China Economic Review 63 (2020) 101534

Contents lists available at ScienceDirect

China Economic Review

journal homepage: www.elsevier.com/locate/chieco

Rural household migration in China – the roles of actual and perceived tenure security

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ARTICLE INFO

Keywords:
Migration
Land tenure security
Household perceptions
Land rental market
China

ABSTRACT

Migration can make an important contribution to rural poverty reduction and overall productivity growth, but it may be limited by prevailing rural land tenure arrangements. Since 1998, the Chinese government has implemented a number of land tenure reforms with the aim of improving the tenure security and the transferability of land. Although these reforms enhanced legal tenure security, it is not clear to what extent they remove existing land tenure bottlenecks in migration. Both actual tenure security, i.e. local implementation of laws that warrant tenure security, and household perceptions of tenure security are likely to play a role. In this paper we examine the impacts of actual and perceived tenure security on rural household migration in China, taking into account the degree of development of land rental markets. We argue that actual and perceived tenure security can have both positive and negative effects on migration decisions and that the presence of land rental markets may modify these effects. A two-step control function approach that controls for endogeneity of tenure security perceptions is applied to household and village-level data collected in Jiangsu, Jiangxi, Liaoning provinces and Chongqing municipality. We find that both actual and perceived tenure security affect migration, but the impact of perceived tenure security measured by land reallocation expectations is much stronger and is positive, whereas the independent impact of actual tenure security is negative. Households perceiving a lower risk of losing land when one or more members migrate are more inclined to migrate, independent of the availability of land rental markets in their villages. Actual tenure security, as measured by absence of land reallocations and possession of land certificates, has an independent negative effect on migration only in villages with underdeveloped land rental markets.

1. Introduction

Migration can play an important role in reducing rural poverty and improving overall productivity at a national level (Au & Henderson, 2006; Rozelle, Guo, Shen, Hughart, & Giles, 1999). First, migration can absorb surplus family labour that cannot be fully employed on the farm (Bowlus & Sicular, 2003; Woldenhanna & Oskam, 2001). It thereby increases and diversifies the income of rural households (Atamanov & Van den Berg, 2012; De Brauw, Huang, Rozelle, Zhang, & Zhang, 2002). Second, land may be rented by more efficient farmers when less efficient farmers migrate (Ma, Heerink, Feng, & Shi, 2017). Third, in areas lacking a well-functioning credit market, migrant remittances can provide cash for investing in agricultural production (De Brauw & Rozelle, 2008;

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https://doi.org/10.1016/j.chieco.2020.101534
Received 1 October 2019; Received in revised form 16 June 2020; Accepted 28 July 2020
Available online 05 August 2020

Matshe & Young, 2004) and are therefore expected to increase agricultural productivity. Moreover, the insurance effect of more diversified household incomes may shift farm production towards riskier but also more profitable crops and thereby raise the incomes of smallholder farmers (Gehrke, 2019; Taylor & Martin, 2001).

Rural land tenure insecurity can be an important obstacle to migration (De La Rupelle, Quheng, Shi, & Vendryes, 2008; Yang, 1997). When households face a high risk of losing part or all of their rural land, potential migrant members may prefer to stay at home instead of migrating to urban areas for work (Ma, Heerink, van Ierland, & Shi, 2016). Empirical studies on the impact of land tenure security on migration in China find evidence supporting this relation. Giles and Mu (2017) and De La Rupelle et al. (2008) find that land tenure insecurity, caused by the threat of periodical land reallocations within villages, has a significant negative impact on migration. Deininger, Jin, Xia, and Huang (2014) find that the recognition of land rights through land certificates encourages temporary migration of rural labour.

The impact of tenure security on migration is likely to depend on the degree of land rental market development (Deininger et al., 2014; Yang, 1997). Households that can rent out part or all of their land are likely to be involved in migration if they have sufficient guarantees that they can cultivate their land again when needed. Empirical evidence for rural China provides support for this assertion. Mullan, Grosjean, and Kontoleon (2011) find that greater perceived land tenure security tends to increase migration when renting land is permitted, while it reduces migration when renting land is restricted. Ma et al. (2016) find that household perceptions of land tenure security significantly affect migration decisions in villages where the land rental market is underdeveloped.

Empirical studies on land tenure security and migration in China focus either on household perceptions of tenure security (so-called 'perceived tenure security'), as in the two studies mentioned (Ma et al., 2016; Mullan et al., 2011), or on existing land tenure arrangements (so-called 'actual tenure security'), such as the frequency of land reallocations and the recognition of land rights through land certificates. Studies in the latter group commonly use indicators of actual tenure security as proxies for tenure security perceptions that drive rural household migration decisions. But existing land tenure arrangements may also affect migration through channels other than tenure security perceptions. In villages where no land reallocations take place, households may have invested more in land quality and thereby have fewer incentives to migrate than those in villages with land reallocations. Moreover, actual possession of land certificates is likely to have an independent effect on migration in addition to the perceived importance attached to such documents.

To our knowledge there are no studies available in the literature that analysed the impact of both actual and perceived land tenure security on household migration decisions. The objective of this paper is therefore to examine the effects of actual and perceived land tenure security on migration in China, taking into account the development of land rental markets. The Chinese government implemented a set of major reforms in legal land tenure arrangements and stimulated the development of land rental markets in recent years. As the degree of implementation of these policies differs greatly between different regions in China (Ma, Heerink, Feng, & Shi, 2015), this provides a major opportunity to empirically analyse the impact of changes in land tenure security and land rental markets on migration. We aim to contribute to the literature by empirically estimating the impact of both actual and perceived tenure security on the migration of rural households.

A household survey data set containing data on tenure security, land rental markets, households' participation in migration and other relevant variables in four different regions is used for the empirical analysis. The data were collected through four surveys held among 1486 households in Jiangsu and Jiangxi provinces in 2015 and in Liaoning province and Chongqing municipality in 2016. A two-step control function (2SCF) approach is applied to address the potential endogeneity of perceived land tenure security.

The paper is organized as follows. Section 2 describes the land tenure system and its reforms in rural China. Section 3 discusses the mechanisms through which actual and perceived land tenure security are expected to affect household migration decisions, and explains why the impacts are likely to depend on the development of the land rental market. Section 4 describes the dataset, presents the model specification and estimation strategy and provides the definitions of variables used in the empirical analysis and their summary statistics. Section 5 summarizes and discusses the estimation results, while Section 6 presents conclusions.

2. Land tenure reforms and tenure security in China

From 1979 to 1983, the collective farming system in China was gradually replaced by the Household Responsibility System (HRS) in which farmland is owned by village collectives and contracted to individual households for a period of 15 years. Although written land contracts indicating the contractual relationship between households and the collective were issued, land could still be reallocated periodically during the contract period in response to demographic changes in households or for other reasons.

When the initial 15-year contract expired around 1998, land use rights were assigned to rural households for another 30 years during the so-called second-round land allocation (hereafter called '1998 land allocation'). During this 30-year period, the central state issued a number of laws and regulations to strengthen household land tenure security. Land certificates were required to be issued to all rural households. Full-scale land reallocations, under which "all farmland in the village was given back to the collective and redistributed among village households", were completely prohibited (Ma et al., 2015: 294). Partial land reallocations, which affect only a share of the households in a village, were permitted only "in case of a natural disaster, land expropriation or other special circumstances", and conditional on "acceptance by two-thirds of villagers' representatives and approval by higher-level authorities" (Ma et al., 2015: 295).

These national laws and regulations were not always implemented by lower level governments. Due to contradictions with village self-governance rules, limited knowledge of national policies, differences between regions in local resource endowments, levels of economic development and other relevant contextual factors, land reallocations were still implemented in some regions, while the possession of land certificates and their contents also differ between regions (Ma et al., 2015; Ma, Heerink, van Ierland, Lang, & Shi,

2019; Ren, Zhu, Heerink, Feng, & van Ierland, 2019a). A survey held in 115 villages in six provinces of China indicated that 42% of the surveyed villages reallocated land between 1998 and 2008 (Wang, Tong, Su, Wei, & Tao, 2011). Another national survey covering six provinces in China showed that approximately one-third of the surveyed households lacked a land certificate until 2008 and more than one-third of the households experienced land reallocations between 1978 and 2008 (Deininger et al., 2014).

Households' perceptions of land tenure security remain weak in some regions. For instance, a survey held in rural Xinjiang province of China in 2008 showed that 40% of the surveyed households worried about losing land in the future (Rao, Spoor, Ma, & Shi, 2017). A survey held in two other provinces in China, i.e. Gansu in 2010 and Jiangxi in 2011, showed that only 40% (33%) of the interviewed households in Gansu (Jiangxi) expected that land would not be reallocated within five years (Ma et al., 2019).

Since 1984, the central government has been continuously encouraging rural households to participate in the land rental market via the No. 1 Document. But the land rental market initially remained virtually inactive. Just 3% of contracted land was transferred to other households in 1995 (Kung, 2002). The 2002 “Rural Land Contract Law” and the 2007 “Property Law” specified rural households' rights to transfer, to rent and to exchange contracted land. Market-based land transfers have been propagated in each year's No. 1 Document since 2008. Since then, the occurrences of land transfers have increased rapidly. The share of transferred land to the total area of household contracted land rose from 12% in 2009 to 33% in 2015 (Ministry of Agriculture (MOA), 2016). In 2015, the central government indicated that China was planning to legally separate land use rights into operational rights and contracting rights while maintaining collective ownership. Under this so-called “three rights separation” regulation, operational rights can now be freely transferred (Huang & Ding, 2016; Wang & Zhang, 2017). Land contracting rights, however, cannot be transferred; they belong to the rural households that reside in the village and originally received them from the collective. Both the contracting rights of leasers and the operational rights of tenants are legally protected. This institutional change is expected to further facilitate land transfers.

3. Theoretical framework

Following van Gelder (2010) and Ma et al. (2015), we make a distinction between legal, actual and perceived tenure security. Legal tenure security “sees tenure security as a legal construct” and “equates formal property rights with tenure security”; actual tenure security “is based on the actual control of property, regardless of the legal status in which it is held”; perceived tenure security “refers to household perceptions of tenure security” (Ma et al., 2015: 293). Most empirical studies on tenure security and migration in China use indicators of actual land tenure security, such as household past experiences with land reallocations and possession of land certificates. These studies implicitly assume that migration decisions depend on household tenure security perceptions which are strongly related to actual tenure security. We will first discuss the different mechanisms through which tenure security perceptions may affect migration, then explain why actual security may have some independent effects on migration that are not related to tenure security perceptions and/or changes therein, and finally discuss the role of land rental markets in shaping the relationships between tenure security and migration.

3.1. Impact of perceived land tenure security

Three possible ways in which rural household migration decisions might be affected by perceived land tenure security can be distinguished. First, perceived land tenure security has a positive impact on migration through reducing the risk of land reallocations (hereafter called ‘risk-reducing effect’). Migration entails a decrease in household size if one or more members migrate and the others remain in the village. Due to land scarcity and incomplete implementation of the policy that restricts land reallocations, migration may encourage the village leader to reallocate some of a household's land to other households (Ma et al., 2016). Thus, households perceiving a relatively high risk of losing land may refrain from migration (De La Rupelle et al., 2008; Mullan et al., 2011).

Second, perceived land tenure security may have a negative land investment effect on migration. Higher perceived land tenure security tends to stimulate land investments (Brasselle, Gaspart, & Platteau, 2002). Households making investments in land usually spend more time working on the land and thus participate less in migration (Mullan et al., 2011). The higher incomes earned from agriculture reduce the need for earning off-farm income.

Third, perceived land tenure security has a positive land renting-out effect on migration. Greater perceived land tenure security promotes household incentives to rent out land, because the risk of land not being returned to the lessor after the rental period ends is lower. The additional income earned from renting out land may be used to finance the transportation, living, job-hunting costs and other start-up costs of migration (De Janvry, Emerick, Gonzalez-Navarro, & Sadoulet, 2015; Yang, 1997). Thus high perceived land tenure security may encourage credit-constrained households to rent out land and migrate simultaneously (Benjamin & Brandt, 2002).

In summary, perceived land tenure security has a positive risk-reducing effect, a negative land investment effect and a positive land renting-out effect on migration. These effects are shown schematically in Fig. 1, with the mediating effects indicated in ovals. The net effect of perceived land tenure security on migration is inconclusive, given that the magnitudes of the three effects are unknown.

3.2. Impact of actual land tenure security

Actual land tenure security might influence household migration in at least three different ways. First, it affects migration through the land tenure security perceptions of households. When actual tenure security is high, household perceptions of their tenure security will generally be high as well (Ren, Zhu, Heerink, Feng, & van Ierland, 2019b). Two major aspects of actual tenure security in

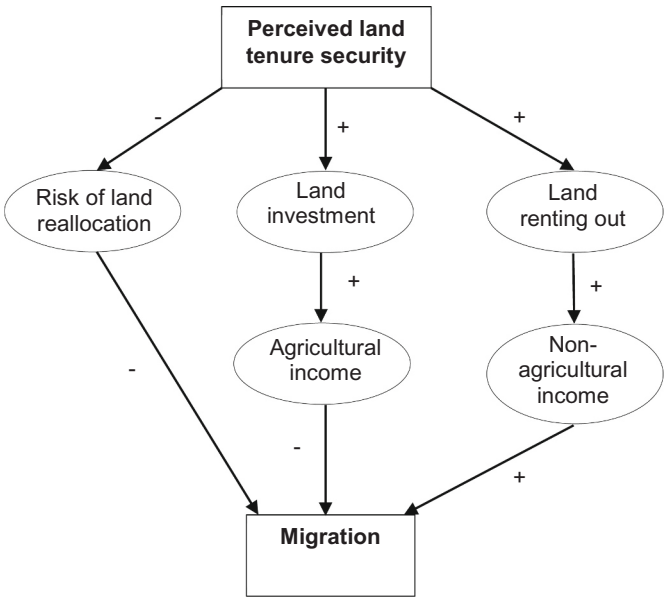

Fig. 1. Conceptual framework for impact of perceived land tenure security on migration.

China are the occurrence of land reallocations and the possession of land certificates. Households that experienced one or more land reallocations since the 1998 land allocation are more likely to expect additional land reallocations to occur in the future, and are less likely to believe that land certificates protect their land rights than those whose land has never been reallocated (Kung, 2000). Land certificates provide a basis for legal protection against illegal land occupation and land conflicts. Households that possess land certificates will generally perceive their land tenure to be relatively secure (Ren et al., 2019b).

Apart from its impact through perceived tenure security, other mechanisms may exist through which actual tenure security affects migration. One such mechanism is the negative land quality effect. Households with relatively high actual land tenure security are expected to have better quality land because they have made more land investments. In the case of China, households that have not experienced land reallocations since the 1998 allocation and that possess land certificates are more likely to have invested in improving land quality (Deininger, Ali, & Alemu, 2011). Households with higher quality land can generate more income from agriculture, and hence have a lower need to earn off-farm income.

In addition, actual land tenure security may have a positive impact on migration through land rentals. When no land reallocations take place in a village, inequality among households in per capita land holdings tends to increase due to changes in household sizes over time; land rentals may be used to reduce this inequality (Deininger and Jin, 2005). The income earned from renting out land might ease liquidity constraints on migration. The opposite holds for renting in land. Similar effects may occur with possession of land certificates. It is not only the tenure security derived from land certificates that matters for land rental decisions, but also the actual possession of certificates. When the perceived effectiveness of land certificates for protecting land rights is similar, land rentals are more likely to occur in villages that issued land certificates as compared to villages that did not do so.

The three effects discussed above are shown schematically in Fig. 2, with the terms in ovals again indicating the mediating effects. Apart from the impact of actual land tenure security through perceived land tenure security, actual land tenure security has a negative land quality effect and an indeterminate land renting effect on migration. Empirical research is needed to provide quantitative estimates of the sign (positive or negative) and magnitude of the net effect of actual tenure security on migration.

3.3. The role of land rental market development

The degree of land rental market development can play an important role in several of the pathways shown in Figs. 1 and 2. The positive risk-reducing effect of higher perceived tenure security will be weaker in villages with active land rental markets as land rentals enable land to be transferred from households with large per capita land holdings to households with smaller land holdings and hence decrease the risk of land reallocations within villages (Deininger & Jin, 2005). The positive land renting-out effect of higher perceived tenure security on migration will be stronger, because a more developed land rental market allows more households with (potential) migrants to rent out land, and to use the income from land rentals to cover costs of migration. For similar reasons, the (indeterminate) land renting effect of actual land tenure security on migration is expected to be stronger in villages with a more developed land rental market.

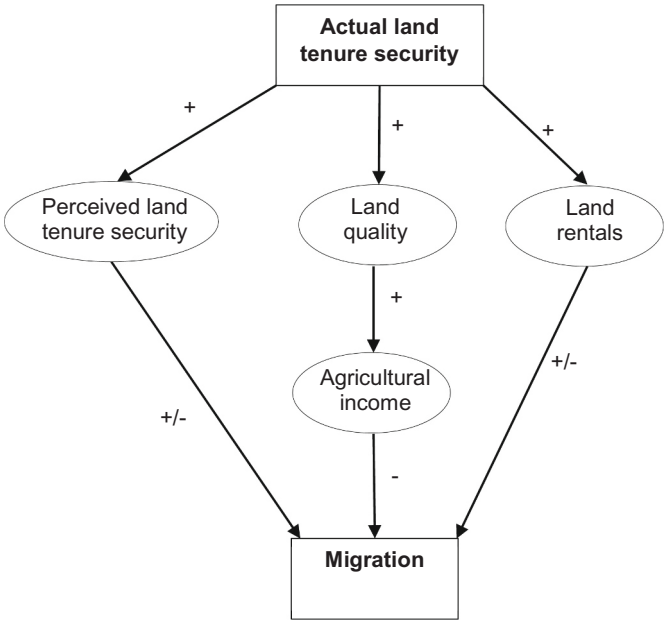

Fig. 2. Conceptual framework for impact of actual land tenure security on migration.

4. Data and empirical strategy

4.1. Data collection

The data were collected in 2015 in Jiangsu province and Jiangxi province and in 2016 in Liaoning province and Chongqing municipality, China. These four areas are located in each of China's four major agro-ecological zones. The survey obtained information on land tenure arrangements, labour allocation, development of land rental markets and basic village and household characteristics, using structured village leader and household questionnaires and face-to-face interviews.

The data set covers 124 villages and 1486 households. Four counties were selected from each province, one from each quartile on the list of counties sorted according to the average grain yield (tons/thousand hectares) in the last three years. Random numbers generated by Excel were used for this purpose. Counties with less than 10% arable land area in the total arable land area of the prefecture in which the county is located were excluded from the list. Within each county, we selected townships by applying the same procedure as for county selection, using the arable land area of townships as the criterion. The ratio of a county's arable land area to the total arable land area of the four selected counties was used to determine the number of townships to be selected in each county. Two villages were then randomly selected in each township and around ten households were randomly selected in each village. Omitting 216 households that either did not have working age household members or had missing information on one or more of the variables used in our analysis, we used the survey data of 1270 households for the empirical analysis.

4.2. Model specification

Our objective is to examine the impact of actual and perceived land tenure security on migration, taking into account the degree of development of land rental markets. To this end, we specify the following model:

$$M = \alpha_0 + \alpha_1 A + \alpha_2 L * A + \alpha_3 P + \alpha_4 L * P + \alpha_5 L + \alpha_6 X + \varepsilon \quad (1)$$

where M represents household participation in migration; A and P denote actual land tenure security and perceived land tenure security, respectively; L represents degree of land rental market development; X is a set of control variables, including natural capital, physical capital, human capital, social capital, demographic factors, local conditions and regional characteristics; α_i are the coefficients to be estimated ($i = 1, \ldots,6$); ε is an error term with standard properties. Interaction terms between L and A and between L and P are added to the model to examine the impact of the degree of land market development on the relation between (actual and perceived) tenure security and migration.

No data are available in the data set on most of the mediating effects discussed in Section 3. We therefore focus our empirical analysis on the estimation of the net effects of actual and perceived tenure security. In the case of actual tenure security, the estimated effect reflects its independent impact at given levels of perceived tenure security because perceived tenure security is one of the explanatory variables included in the model. In other words, the coefficient estimate for actual tenure security indicates the net impact of the (negative) land quality effect and the (indeterminate) land renting effect (see Fig. 2).

Table 1
Definitions and summary statistics of variables included in the regression analysis (1270 observations).

Variable	Description	Mean	S. D.	Min	Max	Expected sign
Migration variables						
Migration decision	=1 if the household has at least one migrant (= member living outside the county for employment purposes for six months or more); =0 otherwise	0.39	0.49	0	1	−
Number of migrants	Number of migrants in a household	0.57	0.83	0	4	−
Migration duration	Total months spent on migration by migrated household members	6.36	9.32	0	48	−
Actual land tenure security						
Absence of land reallocations	=1 if the village has not reallocated farmland since 1998 land allocation; =0 otherwise	0.65	0.48	0	1	+/−
Possession of land certificates	=1 if the village issued land certificates to households in 1998 land allocation; =0 otherwise	0.70	0.46	0	1	+/−
Perceived land tenure security						
No land reallocations expected	=1 if the household expects their land will not be reallocated within the next five years; =0 otherwise	0.82	0.38	0	1	+/−
Perceived effectiveness of land certificates	=1 if the household believes that land certificates can protect its land rights; =0 otherwise	0.81	0.40	0	1	+/−
Land rental market						
Land rental market development	=1 if the share of transferred land in the village exceeds the average national level of 2015 (33%); =0 otherwise	0.22	0.41	0	1	+/−
Natural capital						
Land area per capita	Area of contracted land per capita (mu)	2.76	3.60	0.1	45	−
Number of land plots	Number of contracted land plots	8.04	7.08	1	50	+/−
Physical capital						
Machinery	=1 if the household possessed at least one machine the year before last year; =0 otherwise	0.35	0.48	0	1	−
Houses[1]	The number of houses the household owned the year before last year	1.19	0.45	0	6	+/−
Human capital						
Average age of labourers	Average age of labourers (household members aged between 16 and 65 years old, excluding students)	46.14	8.13	24	65	−
Education level of labourers	Ratio of labourers taken junior high school or higher to all labourers in the household	0.66	0.35	0	1	+
Off-farm experience of labourers	Ratio of labourers with off-farm experience the year before last year to all labourers in the household	0.60	0.34	0	1	+
Social capital						
Village official	=1 if the household head is/was village official; =0 otherwise	0.25	0.43	0	1	+/−
Demographic factors						
Number of labourers	Number of household members aged between 16 and 65 years old, excluding students	2.92	1.07	1	8	+
Dependency ratio	Number of household members aged over 65 or below 16 divided by household size	0.22	0.19	0	0.8	+/−
Female labour ratio	Ratio of female labourers to all labourers in the household	0.50	0.17	0	1	−
Local conditions						
Large-scale farming	=1 if there is large-scale farming in the village; =0 otherwise	0.35	0.48	0	1	+/−
Distance to town[2]	Distance from the office of the village committee to the nearest township centre (km)	5.56	4.20	0	26	+/−
Regional characteristics						
Jiangsu	=1 if the household is from Jiangsu; =0 otherwise	0.18	0.38	0	1	+/−
Liaoning	=1 if the household is from Liaoning; =0 otherwise	0.29	0.45	0	1	+/−
Chongqing	=1 if the household is from Chongqing; =0 otherwise	0.25	0.43	0	1	+/−
Instrument variables						
Mean household opinion about policy	Share of other interviewed households in the village that agree with the land stabilizing policy	0.55	0.21	0	1	−
Land area per capita in the village	Area of farmland in the village per capita (mu)	2.47	2.33	0.14	10.63	−

Source: Authors' calculations from household surveys; for actual land tenure security, land rental market and local conditions, information provided in the village leader surveys by the leader of the village in which a household resides has been used.

[1] The minimum value is zero because four households in our sample do not own houses. Rural households in China can sell their own house built on the construction land assigned to them and live in a rented house.

[2] The minimum value is zero because two villages in our sample border on the township centre.

4.3. Variable definitions and expected effects

Table 1 shows the variable definitions and descriptive statistics. Household participation in *migration* is measured by three different indicators, namely migration decision, number of migrants and migration duration. Following the definition used by the National Bureau of Statistics of China, a migrant is defined as an individual who lived outside the home county for employment purposes for at least six months during the calendar year before the survey (De La Rupelle et al., 2008). Migration decision takes a value of 1 if at least one household member migrated and 0 otherwise. Number of migrants is the number of migrants in the

household. Migration duration is the total number of months spent on working outside the county by migrated household members. In the sample that we use for the empirical analysis, 39% of the households have at least one migrant, the average number of migrants is 0.57, and the migration duration is 6.36 months on average (see Table 1).

Actual land tenure security is measured by absence of land reallocations and possession of land certificates. To avoid misreporting errors in households' responses to these questions, we use data from village leader surveys as indicators of the actual land tenure security of households (Deininger et al., 2014; Kung, 2000; Kung & Bai, 2011). Absence of land reallocations equals 1 if the land was not reallocated since the 1998 land allocation in the village in which the household lives, and 0 otherwise. Possession of land certificates takes the value of 1 if the village issued land certificates to households during the 1998 land allocation, and 0 otherwise. Land reallocations have been conducted at least once since 1998 for 65% of the households in the sample, whereas land certificates were issued during the 1998 land allocation round in 70% of the villages in which the surveyed households live (see Table 1).

Perceived land tenure security is represented by household-level variables indicating that no land reallocations are expected and the perceived effectiveness of land certificates. The former takes the value of 1 if a household expects its land will not be reallocated within the next five years, and 0 otherwise, while the latter takes the value of 1 if the household believes that land certificates can protect its land rights, and 0 otherwise. About four-fifths of the surveyed households do not expect their land to be reallocated within five years (82%) and believe that their land certificates can protect their land rights (81%). As discussed in Section 3, the impacts of actual and perceived land tenure security can be either positive or negative, depending on the relative strength of the different underlying mechanisms.

A dummy variable, obtained from the village leader surveys, is introduced to measure *land rental market development* in the village. The interaction terms of (actual and perceived) land tenure security with this dummy variable allow us to examine whether the effects of land tenure security on migration for villages with relatively developed land rental markets differ from the effects for villages with underdeveloped land rental markets. In order to do so, we need an objective criterion for distinguishing between more developed and less developed land rental markets. We use the average degree of land rental market development in rural China for that purpose. Accordingly, the value of the land rental market dummy variable equals 1 if the share of transferred land in the village exceeds the average national level of 2015 (33%) and 0 otherwise. Apart from its interactive effects with tenure security (see Section 3.3), the degree of land rental market development itself is also expected to affect migration decisions. A developed land rental market allows prospective migrants to rent out land and reduces the opportunity costs of migration (De Janvry et al., 2015; Yang, 1997). But it also allows other households to rent in land and thereby stimulates them to remain in the village. Thus, the standalone land rental market development variable has an indeterminate impact on migration. Land rental markets are less developed on average in our research areas as compared to the national average, since only 22% of the sample households live in villages where the share of transferred land in total contracted land exceeds the national average. Substantial differences exist across the four regions. In Jiangsu province, 46% of the surveyed households live in villages with the share of transferred land exceeding the national average, whereas the ratio is merely 5% for the surveyed households in Liaoning province.

Several control variables are included in the model. *Natural capital* is represented by the contracted land area per capita and the number of contracted land plots. Large per capita land endowments decrease a household's probability of migration (Atamanov & Van den Berg, 2012). Number of land plots is used as an indicator of land fragmentation. On the one hand, fragmented land causes an increase in travel time and difficulties in management. Households will therefore obtain lower agricultural incomes as compared to households with similar land sizes and fewer plots, and are more likely to migrate. On the other hand, land fragmentation allows households to gain access to land with different quality at different locations and thereby spread the risk of loss from natural disasters (Tan, Heerink, & Qu, 2006). In summary, the effect of fragmentation on farm income and therefore migration could be either positive or negative. Contracted land per capita is 2.76 mu[1] on average and the mean number of plots equals 8.04 for the households in our sample. Land endowment is the scarcest and most fragmented for the surveyed households living in Chongqing, with an average of 1.23 mu per capita and 14 plots per household.

Physical capital is measured by a household's possession of machinery and houses. Households possessing machinery are more likely to focus on farm production rather than migration as a livelihood strategy than those without machinery. Thus the impact of possession of machinery is expected to be negative. Households with more houses are generally wealthier and therefore better able to cover the costs of migration. On the other hand, wealthier households may be less motivated to increase family income through migration. Thus the number of houses is expected to have either a positive or negative impact on migration. Around one-third of the surveyed households (35%) possessed at least one machine for agricultural production in the year before the survey. The mean number of houses owned by households equals 1.19.

Human capital is represented in the model by the average age, education level, and off-farm experience of labourers. Younger household members generally have more opportunity to migrate than older members (Hare, 1999). Consequently, the average age of labourers is expected to have a negative impact on migration. Education level is measured by the ratio of labourers with at least junior high school to all labourers in a household. More educated individuals generally have more opportunities to find a relatively stable job in urban areas (De Brauw et al., 2002). Thus, the impact of education level is expected to be positive. Off-farm employment experience is measured by the ratio of labourers with off-farm experience in the year before last to all labourers in a household. It is expected to have a positive impact on migration because of lower transaction costs in finding off-farm employment. As can be seen in Table 1, the average age of labourers in our sample is around 46. About two-thirds of the labourers in our sample have taken junior high school or higher, while 60% of the labourers have off-farm employment experience.

[1] Fifteen mu equals one hectare.

Social capital is represented by a dummy variable indicating whether the household head is, or has been, a village official. We define village official in a broader sense, including members of village committees and leaders of natural villages. Village officials may have better access to employment information and are therefore more likely to migrate, but village officials may also tend to combine local off-farm employment with work for the village committee. Thus, the impact of the village official dummy on migration is ambiguous. One quarter of the household heads in our sample is, or has been, a village official.

The impact of *demographic factors* on migration is controlled by including the number of labourers, the dependency ratio and the female labour ratio in a household in the model. The number of labourers reflects a household's labour availability. When there are more labourers in a household, it is more likely that at least one of them migrates. The dependency ratio is defined as the share of household members aged over 65 or below 16 in a household. On the one hand, dependents require care by other household members, reducing the likelihood of migration (Deininger et al., 2014). On the other hand, the share of income spent on education, health care and food will be relatively high in households with high dependency ratios. This may increase the pressure to migrate. The dependency ratio therefore has a mixed impact on migration. Female labourers are less likely to participate in migration than males because of their traditional roles in rural families (Shi, Heerink, & Qu, 2007). In our sample, the number of labourers ranges from one to eight, with a mean value of 2.92. The dependency ratio equals 0.22 on average, whereas the female labour ratio equals exactly 0.50 on average.

Local conditions included in the model comprise the presence of large-scale farming and market access in the village where a household lives. Large-scale farming is defined as the presence of agribusinesses, family farms, land cooperatives or other large-scale farms in the village. The competition for land by large-scale farms reduces on-farm income earning opportunities and thereby stimulates migration. But it may also provide households with opportunities for local off-farm employment, thereby reducing migration incentives. Market access is measured by the distance from the village to the nearest township centre. A longer distance to the township centre generally implies higher transportation and other costs for migrants, but may also imply a lower availability of local off-farm employment opportunities that would compete with migration. Thus, the effects of large-scale farming and market access on migration are both ambiguous. About one-third of the households in our sample (35%) live in villages with large-scale farming. The distance from the village to the township centre is 5.56 km on average and ranges from 0 to 26 km in our sample.

Regional characteristics, represented by dummy variables for three of the four regions, are introduced to control for agro-climatic or other unobserved factors that differ between the four regions in which the villages in our sample are located, and that may affect migration.

4.4. Estimation method

Land tenure security perceptions may be endogenous, because they may be affected by households' migration decisions (Brasselle et al., 2002; Ma et al., 2016; Mullan et al., 2011). Households with migrants may perceive a higher risk of land reallocations and may attach a lower value to land certificates as devices that can protect land rights. Given that the perceived land tenure security indicators are binary variables, and that the dependent variables include one binary variable (i.e., migration decision), one integer (i.e., number of migrants) and one continuous variable (i.e., months spent on migration), we use a two-step control function (2SCF) approach to produce consistent coefficient estimates (Liu, Rommel, Feng, & Hanisch, 2017; Wooldridge, 2014).

In the first step of 2SCF, probit models of perceived land tenure security are estimated:

$$P = \gamma_0 + \gamma_1 A + \gamma_2 L + \gamma_3 X + \gamma_4 Z + \mu \tag{2}$$

where Z represents instrumental variables that affect perceived land tenure security (P), but do not affect migration (M) directly, and μ is the error term, A, L and X are the same as in Eq. (1), and γ_0 - γ_4 are the coefficients to be estimated.

The generalized residuals R of Eq. (2) are obtained from the first step as:

$$R = P\lambda(\gamma_1 A + \gamma_2 L + \gamma_3 X + \gamma_4 Z) - (1 - P)\lambda(-\gamma_1 A - \gamma_2 L - \gamma_3 X - \gamma_4 Z) \tag{3}$$

where $\lambda(\cdot) = \phi(\cdot)/\Phi(\cdot)$ is the inverse Mills ratio; $\phi(\cdot)$ denotes the standard normal density function and $\Phi(\cdot)$ is the standard normal cumulative distribution function. A Wald test over the joint significance of instruments in Eq. (2) is performed to test the strength of the instruments.

In the second step, the obtained generalized residuals R are added to Eq. (1), which becomes:

$$M = \alpha_0 + \alpha_1 A + \alpha_2 L * A + \alpha_3 P + \alpha_4 L * P + \alpha_5 L + \alpha_6 X + \alpha_7 R + \epsilon \tag{4}$$

The probit model is applied to estimate the model explaining the migration decision and the tobit model is applied to estimate the models with the number of migrants and migration duration as dependent variables. A Wald test over the joint significance of generalized residuals can be applied to test the null hypothesis that perceived land tenure security is exogenous (Brasselle et al., 2002; Liu et al., 2017). *Re*-estimation of Eq. (4) with instrumental variables Z included as explanatory variables may be used to test over-identification of instruments (see Eq. (5)) (Abdulai, Owusu, & Goetz, 2011; Lee, 1992):

$$M = \alpha_0' + \alpha_1' A + \alpha_2' L * A + \alpha_3' P + \alpha_4' L * P + \alpha_5' L + \alpha_6' X + \alpha_7' R + \alpha_8' Z + \epsilon' \tag{5}$$

If instruments (Z) are not jointly significant in Eq. (5), they can be excluded from Eq. (4), and there is no over-identification problem of instruments. To address the possible correlation of errors for households living within the same village, we use clustered standard errors at the village level.

We include two instrumental variables in the empirical analysis: (i) the share of other interviewed households in the same village

Table 2
Regression results for perceived land tenure security (1st stage of control function approach)[1].

	No land reallocations expected	Perceived effectiveness of land certificates
Actual land tenure security		
Absence of land reallocations	0.42** (0.17)	−0.05 (0.13)
Possession of land certificates	0.27 (0.18)	0.08 (0.15)
Land rental market		
Land rental market development	−0.07 (0.21)	0.11 (0.16)
Natural capital		
Land area per capita	0.03 (0.03)	−0.01 (0.02)
Number of plots	−0.03*** (0.01)	−0.00 (0.01)
Physical capital		
Machinery	−0.12 (0.10)	0.20* (0.12)
House	0.21* (0.12)	0.07 (0.12)
Human capital		
Average age of labourers	−0.01 (0.01)	−0.01** (0.01)
Education level of labourers	−0.41** (0.17)	0.17 (0.15)
Off-farm experience of labourers	0.16 (0.16)	−0.12 (0.13)
Social capital		
Village official	0.10 (0.11)	0.33*** (0.11)
Demographic factors		
Number of labourers	−0.06 (0.05)	−0.05 (0.05)
Dependency ratio	−0.20 (0.32)	−0.61** (0.24)
Female labour ratio	0.27 (0.26)	−0.02 (0.29)
Local conditions		
Large-scale farming	0.39** (0.17)	−0.16 (0.11)
Distance to town	−0.02 (0.02)	0.01 (0.01)
Regional characteristics		
Jiangsu	−0.05 (0.23)	0.55*** (0.17)
Liaoning	0.56** (0.27)	0.91*** (0.21)
Chongqing	0.96*** (0.27)	1.04*** (0.20)
Instrumental variables		
Mean household opinions about policy	1.46*** (0.44)	0.95*** (0.23)
Land area per capita in the village	0.03 (0.04)	−0.03 (0.03)
Constant	−0.10 (0.54)	0.64 (0.56)
Observations	1270	1270
Log likelihood	−442.84	−523.44
R^2	0.25	0.16
χ^2-statistics for the joint significance of instrumental variables (*p*-value)	11.94 (0.0026)	19.01 (0.0001)

[1] Standard errors clustered at village level are in parentheses.
* $p < .1$.
** $p < .05$.
*** $p < .01$.

that agree with the land stabilizing policy; and (ii) land area per capita in the village. These variables are assumed to affect a household's perceived land tenure security and to have no direct effect on a household's migration decision. When more households agree with the policy that land cannot be reallocated within 30 years in the village, a household is less likely to expect a land reallocation and more likely to expect that land certificates do protect land rights (Ma, Heerink, van Ierland, van den Berg, & Shi, 2013). Agreement with the policy by other households in the same village is unlikely to have a direct effect on a household's migration decision. The land endowments of a village are closely related to village land reallocation decisions (Kung & Bai, 2011). Villages with relatively abundant land are more likely to choose stable land tenure arrangements. Households in villages with more land per capita are therefore less likely to expect a land reallocation and more likely to believe that land certificates will protect land rights. Migration decisions of a household are unlikely to have a direct relationship with the total land endowments of the village in which the household lives.

5. Results and discussion

5.1. Factors affecting perceived land tenure security

To account for potential endogeneity, we first estimated the equation explaining perceived land tenure security, i.e. Eq. (2). Estimation results for the two perceived tenure security indicators are reported in Table 2. In both models, the *p*-values of χ^2-statistics for the joint significance of the instruments indicate that they significantly affect perceived land tenure security. Mean household opinions about the policy of no land reallocations (for the other interviewed households in the same village) has a statistically significant positive effect at a 1% testing level. This is consistent with results found for other parts of China (Ma et al., 2013).

Estimation results for actual tenure security and other explanatory variables provide some interesting insights. With regard to actual tenure security, we find that absence of land reallocations has a significant positive impact on household perceived tenure

security regarding land reallocations. This is consistent with previous studies that households with past experience of land reallocations are more likely to expect a land reallocation within the next five years (Kung, 2000; Ren et al., 2019b). Possession of land certificates does not significantly affect the perceived importance of land certificates nor expectations regarding land reallocations. This finding provides further support for earlier studies (Brandt, Rozelle, & Turner, 2004; Ho & Spoor, 2006; Ren et al., 2019b) which argued that the lack of a well-developed legal system and an inefficient implementation system severely limited the effectiveness of land certificates that were issued in China after the second-round land contracting in 1998.

The dummy variable representing the development of the land rental market in a village does not have a significant effect on land tenure perceptions. Land area per capita also does not have a significant effect, but households with a larger number of plots are more likely to expect land reallocations in the near future. This suggests that the number of plots allocated to households rather than the size of the contracted land affects household expectations about future land reallocations. Physical capital exerts positive effects on perceived land tenure security. Specifically, possession of machinery increases the perceived effectiveness of land certificates, whereas ownership of a house reduces expectations that land reallocations will take place in the near future. By contrast, human capital is found to have negative effects. Households with more educated labourers are more likely to expect a land reallocation, while households with relatively old labourers tend to perceive land certificates to be less effective. Social capital, as measured by the household head being or having been a village official, positively affects the perceived effectiveness of land certificates but has no significant effect on perceptions regarding land reallocations. Finally, we find that households with a high dependency ratio perceive land certificates as less effective, and that households living in villages with large-scale farms are less likely to expect land reallocations in the near future.

5.2. Factors affecting migration

Table 3 shows the estimation results of Eq. (4) for each of the three dependent variables, i.e. migration decision, number of migrants and migration duration. The test results for the overidentifying restrictions, presented in the last row of the table, do not provide evidence for the hypothesis that the instruments affect migration only via perceived land tenure security should be rejected. The test results for the vector of generalized residuals derived from the first-stage estimations, presented in the penultimate row, show that the coefficients of generalized residuals are jointly significantly different from zero in all equations. We therefore reject the null hypothesis that the coefficients of the perceived land tenure security variables would be the same if we do not control for potential endogeneity.

We also estimated a standard probit model for migration decision, and tobit models for the number of migrants and migration duration, ignoring potential endogeneity. There are important differences in results (Table A.1) compared to Table 3, indicating a bias if the endogeneity is not adequately dealt with.

The regression results presented in Table 3 show that the estimated coefficients of all interaction terms are not significant. Care should be taken, however, in interpreting this finding, as the interpretation of interaction terms in nonlinear models is controversial (Ai & Norton, 2003). To obtain more insight into the effect of land tenure security under different levels of land rental market development, we calculate the average marginal effects of the land tenure security variables following Karaca-Mandic, Norton, and Dowd (2012). Specifically, we calculate the average marginal effects of land tenure security for households living in villages where the land rental market is relatively developed and its impact for households residing in villages where the land rental market is underdeveloped. This allows us to directly compare the effects of land tenure security between villages with different levels of land rental market.

The average marginal effects land tenure security variables are presented in Table 4. They indicate that both actual and perceived land tenure security significantly affect migration decisions. As regards actual tenure security, both the absence of land reallocations and the possession of land certificates have significant negative impacts on each of the three migration indicators in villages with underdeveloped land rental markets. But the impact of actual tenure security is insignificant in villages where land rental markets are relatively developed. These results suggest that the overall impact of the (negative) land quality effect and the (indeterminate) land renting effect tends to be negative in villages with underdeveloped land rental markets. In other words, when land renting out is not a real option, households tend to invest more in land when actual tenure security is high and are therefore less likely to be involved in migration. The estimated marginal effect on the migration decision equals -0.09 for absence of land reallocations since 1998 and -0.10 for possession of land certificates for households in villages with underdeveloped land rental markets, implying that households that did not experience a land reallocation in these villages are 9 percentage points less likely to have a migrant member, while households that possess a land certificate are 10% points less likely to have such a member. The estimated marginal effects of absence of land reallocation and possession of land certificates on the number of migrants are -0.34 and -0.43, respectively. This implies that the number of migrants in a household is expected to be 0.34 lower when households in villages with underdeveloped land rental markets experienced no land reallocation and 0.43 lower when they possess land certificates.

With regard to perceived land tenure security, we find that households that expect no land reallocations in the near future are more likely to migrate. The estimated effects are significant for all three migration variables and are independent of the development of the land rental market. This means that the positive effect of higher perceived tenure security on migration through a lower risk of land reallocation is stronger than the negative effect through higher land investments, whereas the (positive) effect through land renting-out seems negligible. Household perceptions regarding the importance of land certificates do not significantly affect the three

Table 3
Regression results for migration (2nd stage of control function approach)[1,2].

	Migration decision	Number of migrants	Migration duration
Actual land tenure security			
Absence of land reallocations	−0.31** (0.12)	−0.34** (0.15)	−3.59** (1.81)
Absence of land reallocations × land rental market development	0.21 (0.31)	0.11 (0.40)	1.88 (4.68)
Possession of land certificates	−0.32*** (0.12)	−0.43*** (0.15)	−4.92*** (1.79)
Possession of land certificates × land rental market development	0.15 (0.28)	0.25 (0.35)	2.44 (4.08)
Perceived land tenure security			
No land reallocations expected	2.25*** (0.50)	2.72*** (0.61)	30.19*** (7.03)
No land reallocations expected × land rental market development	−0.26 (0.26)	−0.24 (0.37)	−2.65 (4.22)
Perceived effectiveness of land certificates	−0.73 (0.77)	−0.49 (0.94)	−5.29 (10.77)
Perceived effectiveness of land certificates × land rental market development	0.35 (0.24)	0.37 (0.32)	4.11 (3.55)
Land rental market			
Land rental market development	−0.25 (0.34)	−0.25 (0.48)	−3.23 (5.33)
Natural capital			
Land area per capita	−0.04** (0.02)	−0.05** (0.02)	−0.55** (0.26)
Number of plots	0.01 (0.01)	0.01 (0.01)	0.15 (0.10)
Physical capital			
Machinery	−0.14 (0.09)	−0.21* (0.12)	−2.37* (1.35)
House	−0.15 (0.10)	−0.18 (0.12)	−1.97 (1.38)
Human capital			
Average age of labourers	−0.05*** (0.01)	−0.06*** (0.01)	−0.62*** (0.10)
Education level of labourers	−0.03 (0.13)	0.06 (0.16)	0.91 (1.86)
Off-farm experience of labourers	0.60*** (0.15)	1.03*** (0.19)	11.77*** (2.15)
Social capital			
Village official	−0.17* (0.10)	−0.27** (0.13)	−2.86* (1.48)
Demographic factors			
Number of labourers	0.35*** (0.05)	0.59*** (0.06)	6.65*** (0.68)
Dependency ratio	−0.11 (0.24)	0.15 (0.30)	2.04 (3.48)
Female labour ratio	−0.23 (0.29)	−0.26 (0.36)	−3.49 (3.99)
Local conditions			
Large-scale farming	−0.37*** (0.11)	−0.44*** (0.14)	−4.64*** (1.62)
Distance to town	0.02* (0.01)	0.03** (0.01)	0.33** (0.15)
Regional characteristics			
Jiangsu	0.30 (0.21)	0.10 (0.25)	1.04 (2.92)
Liaoning	−0.15 (0.24)	−0.37 (0.30)	−4.47 (3.44)
Chongqing	0.26 (0.27)	0.05 (0.32)	−0.16 (3.74)
Generalized residuals			
Generalized residual from no land reallocation expected	−1.08*** (0.27)	−1.33*** (0.33)	−14.87*** (3.83)
Generalized residual from perceived effectiveness of land certificates	0.32 (0.43)	0.18 (0.53)	1.61 (6.07)
Constant	0.16 (0.76)	−1.02 (0.96)	−12.19 (10.88)
Observations	1270	1270	1270
Log likelihood	−679.11	−1252.32	−2449.06
R^2	0.20	0.14	0.08
χ^2-statistics for joint significance of generalized residual (*p*-value)	15.95 (0.003)	16.56 (0.0003)	15.78 (0.0004)
χ^2-statistics for overidentification (*p*-value)	1.05 (0.5901)	1.10 (0.5747)	1.30 (0.5236)

[1] Standard errors clustered at village level are in parentheses.
[2] χ^2-statistics for joint significance of instrumental variables in the first stage (*p*-value): no land reallocations expected regression: 11.94 (0.0026), perceived effectiveness of land certificates regression: 19.01 (0.0001).
* $p < .1$.
** $p < .05$.
*** $p < .01$.

migration variables. Hence, the actual possession of land certificates seems to play a more important role in migration decisions (see above) than perceptions attached to these documents. The estimated average marginal effects for expectations regarding land reallocations are relatively large. For example, households are 40–41 percentage points more likely to have a migrant member when they do not expect a land reallocation within the coming five years than households that do expect such land reallocations.

Land rental market development as a standalone variable does not significantly affect migration (see Table 3). In other words, development of land rental markets does not affect migration on its own. This is consistent with findings for forest land in China in Mullan et al. (2011). Although the option to rent out land may stimulate migration, this finding indicates that the renting of land by other households in the village has a roughly similar negative effect on migration. The development of land rental markets only affects migration when the degree of actual tenure security changes as the significant interaction term with actual tenure security suggest.

Table 4
Average marginal effects for land tenure variables[1,2].

	Migration decision	Number of migrants	Migration duration
Actual land tenure security			
Absence of land reallocations (Land rental market development = 0)	−0.09** (0.04)	−0.34** (0.15)	−3.59** (1.81)
Absence of land reallocations (land rental market development = 1)	−0.03 (0.09)	−0.23 (0.39)	−1.71 (4.55)
Possession of land certificates (Land rental market development = 0)	−0.10*** (0.04)	−0.43*** (0.15)	−4.92*** (1.79)
Possession of land certificates (Land rental market development = 1)	−0.05 (0.07)	0.19 (0.31)	−2.48 (3.61)
Perceived land tenure security			
No land reallocations expected (Land rental market development = 0)	0.41*** (0.03)	2.72*** (0.61)	30.19*** (7.03)
No land reallocations expected (Land rental market development = 1)	0.40*** (0.05)	2.48*** (0.72)	27.54*** (8.17)
Perceived effectiveness of land certificates (Land rental market development = 0)	−0.22 (0.22)	−0.49 (0.94)	−5.29 (10.77)
Perceived effectiveness of land certificates (Land rental market development = 1)	−0.11 (0.24)	−0.12 (1.00)	−1.17 (11.30)

[1] Standard errors clustered at village level are in parentheses.
[2] Average marginal effects for control variables are not reported for brevity.
** $p < .05$.
*** $p < .01$.

We find significant impact for some of the other control variables. Among the two natural capital variables, land area per capita has a significant negative impact on all three migration variables, while the estimated coefficients for number of plots do not differ significantly from zero. This finding confirms earlier findings that households with larger land holdings are less likely to migrate (Zhao, 1999a, 1999b; Zhu, 2002). Land fragmentation, however, is not found to significantly affect migration decisions.

As for physical capital variables, the possession of machinery has a significant negative impact (at a 10 percent testing level) on the number of migrants and migration duration, but not on the migration decision itself. This finding provides some evidence supporting the finding of Deininger et al. (2014) that lack of machinery motivates households to migrate. Possession of houses is found to have no statistically significant impact.

Two of the human capital variables have a significant impact on migration. As expected, the average age of labourers has a negative effect on all three migration variables and the off-farm experience of labourers has a positive effect. However, the education level of labourers does not have a significant effect. Mixed effects are found in the available literature for the impact of education on migration (e.g. Ma et al., 2016; Meng & Zhao, 2018). The education variable in our model is the share of labourers with junior high school or higher; it does not consider differences in schooling for those without junior high school and those who graduated from junior high school.

Social capital, as measured by a dummy variable indicating whether the household head is or has been a village official, negatively affects all three migration variables. This finding suggests that village officials tend to work more on-farm or participate in local off-farm employment, which is easier to combine with working for village committee.

Among the three demographic factors, only the number of labourers is found to have a significant impact on migration. The positive coefficient estimated in all three equations confirms the results of earlier studies that households with more members of working age are more involved in migration (Deininger et al., 2014). The dependency ratio and the female labour ratio do not have significant effects.

The two local conditions variables are both found to play a significant role in migration. The negative coefficient for large-scale farming suggests that large-scale farms provide households living nearby with increased opportunities to work on these farms or to generate more local off-farm employment and thereby reduce incentives to migrate. Distance to town is found to have a positive impact on migration, as found also by Ma et al. (2016) in Gansu, China. A possible explanation for this finding is that households living nearer to the township centre have better access to local off-farm work.

The coefficient estimates for the three regional dummy variables do not differ significantly from zero. This finding indicates that there are no unobserved factors affecting migration that differ significantly between the four provinces where we held the survey.

5.3. Robustness checks

To test the robustness of our main findings, we performed three additional analyses. First, we performed the “plug-in” approach to check the robustness of general results obtained from the 2SCF approach. In the first step, the probit models were estimated for Eq. (2) to obtain predicted values of perceived land tenure security variables. In the second step, the probit model or tobit model for Eq. (1) was estimated by replacing the original endogenous variables in Eq. (1) with predicted values from the first step. The results are reported in Table A.2. They are basically consistent, with one exception. The interaction between perception on land certificates and land rental market development has a significant positive impact on migration, while it is not significant using the 2SCF approach. A possible explanation is that the “plug-in” approach might yield biased estimates when the endogenous variable is discrete (Brasselle et al., 2002).

Second, we replaced possession of land certificates issued in the 1998 land allocation with the possession of either the 1998 land certificates or new certificates issued in the new-round land certification programme that was underway when we conducted our survey. The regression results are displayed in Table A.3. The estimated coefficients for possession of at least one land certificate are also positive but are not statistically significant at the 10% testing level. The other main findings, however, remain unchanged.

Third, to check whether the choice of the education variable affects its insignificant impact and the main conclusions of our analysis in general, we used two alternative indicators of the education level of the household. One is a dummy variable indicating whether the household head had taken junior high school or not, the other is a categorial variable with values ranging from 0 to 3 indicating the highest education level obtained by the household head. The regression results are displayed in Table A.4. They show that using these alternative measures of education does not affect the insignificant impact found for education on the migration of rural households nor does it change the main conclusions of our analysis.

6. Conclusion

In this paper, we investigated the impact of perceived and actual land tenure security on migration in rural China, taking into account the development of land rental markets. In theory there are several mediating channels between tenure security and migration. As a result, perceived and actual land tenure security can either positively or negatively affect migration. Testing this empirically, the two-step control function (2SCF) approach was applied to deal with the potential endogeneity of perceived land tenure security.

The main conclusion of our analysis is that both actual and perceived tenure security affect migration, but the impact of perceived tenure security as measured by land reallocation expectations is much stronger and is positive, whereas the separate impact of actual tenure security, i.e. its impact apart from affecting tenure security perceptions, is negative. This finding confirms that households perceiving a high risk of losing land when one or more members were to migrate may refrain from migration. Higher perceived tenure security may also stimulate land rentals and investments in farmland, but the subsequent effects on migration seem relatively minor. Actual tenure security, as measured by absence of land reallocations and possession of land certificates, negatively affects migration only in villages with less-developed land rental markets. This finding suggests that households tend to invest more in farmland when actual tenure security is high and when land renting is not an option, and as a consequence are less likely to be involved in migration.

Several policy implications may be generated from these conclusions. First, household perceptions of tenure security play a major role in migration decisions. Households that expect no land reallocations in the future are more likely to allocate labour to migration. Thus, convincing households that land reallocations will not occur when one or more members migrate can contribute to a more efficient allocation of labour, and thereby to poverty reduction and overall productivity growth. One way to do so is to improve the awareness and the understanding of households of the policy that prohibits land reallocations. We found that perceived tenure security is significantly higher when more households in a village agree with the policy that land cannot be reallocated in the village within 30 years.

Second, improving actual tenure security through issuing of land certificates and implementing bans on land reallocation may in fact reduce migration, and thereby equity and efficiency, when the local land rental market is underdeveloped and tenure security perceptions remain unchanged. It is therefore important to identify existing bottlenecks in the functioning of land rental markets in regions where they remain underdeveloped, and to develop policies to remove these bottlenecks.

Third, another interesting finding from our analysis is that the presence of large-scale farms in a village tends to reduce migration. Hence, the ongoing process of farm-scale expansion in Chinese agriculture does not lead to massive outmigration as is sometimes feared, but seems to contribute to the creation of more local off-farm opportunities. Whether these employment opportunities are inside or outside agriculture is an issue that needs further research.

Methodologically this paper applied a two-step control function (2SCF) approach to household and village-level survey data to deal with the potential endogeneity of perceived land tenure security. Our results may still be affected to some extent by unobserved factors that differ between households or villages and that may be related to both the dependent and the main explanatory variables in our model. For future research, we therefore suggest that the robustness of the main findings be checked by using panel data instead of cross-section survey data. Additionally, we tested only the overall effects of actual and perceived land tenure security in our empirical analysis. For follow-up research, we propose investigating in more details the different channels through which actual and perceived land tenure security affect migration.

Acknowledgements

This work was supported by the National Natural Science Foundation of China [grant numbers 71673144, 71773046 and 7191101210], the Specialized Research Fund for the National Social Science Fund of China [grant number 18VSJ060], the National Key R&D Program of China [grant number 2016YFE0103100], the 111 Project (B17024), and the Programme Strategic Scientific Alliances (PSA) of the Royal Netherlands Academy of Sciences (KNAW) and the Ministry of Science and Technology, China [grant number PSA-SA-E-01]. Special thanks go to the ALFABET project under European Commission's Erasmus Mundus Programme [grant number 2014-0857/001-001] for supporting this research project.

Appendix

Table A.1
Estimation ignoring the potential endogeneity of perceived land tenure security[1].

	Migration decision	Number of migrants	Migration duration
Actual land tenure security			
Absence of land reallocations	−0.04 (0.12)	0.01 (0.16)	0.29 (1.84)
Absence of land reallocations × land rental market development	0.21 (0.31)	0.13 (0.40)	2.05 (4.73)
Possession of land certificates	−0.17 (0.13)	−0.24 (0.16)	−2.71 (1.91)
Possession of land certificates × land rental market development	0.08 (0.28)	0.15 (0.37)	1.29 (4.23)
Perceived land tenure security			
No land reallocations expected	0.39*** (0.14)	0.47*** (0.18)	4.97** (2.04)
No land reallocations expected × land rental market development	−0.30 (0.26)	−0.33 (0.38)	−3.67 (4.30)
Perceived effectiveness of land certificates	−0.12 (0.12)	−0.11 (0.15)	−1.64 (1.76)
Perceived effectiveness of land certificates × land rental market development	0.34 (0.24)	0.35 (0.32)	3.88 (3.59)
Land rental market			
Land rental market development	−0.23 (0.34)	−0.17 (0.49)	−2.25 (5.48)
Natural capital			
Land area per capita	−0.03 (0.02)	−0.04* (0.02)	−0.46* (0.26)
Number of plots	−0.00 (0.01)	0.00 (0.01)	0.02 (0.09)
Physical capital			
Machinery	−0.22** (0.09)	−0.30** (0.12)	−3.33** (1.34)
House	−0.09 (0.10)	−0.10 (0.12)	−1.08 (1.37)
Human capital			
Average age of labourers	−0.05*** (0.01)	−0.06*** (0.01)	−0.62*** (0.09)
Education level of labourers	−0.19 (0.13)	−0.12 (0.16)	−1.10 (1.80)
Off-farm experience of labourers	0.67*** (0.14)	1.12*** (0.19)	12.68*** (2.18)
Social capital			
Village official	−0.17** (0.08)	−0.24** (0.11)	−2.45* (1.29)
Demographic factors			
Number of labourers	0.33*** (0.04)	0.57*** (0.06)	6.42*** (0.67)
Dependency ratio	−0.10 (0.22)	0.12 (0.28)	1.67 (3.17)
Female labour ratio	−0.11 (0.28)	−0.13 (0.35)	−1.99 (3.93)
Local conditions			
Large-scale farming	−0.18 (0.11)	−0.22 (0.14)	−2.24 (1.59)
Distance to town	0.01 (0.01)	0.02 (0.01)	0.24 (0.16)
Regional characteristics			
Jiangsu	0.31* (0.18)	0.18 (0.23)	1.98 (2.63)
Liaoning	0.15 (0.16)	0.09 (0.20)	0.80 (2.33)
Chongqing	0.55*** (0.17)	0.50** (0.20)	5.08** (2.34)
Constant	0.74 (0.52)	−0.04 (0.67)	−0.78 (7.48)
Observations	1270	1270	1270
Log likelihood	−687.59	−1261.60	−2458.41
R^2	0.19	0.14	0.07

[1] Standard errors clustered at village level are in parentheses.
* $p < .1$.
** $p < .05$.
*** $p < .01$.

Table A.2
Estimation results based on "plug-in" approach[1,2].

	Migration decision	Number of migrants	Migration duration
Actual land tenure security			
Absence of land reallocations	−0.31** (0.15)	−0.38** (0.19)	−4.13* (2.21)
Absence of land reallocations × land rental market development	−0.07 (0.46)	−0.21 (0.60)	−2.65 (6.73)
Possession of land certificates	−0.30** (0.13)	−0.43*** (0.16)	−4.75** (1.88)
Possession of land certificates × land rental market development	0.17 (0.28)	0.29 (0.35)	2.71 (3.96)
Perceived land tenure security			
Predicted no land reallocations expected	2.64*** (0.75)	3.47*** (0.97)	39.15*** (11.13)
Predicted no land reallocations expected × land rental market development	−0.08 (1.07)	−0.26 (1.41)	2.23 (15.65)
Predicted perceived effectiveness of land certificates	−1.59 (1.35)	−1.86 (1.71)	−22.61 (19.49)
Predicted perceived effectiveness of land certificates × land rental market development	1.92** (0.93)	2.55* (1.35)	26.22* (15.22)
Land rental market			
Land rental market development	−1.50* (0.88)	−1.82 (1.23)	−22.22 (13.77)
Natural capital			
Land area per capita	−0.04** (0.02)	−0.06** (0.02)	−0.65** (0.28)
Number of plots	0.01 (0.01)	0.02* (0.01)	0.19* (0.11)
Physical capital			
Machinery	−0.12 (0.10)	−0.17 (0.13)	−1.84 (1.46)
House	−0.17* (0.10)	−0.21* (0.12)	−2.24 (1.37)
Human capital			
Average age of labourers	−0.05*** (0.01)	−0.06*** (0.01)	−0.65*** (0.11)
Education level of labourers	0.02 (0.15)	0.14 (0.19)	1.98 (2.16)
Off-farm experience of labourers	0.56*** (0.15)	0.96*** (0.20)	10.91*** (2.21)
Social capital			
Village official	−0.14 (0.13)	−0.22 (0.16)	−2.06 (1.86)
Demographic factors			
Number of labourers	0.34*** (0.05)	0.59*** (0.06)	6.56*** (0.71)
Dependency ratio	−0.21 (0.27)	0.01 (0.34)	0.16 (3.89)
Female labour ratio	−0.28 (0.29)	−0.34 (0.36)	−4.52 (3.99)
Local conditions			
Large-scale farming	−0.44*** (0.14)	−0.56*** (0.16)	−6.19*** (1.91)
Distance to town	0.03** (0.01)	0.04** (0.01)	0.41** (0.16)
Regional characteristics			
Jiangsu	0.38 (0.27)	0.25 (0.34)	2.97 (3.83)
Liaoning	−0.05 (0.33)	−0.22 (0.41)	−2.54 (4.63)
Chongqing	0.31 (0.36)	0.14 (0.44)	1.08 (5.00)
Constant	0.55 (0.95)	−0.41 (1.18)	−4.24 (13.33)
Observations	1270	1270	1270
Log likelihood	−681.12	−1253.81	−2450.26
R^2	0.20	0.14	0.08

[1] Standard errors clustered at village level are in the parentheses.

[2] The χ^2-statistics for the significance of instrument variables in the first step: 11.94 ($p = .0026$) for no land reallocations expected, and 19.01 ($p = .0001$) for perceived effectiveness of land certificates.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

Table A.3
Estimation results using the possession of at least one land certificate[1,2].

	Migration decision	Number of migrants	Migration duration
Actual land tenure security			
Absence of land reallocations	−0.32** (0.12)	−0.35** (0.15)	−3.68** (1.83)
Absence of land reallocations × land rental market development	0.22 (0.30)	0.14 (0.39)	2.05 (4.60)
Possession of at least one land certificate	−0.21 (0.15)	−0.30 (0.19)	−3.29 (2.20)
Possession of at least one land certificate × land rental market development	0.11 (0.32)	0.14 (0.42)	1.64 (4.79)
Perceived land tenure security			
No land reallocations expected	2.09*** (0.55)	2.53*** (0.67)	27.92*** (7.74)
No land reallocations expected × land rental market development	−0.25 (0.26)	−0.22 (0.37)	−2.52 (4.13)
Perceived effectiveness of land certificates	−0.75 (0.77)	−0.51(0.95)	−5.50 (10.93)
Perceived effectiveness of land certificates × land rental market development	0.34 (0.24)	0.35 (0.32)	3.91 (3.56)
Land rental market			
Land rental market development	−0.22 (0.36)	−0.19 (0.51)	−2.59 (5.69)
Natural capital			
Land area per capita	−0.03** (0.02)	−0.05** (0.02)	−0.53** (0.26)
Number of lots	0.01 (0.01)	0.01 (0.01)	0.13 (0.10)
Physical capital			
Machinery	−0.14 (0.09)	−0.21* (0.12)	−2.40* (1.36)
House	−0.15 (0.10)	−0.18 (0.12)	−1.95 (1.38)
Human capital			
Average age of labourers	−0.05*** (0.01)	−0.06*** (0.01)	−0.62*** (0.10)
Education level of labourers	−0.04 (0.13)	0.05 (0.16)	0.71 (1.86)
Off-farm experience of labourers	0.61*** (0.15)	1.05*** (0.19)	11.92*** (2.17)
Social capital			
Village official	−0.17 (0.10)	−0.27** (0.13)	−2.82* (1.48)
Demographic factors			
Number of labourers	0.35*** (0.05)	0.59*** (0.06)	6.62*** (0.68)
Dependency ratio	−0.12 (0.24)	0.14 (0.30)	1.99 (3.50)
Female labour ratio	−0.21 (0.29)	−0.24 (0.36)	−3.21 (3.98)
Local conditions			
Large-scale farming	−0.35*** (0.11)	−0.42*** (0.14)	−4.44*** (1.67)
Distance to town	0.02* (0.01)	0.03** (0.01)	0.32** (0.16)
Regional characteristics			
Jiangsu	0.27 (0.21)	0.06 (0.26)	0.53 (3.01)
Liaoning	−0.13 (0.24)	−0.35 (0.30)	−4.26 (3.47)
Chongqing	0.26 (0.27)	0.05 (0.32)	−0.16 (3.77)
Generalized residual from no land reallocation expected	−1.00*** (0.30)	−1.22*** (0.37)	−13.62*** (4.24)
Generalized residual from perceived effectiveness of land certificates	0.33 (0.44)	0.20 (0.54)	1.80 (6.16)
Constant	0.24 (0.77)	−0.92 (0.97)	−10.97 (11.09)
Observations	1270	1270	1270
Log likelihood	−681.02	−1254.48	−2451.40
R^2	0.20	0.14	0.08
χ^2-statistics for the joint significance of generalized residuals (*p*-value)	11.20 (0.0037)	11.24 (0.0037)	10.54 (0.0053)
χ^2-statistics for over identification (*p*-value)	1.57 (0.4553)	1.60 (0.4513)	1.88 (0.3901)

[1] Standard errors clustered at village level are in the parentheses.

[2] The χ^2-statistics for the significance of instrument variables in the first step: 12.38 ($p = .0021$) for no land reallocations expected, and 19.48 ($p = .0001$) for perceived effectiveness of land certificates.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

Table A.4
Estimation results using household head education level[1,2].

	(1)[5]			(2)[6]		
	Migration decision	Number of migrants	Migration duration	Migration decision	Number of migrants	Migration duration
Actual land tenure security						
Absence of land reallocations	−0.30** (0.12)	−0.35** (0.15)	−3.66** (1.78)	−0.30** (0.12)	−0.35** (0.15)	−3.67** (1.81)
Absence of land reallocations × land rental market development	0.21 (0.31)	0.11 (0.40)	1.89 (4.73)	0.21 (0.31)	0.12 (0.40)	1.94 (4.72)
Possession of at least one land certificate	−0.32*** (0.12)	−0.43*** (0.15)	−4.93*** (1.79)	−0.32*** (0.12)	−0.44*** (0.15)	−4.98*** (1.79)
Possession of at least one land certificate × land rental market development	0.17 (0.28)	0.26 (0.36)	2.67 (4.11)	0.17 (0.28)	0.27 (0.35)	2.68 (4.09)
Perceived land tenure security						
No land reallocations expected	2.14*** (0.49)	2.71*** (0.60)	30.06*** (6.91)	2.18*** (0.50)	2.73*** (0.61)	30.24*** (6.97)
No land reallocations expected × land rental market development	−0.26 (0.27)	−0.24 (0.38)	−2.67 (4.26)	−0.25 (0.26)	−0.24 (0.37)	−2.61 (4.22)
Perceived effectiveness of land certificates	−0.70 (0.77)	−0.54 (0.95)	−5.81 (10.87)	−0.73 (0.77)	−0.51 (0.94)	−5.44 (10.79)
Perceived effectiveness of land certificates × land rental market	0.34 (0.24)	0.36 (0.32)	3.98 (3.52)	0.33 (0.24)	0.35 (0.32)	3.88 (3.52)
Household head taken junior high school[3]	−0.10 (0.08)	−0.05 (0.10)	−0.74 (1.09)	–	–	–
Household head education level[4]	–	–	–	−0.03 (0.05)	−0.01 (0.06)	−0.15 (0.67)
Generalized residual from no land reallocation expected	−1.03*** (0.27)	−1.32*** (0.33)	−14.83*** (3.72)	−1.05*** (0.27)	−1.33*** (0.33)	−14.94*** (3.78)
Generalized residual from perceived effectiveness of land certificates	0.31 (0.44)	0.21 (0.54)	1.95 (6.16)	0.32 (0.44)	0.19 (0.53)	1.71 (6.11)
Constant	0.25 (0.76)	−0.85 (0.96)	−9.96 (10.92)	0.21 (0.77)	−0.92 (0.97)	−10.75 (11.00)
Observations	1270	1270	1270	1270	1270	1270
Log likelihood	−678.16	−1251.57	−2448.00	−679.11	−1251.85	−2448.43
R^2	0.20	0.14	0.08	0.20	0.14	0.08
χ^2-statistics for the joint significance of generalized residuals (p-value)	15.09 (0.0005)	8.56 (0.0002)	8.25 (0.0003)	15.20 (0.0005)	8.44 (0.0002)	8.12 (0.0003)
χ^2-statistics for over identification (p-value)	1.71 (0.4257)	0.75 (0.4734)	0.88 (0.4161)	1.33 (0.5133)	0.63 (0.5352)	0.75 (0.4741)

[1] Standard errors clustered at village level are in the parentheses.
[2] The results for the other control variables are not reported for brevity.
[3] Household head taken junior high school is dummy variable: =1 if a household head has taken junior high school or higher, and =0 otherwise.
[4] Household head education level is a categorized variable: =3 if taken high school or higher, =2 if taken junior high school, =1 if a household head has taken primary school, and =0 otherwise.
[5] For model (1), the χ^2-statistics for the significance of instrument variables in the first step: 12.03 (p = .0024) for no land reallocations expected, and 19.15 (p = .0001) for perceived effectiveness of land certificates.
[6] For model (2), the χ^2-statistics for the significance of instrument variables in the first step: 11.75 (p = .0028) for no land reallocations expected, and 18.86 (p = .0001) for perceived effectiveness of land certificates.
** $p < .05$.
*** $p < .01$.

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