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Factors affecting farmland rental in rural China: Evidence of capitalization of grain subsidy payments

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ABSTRACT

This study investigates the factors affecting farmland rental prices in China. Special emphasis is put on the capitalization of China's grain subsidy program into land rental rates. Using national representative farm-level data, Heckman sample selection model, and quantile regression (QR) approach, we find that a 10% increase in grain subsidy payments for contracted farmland increases the farmland rental price by about 1%. However, quantile regression results show that the capitalization rate is heterogeneous and varies across the distribution. Findings suggest that family labor input and farm location are important factors driving up farmland rental prices. Moreover, for farm size, rental experience, and natural disaster we detect a negative impact on land rental prices.

1. Introduction

To promote grain production, ensure food security, and improve rural household income, China's government implemented a national grain subsidy program in 2004 (Yi et al., 2015). Since its inception, the program's size has increased continuously (Huang et al., 2013), and the program accounted for 22% of the government's annual agricultural and environmental expenditures in 2014 (Yi and McCarl, 2018). The government initially designed the grain subsidy program (GSP) to increase grain production and to ensure national food security. Thus, researchers focused their efforts on estimating the effects of GSP on agricultural output and rural livelihoods. For instance, Tan et al. (2006) using micro survey data found that the direct grain subsidy has had a modest impact on farmers' income and has reduced income inequality in villages. However, Huang et al. (2011) detected that grain subsidies have no impact on grain production and demand for production inputs. In a recent study, Huang and Yang (2017) stated that the grain subsidy's impact on farmers' income was negligible because the size of the subsidy per farmer was minimal. While there has recently been ample research on developments in land use and rural adjustments in China (e.g. Zhang et al., 2019; Liu et al., 2018; Liu, 2018; Yang et al., 2018; Liu and Li, 2017; Liu et al., 2014; Li et al., 2014; Wang et al., 2013), no study has examined China's GSP from the perspective of human-land relationships, or specifically rural households' land rental activities (e.g., farmland rental behavior, farmland rental prices). During the transition of China's production mode and land use pattern, the farmland rental market is believed to be an essential channel in solving land fragmentation and small-scale nature of Chinese farms (Zhou et al., 2019).

In the last decade, China has experienced significant a development of land rental markets. From 2009 to 2015, land rental area's share of total cultivated land increased from 12% to 33% (Committee of China Agriculture Yearbook, 2010, 2016Committee of China Agriculture Yearbook, 2010Committee of China Agriculture Yearbook, 2010, 2016). A plethora of studies (Kimura et al., 2011; Huang and Ding, 2016; Ito et al., 2016; Zhang et al., 2018a) have investigated the drivers of China's growing farmland rental rates, factors affecting rural households' participation, and the influence of farmland rentals on production and households' welfare. With the popularity of land leasing, land rental costs' share of total input costs has increased significantly. For example, land rental costs in China's agricultural production increased six-fold, from about 6.6 yuan/mu in 2006 to 38.5 yuan/mu[1] in 2016 (Price Division of National Development and Reform Commission, 2012, 2016Price Division of National Development and Reform Commission, 2012Price Division of National Development and

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[1] 15 mu = 1 ha; 6.07 mu = 1 acre.

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Reform Commission, 2012, 2016). According to national representative family farms monitor[2] data, in 2014, on average, more than two-thirds (67.43%) of the farmland in grain production was rented land, and 30% of the total input costs comprised of farmland rental costs (Gao and Du, 2016). Farmland rental costs for Chinese family farms are substantially higher than for farms in the United States, where land rental costs averaged only 10% of renters' production costs (Goodwin et al., 2003). Higher and rising farmland rental expenditures in China's agricultural production could lead to inefficient production, reduced productivity, and reduced income of Chinese grain farmers. Therefore, it is essential to analyze the drivers of farmland rental prices, particularly with the backdrop of China's GSP. Evidence from the United States and Western European countries found that agricultural subsidies are shared by landowners and tenants, through the rising land rental prices (Goodwin et al., 2003; Ciaian and Kancs, 2012; Guastella et al., 2018). However, no study has been conducted so far for smallholders in China.[3]

Hence, this paper aims to investigate the factors affecting farmland rental prices in rural China. Particular attention is given to the impact of grain subsidies on farmland rental prices. Using the 2012 China Family Panel Studies (CFPS) survey data, we first estimate the average capitalization rate of grain subsidies for the entire sample—using Ordinary Least Squares (OLS). Second, we employ quantile regression (QR) to test how grain subsidies affect lower rental rates compared to average or higher farmland rental rates. In this framework, the objective is to understand how grain subsidies affect farmland rental rates across the whole distribution of farmland rental rates. The conditional quantile function (QR) aims to offer a thorough understanding of the stochastic relationships among random variables. Finally, since smallholders in China self-select into land rental markets, we use Heckman's sample selection model to derive the inverse Mills ratio and include it as an explanatory variable in the farmland rental rate equation.

This study highlights several contributions to current research in the related field. First, to our knowledge, this is the first study focusing on the capitalization of grain subsidies into farmland rental prices in rural China. This analysis is necessary because in recent years, Chinese farmers have experienced quickly developing land rental markets, and land rental costs' share of total production costs has gradually increased. Second, this study extends the current understanding of farmland rental prices under rural China's peculiar land tenure system, in which village collectives own rural land and farmers have only constrained land use rights.[4] Third, due to Chinese government's intervention in the farmland rental market, findings from this study could help the government in adjusting relevant land-use policies, reducing farmland costs in crop production, and making farming attractive to new entrants in agricultural production. Finally, unlike previous studies that assumed a homogeneous relationship across the entire distribution of farmland rental prices, we focus on potentially more complex and heterogeneous relationships between government grain subsidies and farmland rental prices.

The rest of this paper is organized as follows. The next section is the background, and Section 3 is the theoretical framework. The econometric model is introduced in Section 4. Data used in this study is presented in Section 5. Section 6 focuses on the empirical results and discussions, and Section 7 concludes the study.

2. Background

Since implementing the Household Responsibility System (HRS) in the late 1970s, China has created a two-tier land tenure system, in which village collectives own rural land, and land use rights are allocated equitably to farmers, also called contractors (Khantachavana et al., 2013). According to China's Land Management Law promulgated in 2002, land use rights are defined not only as the right to farm the land but also as contractors' rights to lease, exchange and swap land (Khantachavana et al., 2013). Contractors' land use rights are partially constrained, and individuals are forbidden to sell or use land as collateral. Land is more evenly distributed in rural China than other Asian countries. China has a large proportion of small farms, on average less than 1 ha, though farm size has increased slightly from about 0.58 ha in 2002 to about 0.78 ha in 2013 (Huang and Ding, 2016).

Although not legally allowed by the state, informal land rental activities in China initially emerged among relatives and neighbors in the 1980s. However, the growth of land rental was slow before the 1990s (Deininger and Jin, 2005). In 1996, just 2.3% of rural households rented in land in some parts of China, especially in the Guizhou, Hunan, and Yunnan provinces (Deininger and Jin, 2005). After a series of land rights reforms[5], achieved by enhancing security and transferability (Ma et al., 2015), land rental markets developed gradually in recent years. Recent statistics reveal that nearly 30 million hectares of farmland have been rented, accounting for 33% of China's total area of household-contracted farmland (Committee of China Agriculture Yearbook, 2016). This means that approximately one-third of the farmland in agricultural production in China is rental land.

Several studies (Gao et al., 2012; Deininger and Jin, 2005) reveal that China has informal land rental markets. The land rental is characterized by oral and short-term rental contracts, as well as zero or low land rents that are below the average market price. Additionally, in the absence of market institutions, China's land rental markets have high transaction costs in searching for potential traders, drafting, negotiating, and safeguarding contracts under the insecure land tenure systems (Kimura et al., 2011). Transaction costs have excluded some farmers from land rental markets; by raising the land rent paid by the tenant and lowering the rents received by the renters (Carter and Yao, 2002).

China's national grain subsidy program started in 2004. In the first year overall, 14.5 billion yuan was spent in terms of a direct grain subsidy, a quality seed subsidy, and an agricultural machinery subsidy (Yi et al., 2015). In 2006, the central government implemented the comprehensive input subsidy to reduce farmers' costs of materials, such as fertilizer and pesticide, as a share of production costs. The crops the grain subsidy program targets are mainly rice, wheat, soybean, and corn. Among the four types of subsidies, the direct grain subsidy, quality seed subsidy, and comprehensive input subsidy are given directly to farmers who grow grain crops (Huang et al., 2011), and the machinery subsidy is given when farmers purchase agricultural machinery.

In practice, it is challenging to implement efficient and accurate subsidies for the direct grain subsidy, quality seed subsidy, and comprehensive input subsidy (Huang et al., 2011). Although local government has a guideline from the central department to distribute grain subsidy according to the actual area planted for the designated grain crops, the policy also allows local government to vary subsidy criteria according to the implementation costs (Huang et al., 2011). Overall, the implementation of farm subsidies by regions can be summarized into three types: (i) the initially owned (contracted) farmland from village collectives during the late 1990s; (ii) the actual farmland area allocated

[2] Family farms are newly developed farm operators, who must be farmers living in villages and cultivating large-scale farmland, and being recognized by government (Huang and Ding, 2016).

[3] For a general overview of land use in China we refer to Liu (2018) and Liu et al. (2014).

[4] The bundle of land use rights includes self-use, lease, exchange and swap, or joint share-holding (Khantachavana et al., 2013).

[5] The reform generally includes extending farmers' land contract rights, restricting land reallocations, issuing farmers land certificates and specifying more freely land transfer rights (Ma et al., 2015).

to grains; (iii) the taxable grain-sown area and production target for an average year[6] (Huang et al., 2011; Yi et al., 2015). To date, most researchers found that the distribution of grain subsidy depends on the size of farmers' contracted farmland[7] (Yi et al., 2015).

The distribution of subsidies to farmers comprises of three steps (Huang et al., 2011). First, the central government determines the total subsidies in a year and allocates them to each province (or to parallel institutions, including municipalities, and autonomous regions) based on the farmland endowment and the percentage of farmland used in grain production. Provinces with grain production as the mainstay can receive higher subsidies (Yi et al., 2015) than provinces that rely on non-grain production. Second, following a similar approach, each province allocates a certain share of the subsidy to the counties based on each county's grain production. In the last stage, once the subsidy criterion is determined, the local bank (at the county level) is responsible for transferring the subsidy to each farmer household through a special account. However, farm households have difficulty distinguishing the type of grain subsidies they receive because the bank does not provide itemized information (Yi et al., 2015).

Fig. 1 shows total grain subsidies in China during the 2004–2015 period. The figure reveals that total subsidies increased more than tenfold, from 14.5 billion yuan in 2004 to 165.25 billion yuan in 2015. Grain subsidies reached a peak (170.05 billion yuan) in 2013 and began to decline after that. Since China's total contracted farmland area in 2016 was about 1.34 billion mu (Committee of China Agriculture Yearbook, 2016), the average agricultural subsidy per mu was about 123 yuan. However, the grain subsidy that each Chinese farmland contractor received in 2015 was about 717 yuan, accounting for about 2% of the total household income.[8] If the grain subsidies are all given to the contracted farmers, there would be no effect on farmland rental prices. In the guidelines set by China's Ministry of Finance, if rural households transfer out part of their farmland, the attached grain subsidy should be given to the tenant who farms the land rather than to the contractors of the farmland. However, the policy does not enforce the provision but suggests that the tenant and contracted farmer negotiate the subsidy. Limited evidence shows that part of the grain subsidy is being capitalized into the land rental price. For example, Huang et al. (2011) found that the rented-in plots have higher land rent when the tenant gets the subsidy, using rural household survey sample investigated from China's six major agricultural provinces. In another study, based on a household sample in 19 provinces (municipalities) of rural China, Yi et al. (2015) found that a share of grain producers who do not cultivate the land receive the subsidy. In other cases, farmland contractors did not receive the grain subsidy—perhaps some tenants and contractors negotiated subsidies into land rental rates in their leasing agreement—and grain subsidies are capitalized in farmland rental prices.

Capitalization of agricultural subsidies into farmland valuation and rental rates has been studied widely in developed economies, mainly the United States and western European countries (Germany, Britain, Ireland, France, and Spain). For example, in the United States, the capitalization rate varies from 25% to 60% (Goodwin et al., 2003; Lence and Mishra, 2003; Nickerson and Zhang, 2014). Decoupled payments had a higher capitalization rate than coupled payments (Goodwin and Mishra, 2006). Studies from European countries (Breustedt and Habermann, 2011; Ciaian and Kancs, 2012; Guastella et al., 2018) found similar effects—an additional euro/hectare in direct payments increased farmland rental prices by between 7.6 cents and 57 cents per hectare. For example, Ciaian and Kancs (2012) found incidence levels between €0.18-0.20 per hectare for additional euro payments. Similarly, Breustedt and Habermann (2011) found amounts equal to €0.38, 0.41, and 0.45 per hectare for additional EU payments. In the case of the US, Kirwan (2009) found that landlords captured one-fifth of the marginal subsidy dollar from Conservation Reserve Program (CRP) payments through higher land rental price. However, when it comes to developing economies, China in particular, no research has investigated the capitalization rate of the grain subsidy program. The Chinese grain subsidy program can be considered coupled, aimed at increasing farmers' income and reducing production costs. It is expected that part of the subsidy will be capitalized into land rental values. Theoretically, agricultural subsidies would be fully capitalized into farmland rent rates under perfect land rental markets, thereby benefiting landowners (Goodwin et al., 2003; Ciaian and Kancs, 2012). However, China has informal land rental markets with high transaction costs, and a higher percentage of the transactions occur between neighbors and relatives than other countries (Wang et al., 2015), hence land rental prices may be lower than the real price under competitive markets.[9] For example, Wang et al. (2015) found a higher share of free rent in kinship transactions than in non-kinship transactions. In a recent study, Zhang et al. (2018b) noticed that land rental transactions between land contractors and cooperatives or agribusiness firms had higher rental prices than those between land contractors and other small farmers.[10] These two studies show no clear consensus on the capitalization rate of grain subsidies into farmland rental prices.

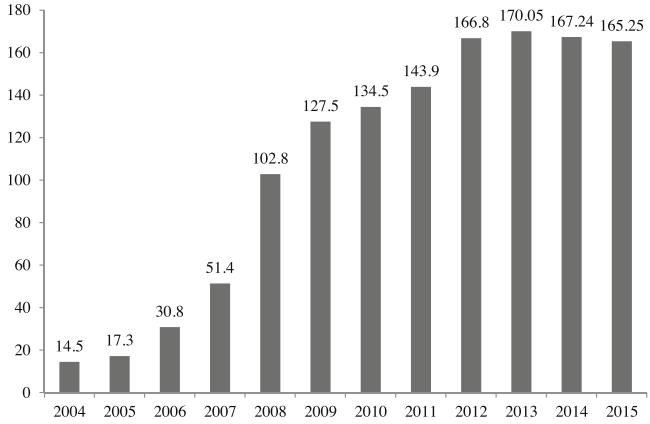

Fig. 1. Total grain subsidies in China, 2004–2015, billion Yuan.
Source: China Agricultural Development Report; Ministry of Finance, China. 1 Yuan ≈ 0.159 US$ (December 31, 2011).

3. Theoretical Framework

Referring to similar studies (Lence and Mishra, 2003; Ciaian and Swinnen, 2006; Ciaian and Kancs, 2012), we adopt a partial equilibrium model to study the distributional effects of grain subsidies on farmland rental pricing. The goal of a farmer engaged in agricultural production is profit maximization. Thus, land market values reflect the

[6] Before 2004, agricultural tax levied on rural households was one source of revenue for the Chinese government. However, after 2004 agricultural tax law has been abolished (Wang and Shen, 2014).

[7] Under HRS, farmers' land use rights expired within a certain number of years. The first round of the contract term for land use rights was 15 years from 1983 to 1997. After that, China prolonged the contract term for another 30 years (from 1998 to 2028). In this period, farmers have a steady land use right.

[8] The total number of farmland contractors was about 230 million and total household income was 44,316 yuan in 2015. The share of income from subsidies for Chinese farmers was much lower than for U.S. and EU farmers because farmers in these countries have significantly larger sown areas (Huang et al., 2011).

[9] A previous study found that transactions between relatives and neighbors had lower land sale prices than sales between strangers (Perry and Robison, 2001). However, in an empirical work, no significant evidence was found between transaction relations and cash rent price (Bryan et al., 2015).

[10] The cooperatives or agribusiness firms can afford higher land rental prices and thus are more competitive in rental markets.

marginal revenue of production. With the hypothesis that the amount of land in agricultural production is A, and the unit cost of land is r, the farmer's profit function π can be represented as:

$$\pi = f(A, D(A)) + s(D(A)) - \sum_i x_i w_i(D(A)) - rA \quad (1)$$

where $f(A, D(A))$ represents a farm's output, with $f_A > 0$, and $f_{AA} < 0$[11], $D(A)$ is the contracted farmland area[12] related to the grain subsidies, $s(D(A))$ is the total subsidies received by the farmer, x_i is a vector of other inputs, and w_i is a vector of average costs of x_i. The amount of farm input affects marginal revenue of production, and further has an impact on the land rental price. The average cost w_i of x_i is related to the contracted farmland because the quality seed subsidy and the comprehensive input subsidy will compensate for some material costs (e.g., seed, fertilizer, and fuel) of farm inputs. Partial differentiation of the profit function with respect to land and setting it equalt to zero leads to:

$$r = \frac{\partial f(A, D)}{\partial A} + \frac{\partial f(A, D)}{\partial D}\frac{\partial D}{\partial A} + \frac{\partial s}{\partial D}\frac{\partial D}{\partial A} - \sum_i x_i\left(\frac{\partial w_i}{\partial D}\frac{\partial D}{\partial A}\right) \quad (2)$$

or

$$r = \frac{\partial f(A, D)}{\partial A} + \frac{\partial D}{\partial A}\left[\frac{\partial f(A, D)}{\partial D} + \frac{\partial s}{\partial D} - \sum_i x_i\left(\frac{\partial w_i}{\partial D}\right)\right] \quad (3)$$

Eq. (3) shows that farmland rent comprises two components, the marginal revenue of land $\frac{\partial f(A,D)}{\partial A} > 0$, and the grain subsidy program, $\frac{\partial D}{\partial A}\left[\frac{\partial f(A,D)}{\partial D} + \frac{\partial s}{\partial D} - \sum_i x_i\left(\frac{\partial w_i}{\partial D}\right)\right]$. Therefore, the farmland rental rate is determined by the marginal value of land and the grain subsidy payments.

Let us now sign the terms in the second component on Eq. (3). The first term $\frac{\partial D}{\partial A} > 0$ is positive because large farms (farm size) have higher shares of contracted farmland through renting-in land from other small farmers. The sign of $\frac{\partial f(A,D)}{\partial D} > 0$, for renting-in farmers, their actual cultivated land area consists of the family own contracted farmland and some parts of renting-in land, namely, $D < A$. The sign on the third term $\frac{\partial s}{\partial D} > 0$ because China's grain subsidy is allocated based mostly on farmers' contracted farmland endowment (Yi et al., 2015). Finally, the sign of $\frac{\partial w_i}{\partial D} \geq 0$ and depends on the kind of farm inputs used. Theoretically, the input subsidy may directly encourage farmers to adopt quality seeds in production; thus it could be positive. The grain subsidy may indirectly keep farmers from engaging in migratory work[13] because engaging in grain production is prerequisite for receiving grain subsidies. Therefore, farmers are motivated and more likely to work on the farm in grain production (Meng, 2012).

Therefore, $\frac{\partial f(A,D)}{\partial D} + \frac{\partial s}{\partial D} \geq \sum_i x_i\left(\frac{\partial w_i}{\partial D}\right)$, $r > 0$. That is when the marginal value of farm inputs is less than or equal to the sum of marginal revenue of land and marginal value of subsidies, then r could be positive. However, when the marginal value of farm inputs is higher than the total of the marginal revenue of land and marginal value of the subsidy, the sign of r could be negative. For rational farmers to maximize farm profits, it is plausible that the decision on the number of production inputs is always less than the point where marginal costs of production inputs is equal to the marginal benefits. Besides, there is no evidence that China's grain subsidy changes farmers' input decisions, perhaps because subsidies are based on the planted grain acreage (Gale et al., 2006; Huang et al., 2011). In this case, we derive $\sum_i x_i\left(\frac{\partial w_i}{\partial D}\right) = 0$ and therefore $r > 0$.

4. Econometric model

Following Eq. (3), the farmland rental price is a function of the amount of grain subsidies, the marginal revenue of land, the contracted farmland area, and the types of material inputs. The empirical model can be specified as:

$$r_i = \alpha_0 + \beta_1 s_i + \beta_2 A_i + \beta_3 MR_i + \beta_4 C_i + \beta_5 ER_i + \gamma P + \varepsilon_i \quad (4)$$

where r_i is land rental price, s_i is the amount of grain subsidies per mu received by the farmer. A_i is the actual area of cultivated farmland of the farm household, which mainly consists of family-owned contracted land and renting-in contracted farmland. Here we use the actual cultivated farmland instead of family-owned contracted farmland area because the renting-in contracted farmland is also subsidy-targeted land. MR_i represents a vector of covariates that controls for the marginal revenue of land. We choose family farm labor input, natural disaster, and soil typography to capture the influences of MR_i (see Table 1). Although we tried to add the seed inputs variable to the model, we found that this variable is collinear with farm size, and we do not have precise information on the quality of seeds, which may be linked to grain subsidy.

Except for the determinants modeled in Eq. (3), the capitalization rate of land-based grain subsidy is also determined by other factors, such as rental contract types, future expectations, as well as formal and informal land institutions (Ciaian and Kancs, 2012). In model (4), C_i represents farmers' rental experience, which can capture the long-term lease relationship between contractors and tenants. In a recent study, Choumert and Phélinas (2017) found that long-term land lease contracts resulted in lower cash rents mainly because a longer transaction relationship might indicate mutual trust—by reducing the enforcement cost between counterparties. ER_i is land expropriation and captures farmers' perception of the future potential of rental income. In the process of China's urbanization, farmlands on the urban fringes were converted into high-value residential buildings, shopping centers, and commercial centers. As Nickerson and Zhang (2014) pointed out, farmland prices also are determined by the value-added in the process of converting land from agriculture to construction land for residential or commercial uses.

P is a vector of provincial location dummies, where the farm is located, α_0 is the intercept, and $\beta_1 - \beta_5$, and γ are the parameters to be estimated, ε_i is a stochastic disturbance. In our survey, a significant number of rural households do not rent any land. Thus, we exclude them from our sample. If the farmer's land rental decision is nonrandom, then the estimation of Eq. (3) could lead to biased estimates. For instance, productive rural Chinese households with limited farmland are more likely to rent in farmland (Jin and Deininger, 2009). As a result, rural Chinese households with quality land have higher probability to grow grain crops and receive grain subsidies than households with poor-quality contracted farmland. Therefore, participation in the land rental market potentially biases the capitalization rate of the grain subsidy program into farmland rental rates (Ciaian and Kancs, 2012).

To solve the potential self-selection problem, we use the Heckman's sample selection approach (Heckman, 1979) and employ a two-stage estimation technique. The first stage models the rural Chinese households' decision to rent in farmland including both characteristics of the farmland (quality and location) and rural households (e.g., female head, age and educational attainment of the head of household, farmworker and fixed agricultural assets, see Table 1). The selection model

[11] f_A and f_{AA} are first and second derivatives of the production function, respectively.

[12] Under China's grain subsidy program, the grain subsidy is targeted at grain production including rice, wheat, soybean, and corn.

[13] Under the imperfection of capital and insurance market, migration, as a livelihood diversified strategy, can improve farmers' income and overcome the liquidity constraints in production agriculture. However, it needs to be noted that migrants face significant costs (e.g., economic cost and emotional costs of being separated from their families) when they choose to migrate. Migrants cannot settle in the city permanently because of the Hukou System in China. As a result only one or two family members migrate to cities, leaving the elderly and children at home. Therefore, if grain subsidy relaxes the liquidity constraints on agricultural production, and smoothes consumption expenditures, family members may not choose to migrate to cities (Stecklov et al., 2005).

Table 1
Variable definition and summary statistics, CFPS2012.
Source: Authors' computation based on CFPS2010 and CFPS2012.

	Participants[a]	Overall
Land rental price[b] (*Yuan/mu*)	239	–
	(292)	–
Female (= 1 if household head is female; 0 otherwise)	0.39	0.42
	(0.49)	(0.49)
Age of household head (HH)	48	50
	(10.8)	(12.7)
Education HH (*years*)	7.2	6.9
	(2.9)	(3.1)
Farm worker (ratio of farm worker to family members, above 16)	0.52	0.39
	(0.25)	(0.30)
Agricultural fixed assets[c] (*Yuan/mu*)	682	252
	(3516)	(1634)
Grain subsidy[d] (agricultural subsidy per mu, *Yuan/mu*)	64	103
	(111)	(584)
Contracted farmland area (*mu*)	8.7	8.9
	(13.5)	(16.1)
Farm size (actual cultivated farmland area, *mu*)	17. 7	8.4
	(46.3)	(19.1)
Rental experience (=1 if land involved renting in 2010; 0 otherwise)	0.50	0.08
	(0.50)	(0.28)
Family farm labor input (Family farm labor working time, *month/mu*)	1.52	2.00
	(2.30)	(5.10)
Natural disaster[e] (= 1 if village located in flood, earthquake and drought areas; 0 otherwise)	0.34	0.32
	(0.47)	(0.47)
Land expropriation (= 1 if village experienced land expropriation before; 0 otherwise)	0.11	0.12
	(0.31)	(0.33)
Hilly (= 1 if farm located in hilly typography; 0 otherwise)	0.36	0.34
	(0.48)	(0.47)
Mountain (= 1 if farm located in mountain typography; 0 otherwise)	0.12	0.15
	(0.33)	(0.36)
Plateau (= 1 if farm located in plateau typography; 0 otherwise)	0.06	0.05
	(0.24)	(0.23)
Plain (= 1 if farm located in plain typography; 0 otherwise)	0.41	0.38
	(0.49)	(0.49)
Grassland (= 1 if farm located in grassland typography; 0 otherwise)	0.002	0.002
	(0.043)	(0.039)
Number of observations	1038	7329

[a] 1038 rural households participated in land rental markets (rented-in land or rented-out land), among them, 1033 rural households reported positive cash rent.
[b] 1 Yuan ≈ 0.159 US$ (December 31, 2011); 15 mu = 1 ha; 6.07 mu = 1 acre.
[c] Includes agricultural machines, irrigation pumps, thresher and trucks.
[d] The grain subsidy is the sum of direct grain subsidy, quality seed subsidy and comprehensive input subsidy and agricultural machinery subsidy.
[e] If village experienced flood, earthquake or drought every 3 or 5 years.

is specified as:

$$R_i = \omega_0 + \lambda_1 s_i + \lambda_2 H_i + \lambda_3 D_i + \lambda_4 MR_i + \lambda_5 C_i + \lambda_6 ER_i + \pi P + \sigma_i \quad (5)$$

where R_i is a dummy variable that equals 1 for land renting-in households. D_i is rural households' contracted farmland area. H_i represent a set of rural households' characteristics including female, age and the household head's educational attainment, farmworkers, and agricultural fixed assets. MR_i, C_i, ER_i, and P are the same covariates as mentioned in Eq. (4). $\lambda_1 - \lambda_6$ and π are the parameters to be estimated, ω_0 is the intercept and σ_i is the stochastic disturbance. Rural households' rental choice is estimated with Probit procedure, and the results are reported in Appendix Table A1. The first stage allows us to calculate the inverse Mills ratio (IMR). Subsequently, we estimate the capitalization rate of grain subsidies in farmland rental rates. In this second stage, the independent variables exclude the demographic and agricultural fixed assets characteristics of the rural households, but include, in addition to other variables, the IMR from the first stage.[14] Specifically, the farmland rental price model can be represented as:

$$r_i = \alpha_0 + \beta_1 s_i + \beta_2 A_i + \beta_3 MR_i + \beta_4 C_i + \beta_5 ER_i + \gamma P + \mu IMR + \varepsilon_i \quad (6)$$

The unobservable factors affecting the probability of participation in farmland rental market (selection into the rental market) are likely to change farmland rental prices (depending on the sign of *IMR*). On the one hand, if the sign of *IMR* is positive and significant, then the unobservable factors influencing the probability of participation in the farmland rental market is likely to be associated with higher farmland rental prices. On the other hand, if the sign of IMR is negative, then the unobservable factors influencing the probability of participation in the farmland rental market is likely to be associated with lower farmland rental prices (Ciaian and Kancs, 2012).

Ordinary Least Squares (OLS) can be utilized to estimate Eq. (6). Here, we use the log form of farmland rental prices, because rental rates and other determinants are complex and nonlinear. It also reduces the heteroscedasticity when using the cross-sectional data (Bontemps and Surry, 2008). Further, in our study, we found that goodness-of-fit in the log form estimation is higher than that in the linear functional form. In the OLS method, assumes an average farmland market price and the variance is constant over the whole distribution of farmland rental prices. However, it is plausible that rural households may value farmland attributes differently (Uematsu et al., 2013), especially under China's informal farmland rental markets. Therefore, to capture the heterogeneous effects of the grain subsidy on farmland rental prices, we use a conditional quantile regression (QR) approach. Uematsu et al. (2013) note that QR can reveal a more comprehensive stochastic relationship between variables, and derive a more robust empirical analysis.

First proposed by Koenker and Bassett (1978), QR estimates the conditional quantile functions, in which quantiles of the conditional distribution of the response variables are modeled by observed covariates. Specifically, QR estimates any point on the conditional distribution by estimating the conditional quantiles $E(Q(q)|X = x) = x'\beta_q$, where $Q(q)$ are qth quantile. Instead of minimizing the sum of squares like OLS, quantile regression minimizes the sum of absolute residuals that can be represented as:

$$Q(q) = \min_{\beta \in R^p} \left[\sum_{i \in (i: y_i \geq x^i \beta)}^{N} q \, |y_i - x_i' \beta_q| + \sum_{\substack{i \in (i: y_i < x^i \beta) \\ q \in (0,1)}}^{N} (1-q) |y_i - x_i' \beta_q| \right] \quad (7)$$

where q is a selected quantile and p is the number of parameters to be estimated. QR promises a more robust and appropriate estimation, fully considering the varying variance related to the increase in the response variable (Koenker and Hallock, 2001). Besides, QR has a semi-parametric regression model and is more flexible in discovering the diverse and heterogeneous relationships between influencing characteristics and farmland rental prices.

5. Data

This study uses data from the China Family Panel Studies (CFPS), a nationwide survey conducted by the Institute of Social Science Survey at Peking University (ISSS, 2015). To get a better understanding of the social, economic, cultural, and educational changes for contemporary China and Chinese people, the CFPS collects extensive information on

[14] Farmland rental decisions are more likely to be made by households, while the farmland rental price is primarily determined by farmland characteristics.

sampled households, individuals, and communities (villages).[15] So far, four rounds of the CFPS survey (2010, 2012, 2014 and 2016) are publicly available. Unfortunately, we can use only the rural family survey data collected in the 2012 CFPS survey (CFPS2012) because this survey collected detailed information on rural households' farmland rental activities, land rental prices, and grain subsidies received by the rural Chinese families. We also used the 2010 CFPS data set (CFPS2010) to collect information on the land quality, which affects the marginal revenue of the land. By matching the two databases, we finally arrived at a sample of 7329 rural Chinese households from 395 villages covering 24 provinces, municipalities, and autonomous regions. Table 1 shows the variable definition and statistical information of the variables used in the empirical model. Among the 1038 rural households rented-in farmland, 1033 rural households reported positive cash farmland rental income. The dependent variable, farmland rental price, is constructed from the CFPS2012 survey. The CFPS2012 data collected information on the total amount of rent paid for renting-in farmland. The study also reports the amount of farmland rented-in by the rural household. Therefore, by dividing the total charges paid for rental land by the area rented in, one can generate the farmland rental prices (per-mu). Table 1 reports that in 2012, the average farmland rental price was about 239 yuan/mu. Fig. 2 shows the distribution of the farmland rental price (log) across quantile (*q* plot).

The primary explanatory variable, grain subsidy per mu, is presented in Table 1. The grain subsidy for rural Chinese households renting-in land was much lower (64 yuan per mu) than for the overall sample of rural households (103 yuan per mu) in 2012. This means that contracted land-based grain subsidies are not necessarily transferred to renting-in farms in the land rental process. Contracted farmland area for the rural household is the basis for farmers to receive subsidies (Yi et al., 2015). Farm size also can affect land productivity (Chen et al., 2011; Li et al., 2013) and in most developing countries, including China, this relationship is negative (or an inverse relationship).[16] If land productivity in Chinese agriculture declines with farm size, large farms would hurt farmland rental prices and vice versa. However, the exact relationship between farm size and land productivity in Chinese agriculture is still an unsettled issue. For example, Chen et al. (2011) did not detect a relationship between farm size and land productivity after controlling for land quality. On the other hand, using panel data from Hubei province in China Li et al. (2013) found an inverse relationship between farm size and land productivity.

The variable rental experience is drawn from the CFPS 2010 farm-level data and represents whether the rental contract existed in 2010. If the land rental contract existed in 2010, there might be a long-term rental relationship between the transacting parties. Family farm labor input could raise land rental rates because more family labor input per unit of land means higher farm productivity in the absence or imperfection of labor markets (Chen et al., 2011; Gao et al., 2012). Our data (CFPS2012) shows that 953 or 92%, of the farms reporting positive cash rents, hired labor for the 2011–2012 production years. Besides, family labor is more efficient than hired labor because of low monitoring costs for farm work, such as fertilizer spreading and sowing (Hayami and Otsuka, 1993; Ciaian and Kancs, 2012). We also include village-level data from the CFPS2010 survey. For example, we include the location of farms in the village typography. Farms located in natural disaster areas (e.g., flood, earthquake, and drought areas) may face higher uncertainty in future agricultural production and low production efficiency (Yao and Liu, 1998). As a result, farmland rental prices may be lower. We use the CFPS 2010 village-level data to control for natural shocks in the farmland pricing model (Kirwan, 2009). The land

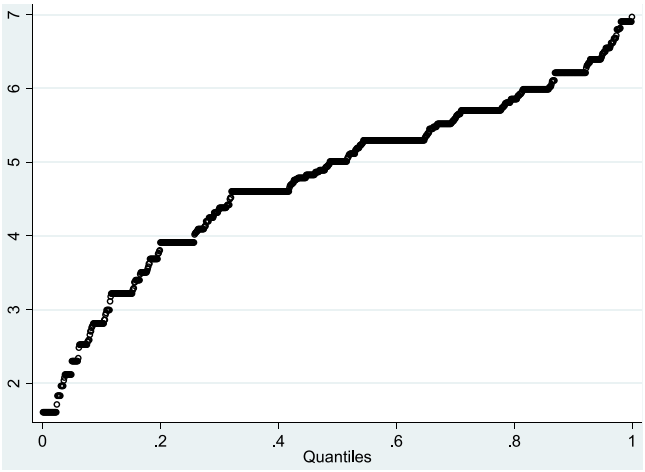

Fig. 2. Distribution of land rental price per mu (log).
Source: Authors calculation.

expropriation[17] variable is taken from the CFPS 2010 village-level data. This variable is included to capture the expected future rent increases arising from land conversion.

We use three soil typography variables to control for productivity and soil property differences in farmland pricing (Choumert and Phélinas, 2017). Soil typography may have heterogeneity in terms of soil texture, structure, moisture content, biomass, and organic matter (Mishra and Moss, 2013). The unobserved land quality information embedded in the soil typography variable may affect both subsidies and land rental rates, thus compounding the real incidence rate of grain subsidies (Kirwan, 2009; Ciaian and Kancs, 2012). The five soil typography variables – mountain, hilly, plateau, plains, and grassland – were extracted from the CFPS2010 survey data and matched with individual household-level data in the CFPS2012 survey data. The soil typography category of mountain area acted as the base dummy variable. Finally, provincial location dummy variables are added to the model to capture grain subsidy allocation policy and land use policies that cannot be achieved by other variables (Uematsu et al., 2013).

Table 1 also indicates that rural Chinese households that are renting-in land have a younger and more educated head of household than rural Chinese households overall. Although the share of farmworkers in the family was higher for households participating in farmland rental markets than for households overall, they had less family farm labor input (per mu) in the 2011–2012 crop production year. Interestingly, farm households participating in farmland rental markets had higher amounts of agricultural fixed assets than households overall. Table 1 reveals that rural Chinese households with farmland rental experience in 2010 were more likely than households without rental experience, to participate in the farmland rental markets in 2012. Lastly, we find that one-third of rural farm households located in a natural disaster, and hilly areas are likely to participate in the farmland rental market. However, a greater share (44%) of rural farm households located in the plains area is likely participates in farmland rental markets than households in other areas.

6. Results and discussion

Table 2 reports the parameter estimates of the factors affecting

[15] See Xie and Hu (2014) for additional information about the CFPS data set.

[16] The inverse farm size and productivity relationship might be driven by the imperfect input/output/credit markets in developing countries (Chen et al., 2011).

[17] Note that farmers are restricted to convert farmland use to constructive land use in China. Constitutionally, government can convert agricultural land into construction land through land expropriation for public service, and takes land from farmers with proper monetary compensation (Bao and Peng, 2016). The monetary compensation is usually much larger than the original agricultural profits.

Table 2
Parameter estimates for the factors affecting land rental price, CFPS2012.

	Land rental price (*log*) (*Yuan/mu*)	
	Model (1)	Model (2)
Grain subsidy (log)	0.086***	0.087***
	(0.025)	(0.025)
Farm size (log)	−0.174***	−0.194***
	(0.060)	(0.061)
Rental experience	−0.084	−0.088
	(0.070)	(0.070)
Family farm labor input (log)	0.141*	0.095
	(0.073)	(0.076)
Natural disaster[a]	−0.151*	−0.158*
	(0.085)	(0.084)
Land expropriation[a]	0.070	0.086
	(0.117)	(0.119)
Hilly typography [a,b]	0.283**	0.252**
	(0.117)	(0.119)
Plateau typography[a]	0.216	0.197
	(0.189)	(0.189)
Plain typography[a]	0.848***	0.805***
	(0.142)	(0.144)
Grassland typography[a]	0.642***	0.589***
	(0.228)	(0.224)
Inverse Mills Ratio (IMR)		−0.244
		(0.161)
Province dummy variables	Controlled	Controlled
Constant	4.750***	5.091***
	(0.329)	(0.392)
Observations	1033	1033
R^2	0.300	0.302

Note: Statistically significant at: *10, * *5 and * * *1 percent levels; Robust Standard errors are in parentheses. The coefficients of province dummy variables are controlled but not reported here due to space concerns.

[a] Data of farm household location was matched by the CFPS2010 survey.

[b] Base area is mountain area.

farmland rental prices in China. Note that Table 2 presents two models: Model (1) is the base OLS model, while Model (2) controls for sample selection bias. Table 2 shows that after controlling for sample selection bias, the estimated coefficients of most variables are still significant (except for the family farm labor input variable). The coefficient on grain subsidy slightly increased from 0.086 in Model (1) to 0.087 in Model (2). We, therefore, adopt the more precise results in Model (2). The coefficient of IMR is not significant, and it does not change the significance level of the explanatory variables.

The ME on grain subsidy is significantly positive. The result indicates that a 10% increase in grain subsidies for contracted farmland increases farmland rental rates by about 1%. In our case, the smallest value of the subsidy received by renting-in farmers is about 0.58 yuan per mu, and the mean value of the subsidy received by renting-in farmers is about 64 yuan per mu. Therefore, according to the results in Table 2, a growth in gain subsidies from about 0.58 to 64 yuan per mu, would increase farmland rental prices about by 9.9 yuan per mu. Accordingly, the capitalization rate of China's grain subsidy is about 16%.[18] Overall, the capitalization rate of China's grain subsidy is lower than those reported for the United States and European Union countries, where the incidence rate averaged around 14%–60% (Goodwin and Mishra, 2006; Kirwan, 2009) in the United States and 7.6%–57% (Breustedt and Habermann, 2011; Ciaian and Kancs, 2012; Guastella et al., 2018) in the EU countries. One explanation for the low capitalization rate of China's grain subsidy in farmland rental prices is that China has an informal farmland rental market with high transaction costs and an imperfectly competitive farmland market, which may depreciate the capitalization rate of the grain subsidy. Another plausible reason may be that land contractors claim most of the grain subsidy. Recall that in some regions, grain subsidies are directly distributed to the bank account of rural households with initial contractors of the land (Yi et al., 2015).

The coefficient on farm size is negative and significant at the 1% level of significance (Table 2). Our results suggest that a 10% increase in farmland area decreases the farmland rental market price by about 2% (Model 2 in Table 2). An explanation is that large farms have lower productivity, thus lower land rental rates (Li et al., 2018). Another reason could be that large farms have more power to negotiate lower farmland rental prices in the marketplace than small farms. Our finding is consistent with other studies in the literature (Kirwan, 2009; Ciaian and Kancs, 2012; Guastella et al., 2018).

The coefficient of natural disaster is statistically significant at the 10% level and negative (Table 2). Findings suggest that farms located in natural disaster areas (e.g., flood, earthquake, and drought areas) have lower farmland rental prices than farms in other areas. Finally, among the four soil typography dummy variables, the coefficients of hilly, plain, and grassland typographies are all positive and statistically significant. The result shows that, in comparison with farms located in mountain soil typography, farms located in the hilly, plain and grassland typographies receive about 25.2%, 80.5%, and 58.9% higher farm rental price. Farms located in plain typography have better access to irrigation facilities, water, fertility, and soil texture for planting crops, resulting in the highest farmland productivity. Recall that high land productivity drives up land rental rates in our theoretical model. Our finding is consistent with Wang et al. (2015), who report that farms located in the plain terrain are more productive in China and India.

Let us turn to the findings from the quantile regression. Table 3 shows parameter estimates for selected quantiles (20, 40, 50, 60, and 80). These estimates show that the coefficient decreases monotonically with the rising quantiles, with the largest absolute magnitude of the coefficient in the 20th quantile. Since the farmland rental price is measured in log, we calculate the multiplier of quantile regression in log coefficient that enables to derive the average marginal effect across quantiles in yuan (Cameron and Trivedi, 2009). For example, adjustment with a multiplier of 193 for the 40th quantile, leads to an implied average marginal grain subsidy effect of 10.8 yuan (193*0.056 = 10.8). This result indicates that the grain subsidy increases the farmland rental prices by 10.8 yuan in the 40th quantile. Similarly, capitalization rates for the 20th, 50th, 60th, and 80th conditional quantiles, grain subsidy in the farmland rental prices are 8.7, 10.3, 10.6, and 19.3 yuan, respectively.[19] Findings here show heterogeneity and an overall incremental trend in the capitalization rate of China's grain subsidy program (a more competitive land rental market).

The impact of farm size is negative and significant for all the quantiles, and overall, the absolute magnitude of the coefficient decreases monotonically across quantiles (except for 50th quantile). This means that farm size has a negatively larger effect on farmland rental prices at the lower quantiles. A plausible reason may be that increasing farm size has an inverse impact on land productivity and hence a smaller impact on farmland rental prices. This finding is reinforced by the estimates on family farm labor input. Table 3 reveals that the parameter estimates on family farm labor input decrease in magnitude with increases in quantile. Family farm labor input has the highest impact on farmland rental prices in the 20th quantile. Recall that family farm labor input and farms located in the plain soil typography are associated with high land productivity (Kirwan, 2009; Ciaian and Kancs, 2012). Table 3 shows that the coefficient of rental experience is negative for all quantiles and statistically significant only for the 80th quantile. Results suggest that long-term experience in farmland renting

[18] Use this folumation, 9.9/(64-0.577).

[19] Using the transfer rate on December 31, 2011, when 1 Yuan = 0.159 US$, then China's grain subsidy program has driven up farmland rental prices by $24/ha, that is derived from (9.9*15*0.159).

Table 3
Quantile regression estimates of factors affecting land rental price, CFPS2012.

	Land rental price (*log*) (*Yuan/mu*)					Wald F-score
	Selected quantiles					
	20	40	50	60	80	
Grain subsidy (log)	0.097***	0.056***	0.043***	0.035***	0.033*	2.40**
	(0.018)	(0.015)	(0.012)	(0.011)	(0.019)	
Farm size (log)	−0.293***	−0.168***	0.046***	−0.099***	−0.080**	6.05***
	(0.035)	(0.042)	(0.014)	(0.031)	(0.034)	
Rental experience	−0.071	−0.019	−0.067	−0.086	−0.097*	0.83
	(0.086)	(0.054)	(0.048)	(0.055)	(0.051)	
Family farm labor input (log)	0.169**	0.095*	0.109**	0.072	0.096**	1.20
	(0.073)	(0.057)	(0.052)	(0.048)	(0.041)	
Natural disaster[a]	−0.242*	−0.198	−0.135*	−0.174***	−0.054	2.42*
	(0.142)	(0.125)	(0.078)	(0.053)	(0.067)	
Land expropriation[a]	−0.083	0.067	0.122	0.199**	0.273**	2.71**
	(0.167)	(0.123)	(0.107)	(0.083)	(0.119)	
Hilly typography[a,b]	0.270*	−0.005	0.056	−0.024	−0.090	3.50**
	(0.154)	(0.146)	(0.112)	(0.108)	(0.126)	
Plateau typography[a]	−0.154	0.042	0.018	0.125	−0.056	0.51
	(0.363)	(0.241)	(0.164)	(0.191)	(0.143)	
Plain typography[a]	1.010***	0.658***	0.597***	0.472***	0.118	10.5***
	(0.151)	(0.159)	(0.145)	(0.113)	(0.114)	
Grassland typography[a]	0.835**	0.363	0.134	0.529	0.411	0.24
	(0.398)	(0.561)	(0.471)	(0.499)	(0.395)	
Inverse Mills Ratio (IMR)	−0.020	−0.180**	−0.163**	−0.179***	−0.307***	
	(0.085)	(0.081)	(0.080)	(0.068)	(0.070)	
Province dummy variables	Controlled	Controlled	Controlled	Controlled	Controlled	
	4.283***	4.844***	4.942***	5.481***	6.063***	
Constant	(0.379)	(0.218)	(0.245)	(0.295)	(0.206)	
R^2	0.191	0.196	0.191		0.194	
Observations	1033					

Note: Statistically significant at: *10, * *5 and * * *1 percent levels; Standard errors are in parentheses.
[a] Data of farm household location was matched by the CFPS2010 survey.
[b] Base typography is mountain typography.

has a negative impact on farmland rental prices, but in the highest price range. For instance, if the current land rent is high, tenants may have positive expectations about future rents and will sign long-term contracts to prevent rents from rising (Choumert and Phélinas, 2017). Finally, the coefficient of land expropriation is significant only for the 60th and 80th quantiles (Table 3). The positive coefficients on land expropriation in the upper quantiles mean that the impact of land expropriation—a proxy for expected future rent increases arising from land conversion—is much stronger for higher farmland rental prices (upper tail). A plausible explanation is that urbanization and other pressure, such as a more developed and competitive land rental market[20] may be putting upward pressure on farmland market prices.

7. Conclusion and policy implications

The rapid development of land rental markets in China is restructuring farmland composition, production costs, and productivity. Meanwhile, since 2004, China has implemented agricultural subsidies to support grain production and farmers' income. Theoretically, part of the agricultural subsidies will be capitalized into farmland rents. Using nationally representative rural survey data, this paper investigates factors affecting farmland rental prices and the capitalization rate of China's grain subsidy program. The study used a Heckman sample selection model and quantile regression (QR) approach. The study found that a 10% increase in China's grain subsidy for contracted farmland increases farmland rental prices by about 1%. Furthermore, results from the quantile regression show a heterogeneous capitalization rate of China's grain subsidy program. China's grain subsidy has driven up farmland rental prices by 8.7, 10.8, 10.3, 10.6, and 19.3 yuan per mu for low quantile to high quantile (20, 40, 50, 60, and 80).

Farm size was found to have a significantly negative effect on farmland rental prices, and the more substantial effect was found at the lower quantiles. Rental experience, a proxy for the long-term rental relationship, only resulted in a 9.7% reduction in farmland rental prices, but only in the 80th quantile. Findings also show that family farm labor input has a positive impact on land rental prices, and farmland rental prices increase by about 0.1%–0.2%. We also found that farms located in natural disaster areas (e.g., flood, earthquake and drought areas) have lower farmland rental prices. However, land expropriation, a proxy for expected future rent increases arising from land conversion, had a positive effect on farmland rental prices, especially in the higher quantiles. Finally, farms located in the plain and grass soil typography had higher farmland rental prices than farms located in the mountain soil typography. This finding confirms the importance of land quality and landscape in determining farmland rental prices. A limitation of this paper is that we cannot distinguish whether land contractors or tenants received the grain subsidy in the implementation of China's grain subsidy program. The low capitalization rate of China grain subsidy program that we found may be because some subsidies are directly given to land contractors, not the tenants. Further studies could focus on the differentiated capitalization rate of grain subsidies based on the subsidy recipient.

The recent development of China's land rental market means one can expect a rise in farmland rental price under a more competitive scenario. Chinese policymakers could take several steps in ensuring China's competitiveness in domestic agriculture by lowering production costs, including farmland rental prices. The first step could be

[20] Thus signaling future land expropriations.

continuing to promote rural labor migration through agricultural mechanization. China still has a significantly large agricultural labor force, about 28.3% of the total labor force (National Bureau of Statistics of China (NBSC, 2015). Agricultural machinery inputs can reduce labor costs and thus reduce farmland rents. Chinese policymakers could also provide subsidies related to inputs and the adoption of technological advancement (e.g., farm machines, etc.). Second, policymakers could offer incentives to longer-term and more stable transactions between tenants (renting-in farmland) and contractor smallholder families (those renting out land). Small farmers in rural China should be encouraged to form interest groups of a community of farmers through land joint-stock cooperation, in which small farmers pool their farmland, and share farming benefits through farmland renting or increased economies of scale. Pooling farmland and leasing the land for large scale farming operation would bring in dividend and jointly sharing the costs and risks with all participants (Zhou et al., 2019). Land joint-stock cooperation builds a more stable and long-term relationship between the transacting parties and helps in reducing the costs of farmland in agricultural production. Finally, policymakers could design incentives, and agricultural subsidies that encourage relevant subjects to carry out land consolidation, development of infrastructure, improving irrigation systems and soil quality (Li et al., 2018), as such initiatives would lessen the pressure on farmland rental prices, and improvement in soils would improve land productivity.

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Appendix A

Table A1
Probit model of factors affecting participation in land rental markets.

Variables	Land Renting In
Female head	−0.020
	(0.042)
Age of household head (log)	−0.247***
	(0.078)
Education of HH (log)	0.061
	(0.048)
Farm worker	0.817***
	(0.070)
Agricultural fixed assets (log)	0.079***
	(0.007)
Owned farmland area (log)	−0.001
	(0.001)
Grain subsidy (log)	0.018
	(0.043)
Natural disaster[a]	−0.010
	(0.062)
Land expropriation[a]	0.175***
	(0.059)
Hilly typography [a,b]	0.177*
	(0.098)
Plateau typography[a]	0.234***
	(0.065)
Plain typography[a]	0.226
	(0.546)
Grassland typography[a]	−0.533
	(0.463)
Constant	−0.020
	(0.042)
Observations:7329	
R^2 = 0.047	

Note: Statistically significant at: *10, * *5 and * * *1 percent levels; Standard errors are in parentheses.

[a] Data of farm household location was matched by the CFPS2010 survey.

[b] Base typography is mountain typography.

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