2009; 0, otherwise	0.045	0.208
Gender	= 1 if the respondent is male; 0, otherwise	0.637	0.481
Age	Age of the respondent	43.380	15.099
Experience	= 1 if respondent has working experience; 0, otherwise	0.591	0.492
Village cadres	= 1 if a member or friend is a cadre	0.298	0.457
Contracted land	Areas of farmland allocated from the village (mu)	7.139	20.530
Income = 1	= 1 if the family income is less than 10 thousand yuan; 0, otherwise	0.140	0.347
Income = 2	= 1 if the family income is 10 to 30 thousand yuan; 0 otherwise	0.356	0.479
Income = 3	= 1 if the family income is 30 to 50 thousand yuan; 0, otherwise	0.264	0.441
Income = 4	= 1 if the family income is 50 to 100 thousand yuan; 0,otherwise	0.166	0.372
Income = 5	= 1 if the family income is over 100 thousand yuan; 0, otherwise	0.071	0.257
Share of agri-income	Share of agricultural income to family income	36.730	33.161
Non-farmers' ratio	Share of labors with non-farming job	0.377	0.344
Low education ratio	Share of labors with primary education	0.532	0.262
Aged labor ratio	Share of labors older than age 50	0.210	0.268
Female labor ratio	Share of female labors	0.328	0.160
Time to county	Time to the center of the county (hour)	0.957	0.637
Terrain = plain	= 1 if the village is in the plain area; 0, otherwise	0.400	0.490

include property rights before land titling and attributes of the respondent, such as land resource endowment, family characteristic, and village characteristics. The definition and summary statistics of all the variables are shown in Table 3.

5.2. Impact of land titling on investment incentives

Table 4 presents the regression results via Ordered Probit model. Model1-Oprobit reports the coefficients via Ordered Probit model. The coefficient of land titling in Model1-Oprobit is 0.130 and significant at the 1% level. Hence, titled farmers have higher willingness to invest than untitled farmers. Model1-OLS reports the coefficients by using ordinary least squares regression. The coefficient is 0.135, showing that farmers with land tilting have 0.135 score higher farmland willingness to invest than those without land titling. Rural Chinese farmers only have land use rights, and the farmland ownership belongs to the villages. However, land titling, which ensures land rights in law, can also increase investment incentives.

Table 4 reports the results of other control variables. Males have higher willingness to invest than females. willingness to invest will be lower as age grows. Household with village cadres will be more willingness to increase land investment than those without cadres. Household with many contracted lands have higher willingness to invest in land than those with few contracted lands. The larger the share of the agricultural income, the higher the willingness to invest of the farmer. Households with many labors involved in non-agricultural work have less willingness to invest than those with few labors. Households with more female labors will have less intention to increase land investment than those with more male labors. Finally, a household in plain will have less willingness to invest in farmland than a household in mountainous.

5.3. Impacts of land titling on investment incentives under different reallocation experiences

We added two variables, big reallocation and small reallocation, in the model (Model2) to identify if land titling has different impacts on investment incentives under different reallocation experiences. We also added two interaction terms in the model, namely, "*Land titling* Small reallocation*" and "*Land titling* Big reallocation*" (as shown in Model3–Model5).

Model2 shows that the coefficient of land titling remains positive and significant after adding "big reallocation and small reallocation" in the model. However, the coefficients of reallocations are insignificant. Model5 shows that the coefficient of land titling is positive at 0.150 and significant at the 1% level. Therefore, land titling certificate would increase willingness to invest in land, conditional on the farmer without reallocation experiences in the past five years. The coefficient of the interaction term *Land titling* Small reallocation* is positive at 0.095 but insignificant. By contrast, the coefficient of the interaction term *Land titling* Big reallocation* is -0.626 and significant at the 1% level. These findings suggest that the effect of land titling on investment incentives is weaker for farmers with big reallocation experience than farmers with or without partial reallocation experience. Farmers with big reallocation experience believe that the farmland may be continually reallocated. Hence, believing that land property rights were secure is hard for them although the land was titled (Table 5).

5.4. Robustness check

Endogeneity problems may exist between land titling and investment incentive for the following reasons. First, households with high intention to invest in farmland may have a higher intention to receive a certificate of land property rights than those with low intention. Second, some unobserved factors influencing the implementation of land titling may influence the investment decision of farmers. We

Table 5
Impacts of land titling on investment incentives under different readjustments.

VARIABLES	Willingness to invest			
	Model2	Model3	Model4	Model5
Land titling	0.132***	0.118***	0.161***	0.150***
	(0.041)	(0.043)	(0.042)	(0.045)
Land titling*small reallocation		0.128		0.095
		(0.121)		(0.122)
Land titling*big reallocation			−0.637***	−0.626***
			(0.187)	(0.188)
Small reallocation	0.038	−0.021	0.041	−0.003
	(0.062)	(0.086)	(0.062)	(0.087)
Big reallocation	−0.010	−0.011	0.293**	0.287**
	(0.098)	(0.098)	(0.137)	(0.138)
Other controls	Yes	Yes	Yes	Yes
Observations	2704	2704	2704	2704

Notes: 1. *** p < 0.01, ** p < 0.05, * p < 0. Robust standard errors are in parentheses. 2. Other controls include all the random variables in Table 4.3. An Ordered Probit model is employed.

employ instrumental variable (IV) method to reduce the possibility of endogeneity problems.

Our IV is the total number of villages in the county. As mentioned before, for the entire land titling work, the provincial government is responsible for organizing and leading, the city level government is responsible for organizing and coordinating, and the county and township governments are responsible for the implementation. The county government must ensure that the land titling project of each village in its jurisdiction is carried out and completed smoothly. Therefore, the more villages in a county, the greater the workload and the slower the progress. If the county has more villages, then the household would experience difficulty acquiring land certificate. Therefore, our IV is correlated with our key independent variable. However, an individual farmer does not know how many villages exist in the county that is not within his decision function. The IV fits the exclusion restriction. We employ the total number of villages as the IV for our study.

Table 6 presents the estimated results. We first employ a Probit model to regress land titling on the IV and other controls (Model6). Accordingly, the possibility of a farmer receiving a land certificate decreases as the total number of villages in the county increases. In addition, households with land reallocation experience since 2009 are

Table 6
Results of the robustness check1.

VARIABLES	Land titling	Willingness to invest		
	Model6	Model7	Model8	Model9
Ln (Num_of_vill)	−0.189***			
	(0.045)			
Land titling		1.277**	0.964	0.871*
		(0.632)	(0.624)	(0.476)
Land titling*small reallocation			3.658	
			(4.171)	
Land titling*big reallocation				−1.983***
				(0.755)
Small reallocation	−0.227***	0.149	−1.563	0.114
	(0.080)	(0.092)	(1.939)	(0.080)
Big reallocation	−0.260**	0.086	0.057	0.980**
	(0.121)	(0.141)	(0.132)	(0.394)
Other controls	Yes	Yes	Yes	Yes
Constant	0.437	3.152***	3.358***	3.244***
	(0.288)	(0.229)	(0.281)	(0.194)
Observations	2704	2704	2704	2704

Notes: 1. *** *p* < 0.01, ** *p* < 0.05, * *p* < 0.1. Standard errors are in parentheses. 2. Other controls include all random variables in Table 4. 3. Num_of_ vill is the total number of villages in the county.

less likely to possess land certificates. These findings are consistent with our proposition.

We employ a Two-Stage Least Squares (2SLS) regression analysis to estimate Model7 to Model9. Model7 focuses on the effect of land titling on the willingness of farmers to invest, whereas Model8 and Model9 focus on this effect under different land reallocations. After considering the possible endogeneity problems, the results are found consistent with the basic estimation. Land titling promotes the willingness of farmers to invest, but the effect is substantially weak for farmers with big re-allocation experience.

The possibility that land reallocation may also have endogeneity problems is another concern because we cannot control all variables associated with the farmer's willingness to invest and the land re-allocations. As such, the coefficients of the interaction terms in Table 6 may be biased. We employ an IV for land reallocation to reduce the possibility of endogeneity problems. Our IV serve as the average land reallocations in the county, excluding the farmer under concern. As mentioned above, land reallocation is closely related to the im-plementation of previous agricultural policies. Land reallocation in different villages is governed by the same official institution; therefore, those occurring in the same county are correlated. However, land re-allocations of other farmers are uncorrelated with the investment in-centive of the farmer under concern.

We employ Probit models to regress land reallocations on the IV and other controls (Model10 and Model11 in Table 7) and find that the possibility of a farmer experiencing land reallocation, small and big, increases as the average reallocations in the county increase. These findings are also consistent with our proposition.

In Model12 and Model13, we use the 2SLS method to estimate the effect of land titling on the willingness to invest under different land reallocation experiences.

The econometric models are as below:

$$y^* = \alpha_3 + \theta_3 R_i + X'_i \beta_3 + v_i, \qquad (3)$$

$$R_i = \alpha_4 + \chi_4 Z_i + X'_i \beta_4 + \varsigma_i, \qquad (4)$$

where $R = (landtitling, realloc, landtitling*realloc)$ and $Z = (\ln(Num\_of\_vill), Co\_ave\_reallc, \ln(Num\_of\_vill)*Co\_ave\_reallc)$[1] ; X is the control matrix; v and ς are the error terms; and $\alpha_3, \alpha_4, \theta_3, \chi_4, \beta_3$ and β_4 are the parameters to be estimated.

We focus on the coefficients of the interaction terms in Model12 and Model13. Accordingly, the coefficient of "Land titling*small realloca-tion" in Model12 is insignificant and that of "Land titling*big re-allocation" in Model13 is negative and significant at the 5% level. After considering the possible endogeneity problem of land reallocations, the results are the same as above. Therefore, our findings are robust (Table 7).

6. Conclusion

Since the introduction of HRS in the early 1980s, farmlands have been frequently reallocated by villages despite the central government policy that guarantees farm households the rights of tenure security for 30 years. China began the new round of land titling program in 2009 to title detailed information of the contracting land for farmer households. This study focuses on the impact of the new round of rural land titling on rural farmers' willingness to invest. It further compares the impact of the new round of rural land titling on the investment of farmer households with different farmland reallocation experiences. We find that the land titling can significantly promote farmer' willingness to invest in farmland. However, the impact varies among farmers with different land reallocation experiences. Land titling will significantly

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[1] Num_of_ vill is the total number of villages in the county; Co_ave_reallc is the average reallocations in the county excluding the farmer under concern.

Table 7
Results of the robustness check2.

VARIABLES	Small reallocation	Big reallocation	Willingness to invest	
	Model10	Model11	Model12	Model13
Co_ave_reallc	2.073***	1.901***		
	(0.146)	(0.176)		
Land titling			−1.165	−0.407
			(1.379)	(0.389)
Land titling*small reallocation			35.04	
			(47.02)	
Land titling*big reallocation				−6.697**
				(3.121)
Small reallocation			−12.10	
			(16.63)	
Big reallocation				3.746***
				(1.275)
Other controls	Yes	Yes	Yes	Yes
Constant	−2.043***	−2.456***	4.870***	3.542***
	(0.226)	(0.301)	(1.743)	(0.187)
Observations	2704	2704	2704	2704

Notes: 1. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Standard errors are in parentheses. 2. Other controls include all the random variables in Table 4.

increase the farmland investment incentive of those who did not ex-perience farmland reallocation in the past five years. Moreover, land titling can strengthen the positive effect of land titling on investment among those who only experienced small reallocation. However, land titling will have significantly negative impact among farmers who have experienced big reallocation. The land titling does not necessarily sti-mulate the investment incentives of farmers. Only when farmers believe that policies can be implemented, and believe that farmland property rights are safe, they may increase to invest. Therefore, to strengthen the legal rights of land through policies is important, but to improve farmers' trust in policies is also important.

Our research has important reference significance for developing countries. The investment incentive impact of farmland titling also exists in other countries where farmers do not own the land. The view of institutional economics that "the clearer property rights are more efficient" is established under the background of private and collective ownership. Thus, the use rights will promote the positive investment incentive effect as long as it is clear and secure enough. Moreover, the basic security of implemental land use rights must be guaranteed. If the root cause of property rights insecurity has not been eliminated, then the farmers will not trust the farmland system reform. This distrust may weaken the impact of land titling or even bring about counter-productive results.

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