Contract Design in China's Rural Land Rental Market: Contractual Flexibility and Rental Payment

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Abstract

Established in the late 1990s, China's rural land rental market is now revolutionizing agriculture by upgrading smallholder production to factory farming. However, there is little empirical evidence on recent developments in this market, in particular on the design of rental contracts, which profoundly affects participants' welfare and agricultural production. I study rental contracts as outcomes of bargains over two contractual terms: contractual flexibility and rental payment. The theory I present shows which equations should be estimated in an empirical test of the bargaining process. The empirical structure indicated by my theory is markedly different from that in existing empirical contributions, which helps to explain why those contributions obtain seemingly inconsistent results. I conducted a survey in 2014 capturing current developments in the market. Applying the survey data to the theoretically justified empirical model, I draw two empirical conclusions in addition to providing support for my characterization of the bargaining mechanism. First, the renting-in agents' ownership of enterprises and their social proximity to the renting-out partners decrease contractual flexibility and increase rental payment, indicating that entrepreneurship within a village social network promotes agricultural development and village prosperity. Second, the rental payment offered to the renting-out agents with long-term non-agricultural employment is higher than that offered to the renting-out agents with short-term or temporary employment, suggesting a potential increase in income inequality within the village.

Keywords: Land rentals, Nash bargaining, contract design, Chinese rural economy

JEL: O13, Q15

Introduction

China's rural land rental market was established in the late 1990s (Liu, Carter and Yao, 1998; Brandt et al., 2002; Kung, 2002; Zhang, Ma and Xu, 2004). In the last two decades, this gradually maturing market has had an unprecedented impact on the rise of future agricultural production and national economic development (Wen, 2010). By the end of 2014, 25.5% of Chinese rural households had participated in the rural land rental market, resulting in a market that occupies 30.4% of national farmland (China Ministry of Agriculture (MOA), 2015).

In contrast to the land rentals in the late 1990s, which barely doubled the production scale by increasing the average farm size from half a hectare to one hectare (Jin and Deininger, 2009),[1] the land rentals in the 2010s are facilitating large-scale farming on more than 3.3 hectares (50 mu).[2] As of 2014, the land rental market had created more than three million large-scale farms, which account for 1.3% of production units (individuals or enterprises) (MOA, 2015). Thus, the market in the 2010s is revolutionizing agriculture by upgrading smallholder production to factory farming.

Besides improving agricultural productivity, the rural land rental market functions as a central hub between the separated urban and rural economies (Cheng and Selden, 1994). Through investment in agriculture through the market, capital from the urban economy flows to agriculture, relaxing credit constraints in the rural economy (Deininger and Jin, 2005). At the same time, the market facilitates a major shift of labor from agriculture to non-agricultural sectors in the cities (Deininger, Jin and Xia, 2014), which reduces the shortage of labor in non-agricultural sectors (Zhang, Yang and Wang, 2011). Thus, the rural land rental market is a vital part of the ongoing national economic reform intended to unify the separated urban and rural economies.

The existing literature focuses on studying market emergence and the constraints on market participation in the late 1990s and early 2000s. Kung (2002),[3] Yao (2000),[4] Zhang, Ma and Xu (2004),[5] and Deininger and Jin (2005)[6] consistently show that rural citizens' active participation in non-agricultural employment accelerated the emergence of the market. Yao (2000) and Deininger and Jin (2005) further built on the literature by identifying the impact of heterogeneity in agricultural capacity on promoting land rentals.[7] Although the rural land rental market in the early 2000s improved post-rental agricultural productivity by 60% (Jin and Deininger, 2009),[8] scholars believe that transaction costs caused by an imperfect labor market

[1] The summary statistics in Jin and Deininger (2009) show that the average mu rented-in is less than 5 mu and the average household land endowment is less than 9 mu. Hence, the maximum post-rental farm is no greater than 14 mu (less than 1 hectare)

[2] 50 mu is the minimum farm size to be considered a large-scale farming operation at the national level (MOA, 2015). Provinces in the north may set a higher minimum production scale for large-scale farming.

[3] The survey data in Kung (2002) was collected in 1999 by MOA in six provinces.

[4] The data in Yao (2000) is a two-year panel in 1988 and 1993 in three counties of Zhejiang Province.

[5] Zhang, Ma and Xu (2004) use a survey data collected in Zhejiang Province in 2001.

[6] The survey data in Deininger and Jin (2005) was collected by China's National Bureau of Statistics in 1997-1999 and 2001 in the three poorest provinces: Guizhou, western Hunan and Yunnan.

[7] Both studies show that land flows from farmers with low capacity to farmers with high capacity in the rural land rental market.

(Yao, 2000) and a collective land property right system (Jin and Deininger, 2009) are not trivial. The transaction costs constrain market participation and prevent the market from attaining its full potential in improving productivity (Deininger and Jin, 2005).

However, as the previous literature concentrates on the early stage of the market within a limited time-frame, 1995-2005,[9] there are two large gaps in the literature. First, the mechanism of contract design in China's rural land rental market has not been studied thoroughly. Investigation of rental contracts has remained at a descriptive level (Ye, Jiang and Feng, 2006; Jin and Deininger, 2009) because the early contracts were characterized by low formality,[10] trivial rental payments,[11] short and non-fixed tenures,[12] and comparative homogeneity. As the market moves towards maturity, the rental contracts in the 2010s can be interpreted as careful and rational bargaining outcomes between the renting-in and renting-out. Thus, the rental contracts, which were not fully functioning at the early stage, have gradually become important in affecting participants' welfare and post-rental production.

The second gap in the literature is that our understanding of the critical institutions shaping the market in the 2010s is insufficient. The institutions that had crucial roles between 1995 and 2005 have become less important in the 2010s as national economic reform has progressed. The security of private land use right studied in Kung (2002) and Jin and Deininger (2009) was strengthened by the 2003 *National Contracting Law of Cultivated Land* (Gao, Huang and Rozelle, 2012). The grain quota studied in Kung (2002) and Zhang, Ma and Xu (2004) was abolished in 2006.[13] As a recommended policy of the Central Committee of the Communist Party of China (CCCPC, 2013),[14] the land rental market is now open to parties from outside of villages, greatly reducing incidence of the village-level outsider exclusion studied by Jin and Deininger (2009).

Hence, the two gaps in the literature call for up-to-date data that reflects the market and its institutions in the 2010s. In addition, new data collection should directly emphasize rental transactions rather than relying on rural household surveys as the old datasets did.[15] Using rural household surveys in the research on rental contracts leads to two potential problems. First, rural household surveys that select samples from all households (market participants and non-participants) may provide a truncated representation of rental attributes and market decisions. Second, rural household surveys that ignore the heterogeneity in market maturity[16] could present an unclear combination of markets with different maturity and thus transactions

[8] Survey conducted by China's National Bureau of Statistics in 2002-2004 in the nine most important agricultural provinces.

[9] There is one exception. Gao, Huang and Rozelle (2012) provide observations of the market in 2008 in the six most important agricultural provinces.

[10] 8.63% were formal contracts in Jin and Deininger (2009).

[11] In the World Bank China Living Standard Survey (CLSS) for 1995-1997, 29% of contracts had non-trivial rental payments.

[12] 24.15% were fixed-tenure at an average length of 2.71 years in Jin and Deininger (2009).

[13] Grain quota was abolished nationwide along with the abolishment of *Agricultural Taxation Clause* in 2006.

[14] Central Committee of the Communist Party of China, Document #1, a series of suggestions on national economic policies

[15] Yao (2000); Kung (2002); Zhang, Ma and Xu (2004); Deininger and Jin (2005); Jin and Deininger (2009); Gao, Huang and Rozelle (2012)

[16] Based on Yao (2000) and Kung (2002), Zhejiang Province had a higher rate of market participant than other provinces in the

with different attributes, making it difficult to estimate causal relationships.

To remedy these deficiencies, I conducted a survey on rental transactions in two mature markets in 2014, providing the most up-to-date evidence of mature markets and shedding light on prospective market operation and policy design in less mature markets. This new dataset offers advantages over the existing datasets by (1) selecting the sample from the pool of market participants and (2) focusing on rental transactions in markets with high maturity.

The use of this dataset is guided by a model of Nash bargaining over two terms of a rental contract: contractual flexibility and rental payment. The results from the bargaining model provide some general lessons for the empirical literature on contract design. In that literature, researchers (Joskow, 1988; Crocker and Masten, 1991; Brickley, 1999; Poppo and Zenger, 2002; Argyres, Bercovita and Mayer, 2007; Ryall and Sampson, 2009) have adopted either a simultaneous-equations framework or a reduced form regression; in both frameworks, one contractual term is viewed as an explanatory variable for another contractual term. I show that this framework is not consistent with a standard bargaining model and use these insights to explain seemingly contradictory results in the existing literature.

Using the survey data for the empirical model justified by my theory, I verify the bargaining mechanism and draw two empirical conclusions. First, I find that the renting-in agents who are non-strangers to their renting-out partners sign less flexible contracts and pay higher rental payments. In addition, contractual flexibility further decreases and rental payments are even higher when the non-stranger renting-in partners own enterprises. Hence, entrepreneurship fostered by the human capital within a village social network promotes agricultural development and village prosperity. Second, the rental payment offered to the renting-out agents with long-term non-agricultural employment is higher than that offered to the renting-out agents with short-term or temporary non-agricultural employment, suggesting a potential increase in income inequality within the village. These empirical conclusions further underscore the pivotal role that the rural land rental market has played in promoting the ongoing economic reform.

The remainder of the paper is organized as follows. Section 1 introduces the features of contract design in China's rural land rental market. Section 2 presents the Nash bargaining game between the renting-in and renting-out agents. It reveals the bargaining mechanism and derives comparative statics results. Drawing support from the theory I present, Section 3 is devoted to clarifying empirical puzzles and theoretical ambiguities in the empirical literature on the relationship between contractual terms. Section 4 describes the data, introduces the empirical measurements of contractual terms and the definitions of exogenous explanatory variables, and states the hypotheses derived from the comparative statics. Section 5 presents the empirical strategy justified by my theory and describes the results. Section 6 concludes by both discussing the policy implications for China and commenting on the broader implications for the empirical modeling and estimation of equations explaining the choice of contractual terms.

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late 1990s.

1 China's Rural Land Rental Contracts

A Chinese rural land rental contract transfers use right of farmland from the renting-out agents to the renting-in. The rural citizens who are entitled to a land use right (Ho, 2001) are the only potential renting-out agents in the market. The renting-in could be individuals or enterprises owned by rural citizens or non-rural citizens. The primary uncertainty associated with a rental contract is the renting-out's position in non-agricultural employment. Although they accounted for 28% of labor in non-agricultural sectors in 2013 (Yearbook, 2013), rural citizens experience high uncertainty in non-agricultural employment in China's separated urban-rural social structure. The separated social structure isolates the rural citizens from the mainstream of the urban economy by keeping them in non-agricultural industries that do not offer long-term employment contracts (Cai, Park and Zhao, 2008). Thus, if the wage rate of a renting-out agent unexpectedly drops below a threshold at which it is optimal to allocate all labor to non-agricultural sectors, a rural citizen has an incentive to reallocate labor back to agriculture by terminating the rental contract before the end of the agreed tenure.

The renting-out's incentives for contract violation are further encouraged by the separated social structure. First, rural citizens are not fully covered by the national unemployment insurance offered to urban citizens. An unemployed renting-out agent who cannot access the urban social welfare system cannot survive in the urban economy on only the income of less than 5000 RMB per year from a land rental. Violating rental contracts is almost the only recourse for a renting-out who is disappointed in the urban economy. Second, the rural citizens are regarded as disadvantaged due to the huge income gap between rural and urban households[17] created by the separated social structure. To prevent the unemployed renting-out from losing his livelihood, the local governments acquiesce to the renting-out's contract violation at a low compensation by taking over dispute mediation of the market. Thus, the local government reduces the renting-out's cost of contract violation.

The renting-out's potential contract violation leads to efficiency loss in post-rental agricultural production. Since investment in agriculture is relation-specific, potential contract violation results in the renting-in's under-investment in agricultural production (Hart and Moore, 1988). Furthermore, potential termination of the contract on one piece of land could lead to productivity loss on other pieces of land because of location specificity. Since the area of farmland per capita is extremely low in China (Yearbook, Annual), large-scale farming is only possible using individual pieces from multiple renting-out partners. Termination of a contract on a piece of land in the middle of rented land could make mechanical farming on other pieces of that land infeasible. Hence, the negative externality from location specificity aggravates the efficiency loss caused by the renting-out's potential contract violation.

Although agricultural production has its own uncertainties, the renting-out's uncertainty in non-agricultural employment is the uncertainty that leads to the most consequential ex-post contractual adaptation in the rural land rental market.[18] Hence, this paper assumes that the renting-out's uncertainty in non-agricultural

[17] The disposable personal income per capita of an urban household was three times of that of a rural household in 2013 (Yearbook, 2013).

employment is the only uncertainty in the market. Facing this uncertainty, the renting-in and renting-out agents design contracts to influence the allocation of ex-post surplus (Segal and Whinston, 2002).

One part of the ex-post surplus is determined by the trade-off between the renting-out's net gain and the renting-in's net loss associated with the renting-out's contract violation (Crocker and Reynolds, 1993). This trade-off is reflected in the bargaining over contractual flexibility, defined as the probability that the renting-out must pay an institutionally determined violation compensation[19] to the renting-in if the renting-out violates the contract. The higher the contractual flexibility the lower the probability that a violator would pay the violation compensation to the renting-in. Another part of the ex-post surplus is determined by the trade-off between the renting-in's willingness to pay and the renting-out's willingness to accept the use right of the renting-out's land, reflected by the bargaining over the rental payment.[20]

In sum, rental payment and contractual flexibility are the two key contractual terms that affect the ex-post surplus of a rental contract. The renting-in and renting-out have conflicts of interest in both. To avoid negotiation failure caused by the conflicting preferences, the renting-in and renting-out bargain cooperatively on contract design to maximize the joint ex-post surplus. The features of China's rural land rental contracts provide two advantages in simplifying the modeling of contract design.

First, location specificity in the market restricts endogenous matching between rental partners. Each renting-in agent first chooses an adjacent piece of land based on his/her agricultural production plan and then negotiates with the rural households owning the use right to that piece of land. The characteristics of the renting-in agent, such as farming expertise, could be endogenously matched with the characteristics of a village. However, the renting-in and renting-out are matched exogenously based on farm distribution shaped by the first collective land distribution in the late 1970s (Ho, 2001). Hence, in the context of China's rural land rental market, it is possible to study the impacts of heterogeneous preferences over uncertainty on contract design without amplifying the problem of endogenous matching (Lafontaine, 1992).

Second, it is possible to identify the conflicting responses to uncertainty between the "buyers" and "sellers" in this market with only one primary uncertainty that leads to one type of ex-post contractual adaptation. Insights learned from the two parties' asymmetrical responses to one type of uncertainty could potentially enrich the literature on contracting. Although China's rural land rental market is an extreme context in that only one side has an incentive to request ex-post contractual adaptation, it sheds light on the impact of uncertainty in more general cases in which one side has comparatively more incentive to request ex-post contractual adaptation with respect to a certain type of uncertainty.

[18]Contract adaptation caused by uncertainty in agriculture is rarely seen in real practice because the rents are comparatively low so that the renting-in are able to pay for the rents even in agricultural failure.

[19]Since the local governments take over dispute mediation, the violation compensation is exogenous to contract design because it is a fixed monetary transfer determined by village institutions with trivial variation across contracts in a local market.

[20]The price adjustment provisions are almost identical across contracts within a village. A great proportion of contracts set the rental payment in the units of rice. The final payment is the agreed units of rice times the national purchase price of the year. In this paper, fluctuation of the national purchase price is not discussed and is assumed constant over years.

2 Theoretical Considerations

This section draws on the existing literature on contract design, which assumes that efficient contracting yields higher joint surplus (Corts and Singh, 2004). The contracting process is that two parties ($\{m,n\}$), the renting-in (in) and renting-out (o), bargain over two contractual terms ($\{i,j\}$): contractual flexibility (F) and rental payment (R). These two contractual terms are the arguments in the individual utility functions over a land rental contract ($U^m(i,j)$).

2.1 Properties of Individual Utility Functions

A renting-out agent gains utility from contractual flexibility ($U_F^o > 0$) by reducing the probability of paying the violation compensation. As the owner of land use right, the renting-out's marginal utility of rental payment is positive ($U_R^o > 0$). I assume that the $U^o(.)$ is concave. A renting-in agent loses utility from contractual flexibility ($U_F^{in} < 0$) because an increase in contractual flexibility decreases the expected compensation paid by the renting-out. Paying for land use right, the renting-in's marginal utility of rental payment is negative ($U_R^{in} < 0$). $U^{in}(.)$ is assumed to be concave.

Besides the conflicting preferences between the renting-in and renting-out over contractual terms, there is a heterogeneity in preferences among the agents of the same side that weigh F and R differently. An individual weight given to each contractual term represents its comparative importance in individual utility. Without loss of generality, I model the heterogeneity in preferences using individual utility functions with specific functional forms.[21] The renting-out's utility function (U^o) is assumed to be a Cobb-Douglas function $F^b R^{1-b}$. The parameters b and $1-b$ represent the comparative importance the renting-out places on F and R respectively. Conditional on fixed contracts with other renting-out partners,[22] the renting-in's utility of a rental contract with one renting-out partner (U^{in}) is assumed to be $A - kF - (1-k)R$, where A represents the renting-in's expected utility of agricultural production on the land collected from all the renting-out partners. Parameters k and $1-k$ represent the comparative importance the renting-in places on F and R, respectively.

2.2 Nash Bargaining Game

The renting-in and renting-out bargain over F and R to maximize the joint surplus of a rental contract. The bargaining power of the renting-out and renting-in are α and $1-\alpha$ respectively. The bargaining power is defined as the capacity to dominate the other in the negotiation. The threat points of the renting-in and renting-out are denoted as $\bar{U^{in}}$ and $\bar{U^o}$. A threat point represents the utility obtained by each agent when an agreement is not reached.

[21] To ensure the existence of unique solutions to each contractual term, U^o is not a linear transformation of U^{in}. The optimal contractual terms cannot be solved uniquely because all combinations of contractual terms on one party's indifference curves are also on the indifference curves of the other party.

[22] It is possible for a renting-in to have multiple renting-out partners.

The threat point of the renting-in ($\bar{U^{in}}$) is the expected utility of agricultural production excluding the land belonging to the single renting-out partner. Losing the land of the single renting-out, the renting-in experiences a direct loss on this piece of land and an indirect loss on other pieces of land through the negative externality of location specificity. The sum of these two types of loss captured by $A-\bar{U^{in}}$ is the renting-in's maximum willingness to pay for the rental contract on this piece of land.

Without reaching rental agreement, the renting-out could keep farming, move to non-agricultural sectors, or partially work in both sectors. Without loss of generality, I assume that the renting-out stays in agriculture if an agreement is not reached agreement.[23] Hence, $\bar{U^o}$ represents the renting-out's utility of household agricultural production before rentals, which is the renting-out's minimum willingness to accept the contract on this piece of land.

The Nash bargaining game leads to an optimal contract that maximizes the joint surplus of the renting-in and renting-out by choosing F and R.

$$\max_{F,R}(F^bR^{1-b}-\bar{U^o})^{\alpha}(A-kF-(1-k)R-\bar{U^{in}})^{1-\alpha}$$

Assuming an interior solution, which is justified below, Eqs (1) and (2) provide the solution for each contractual term (see Appendix A1).

$$F^*=\frac{b}{k}[\alpha(A-\bar{U^{in}})+(1-\alpha)\bar{U^o}\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}] \tag{1}$$

$$R^*=\frac{1-b}{1-k}[\alpha(A-\bar{U^{in}})+(1-\alpha)\bar{U^o}\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}] \tag{2}$$

I denote one party's (m) marginal utility of one contractual term (i) at the interior solution $(\frac{\partial U^m}{\partial i}|_{F=F^*,R=R^*})$ as U^m_{i*} for short. The expression $\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}$ in Eqs (1) and (2) is the ratio between U^{in}_{i*} and U^o_{i*} (see Appendix A2). The interior solutions are rearranged as follows:

$$F^*=(\frac{b}{k})[\alpha(A-\bar{U^{in}})+(1-\alpha)\bar{U^o}\frac{|U^{in}_{F^*}|}{|U^o_{F^*}|}] \tag{3}$$

$$R^*=(\frac{1-b}{1-k})[\alpha(A-\bar{U^{in}})+(1-\alpha)\bar{U^o}\frac{|U^{in}_{R^*}|}{|U^o_{R^*}|}]. \tag{4}$$

I assume that the interior solutions in Eqs (3) and (4) are finite by making ASSUMPTION 1 (see Appendix A3). The b and k excluded by ASSUMPTION 1 are shown by the shaded area along the borders in Figure 1.

ASSUMPTION 1: $b\notin\{0,1\}$ and $k\notin\{0,1\}$.

The interior solutions achieve optimality if the renting-in and renting-out's individual utility at the inte-

[23] Since agricultural profits and non-agricultural wage rates are exogenous, the impacts of $\bar{U^o}$ on the bargaining and thus on the contractual terms are not affected by the source of $\bar{U^o}$.

rior optimal contract ($U^m(F^*,R^*)$) is greater than the two parties' respective threat points ($\bar{U^m}$). To ensure the optimality of interior solutions, I make ASSUMPTION 2 (see Appendix A4).[24]

ASSUMPTION 2: $\frac{A-\bar{U^{in}}}{|U^{in}_{i^*}|} > \frac{\bar{U^o}}{|U^o_{i^*}|}$

$\frac{A-\bar{U^{in}}}{|U^{in}_{i^*}|}$ and $\frac{\bar{U^o}}{|U^o_{i^*}|}$ respectively translate the renting-in's maximum willingness to pay and the renting-out's minimum willingness to accept into the units of the same contractual term. The intuition of ASSUMPTION 2 is that the joint surplus maximized by the interior F^* and R^* is non-negative if the maximum units of each contractual term that the renting-in is willing to pay is greater than the minimum units of that contractual term that the renting-out is willing to accept.

Besides fitting the split-the-difference rule,[25] the renting-in and renting-out's utilities at the optimal contract (Eqs (5) and (6)) reveal that the value of a contract[26] is a bargaining outcome between the renting-in's maximum willingness to pay and the renting-out's minimum willingness to accept in units of utility.

$$U^o(F^*,R^*) = \alpha(A-\bar{U^{in}})\frac{|U^o_{i^*}|}{|U^{in}_{i^*}|} + (1-\alpha)\bar{U^o} \tag{5}$$

$$U^{in}(F^*,R^*) = A - [\alpha(A-\bar{U^{in}}) + (1-\alpha)\bar{U^o}\frac{|U^{in}_{i^*}|}{|U^o_{i^*}|}] \tag{6}$$

Each optimal contractual term (Eqs (3) and (4)) has two composite terms. The first component, $\alpha(A-\bar{U^{in}}) + (1-\alpha)\bar{U^o}\frac{|U^{in}_{F^*}|}{|U^o_{F^*}|}$, is the value of the optimal contract.[27] Taking this first component as a standard unit of measurement, F^* and R^* are respectively $\frac{b}{k}$ and $\frac{1-b}{1-k}$ units of the standard measurement. Thus, the second component, $\frac{b}{k}$ or $\frac{1-b}{1-k}$, reveals the bargaining rule of specific contractual terms after maximizing the joint surplus. Since a decreasing $|b-k|$ indicates an escalated conflict between rental partners on each contractual term, the bargaining rules show that the difference between F^* and R^* in relative magnitude decreases in the intensity of conflicts.[28]

[24] To satisfy ASSUMPTION 2, $b \notin \{0,1\}$, which is excluded by ASSUMPTION 1 (see Appendix A4)

[25] The renting-in and renting-out split $A-\bar{U^{in}}-\bar{U^o}$ based on respective bargaining power.

[26] Multiplying $\frac{A-\bar{U^{in}}}{|U^{in}_{i^*}|}$ by $|U^o_{i^*}|$ and $\frac{\bar{U^o}}{|U^o_{i^*}|}$ by $|U^{in}_{i^*}|$ represent one party's utility valuation of the other party's willingness to pay/accept.

[27] It is the renting-in's valuation of the renting-out's utility received at the optimal contract ($\frac{|U^m_{i^*}|}{|U^n_{i^*}|} \times U^o(F^*,R^*)$) and it is also equivalent to the renting-in's utility paid at the optimal contract ($A-U^{in}(F^*,R^*)$)

[28] An increase in b indicates that the renting-out gains a higher marginal utility from F while an increase in k indicates that the renting-in experiences a higher marginal utility loss from F. Hence, closely matched b and k (small $|b-k|$) indicates high intensity of conflicts over each contractual term.

2.3 Comparative Statics

The bargaining power and the threat points impact F^* and R^* by affecting the value of the optimal contract. With ASSUMPTION 2, the renting-out's gain from $\Delta\alpha$, $A-\bar{U^{in}}$, is greater than the renting-in's loss associated with $\Delta\alpha$, $\bar{U^o}\frac{|U^{in}_{i^*}|}{|U^o_{i^*}|}$. Hence, an increase in α increases both F^* and R^* by increasing the value of the optimal contract, which results in a contract favoring the renting-out.

$$\frac{\partial F^*}{\partial \alpha} = \frac{1-b}{1-k}[(A-\bar{U^{in}}) - \bar{U^o}\frac{|U^{in}_{F^*}|}{|U^o_{F^*}|}] > 0$$

$$\frac{\partial R^*}{\partial \alpha} = \frac{b}{k}[(A-\bar{U^{in}}) - \bar{U^o}\frac{|U^{in}_{R^*}|}{|U^o_{R^*}|}] > 0$$

An increase in one party's threat point results in a contract more favorable to that party. $\Delta\bar{U^o}$ increases the value of the optimal contract, which favors the renting-out by increasing both F^* and R^*. $\Delta\bar{U^{in}}$ decreases the value of the optimal contract, which favors the renting-in by decreasing both F^* and R^*.

$$\frac{\partial F^*}{\partial \bar{U^o}} = (1-\alpha)(\frac{k(1-b)}{(1-k)b})^{b-1} > 0$$

$$\frac{\partial R^*}{\partial \bar{U^o}} = (1-\alpha)(\frac{k(1-b)}{(1-k)b})^{b} > 0$$

$$\frac{\partial F^*}{\partial \bar{U^{in}}} = -\frac{\alpha b}{k} < 0$$

$$\frac{\partial R^*}{\partial \bar{U^{in}}} = -\frac{\alpha(1-b)}{1-k} < 0$$

In sum, the bargaining power and the threat points affect F^* and R^* in the same direction. The contract curve, which is a mapping between F^* and R^* with respect to α or $\bar{U^m}$, slopes upward. Figure 2 shows the indifference curves of the renting-out (a, a' and a'') and the renting-in (b, b', and b'') and visualizes the upward-sloping contract curve with respect to α as an example showing the impacts of α or $\bar{U^m}$ on F^* and R^*.

The comparative importance of contractual flexibility (b or k) impacts F^* and R^* from two perspectives. First, b and k directly affect F^* and R^* through the bargaining rule ($\frac{b}{k}$ and $\frac{1-b}{1-k}$).[29] Second, b and k indirectly affect F^* and R^* through the weighting index $\frac{|U^{in}_{i^*}|}{|U^o_{i^*}|}$.[30] The direct and indirect impacts of b and k could be opposite in sign due specific functional forms (see Appendix A5).

I assume that the most important property of b and k is to directly determine the bargaining rule of F^*

[29] Example: direct impact of b on F^* is $\frac{\partial \frac{b}{k}}{\partial b} \times [\alpha(A-\bar{U^{in}}) + (1-\alpha)\bar{U^o}\frac{|U^{in}_{F^*}|}{|U^o_{F^*}|}]$.

[30] Example: indirect impact of b on F^* is $\frac{b}{k} \times \frac{\partial[\alpha(A-\bar{U^{in}}) + (1-\alpha)\bar{U^o}\frac{|U^{in}_{F^*}|}{|U^o_{F^*}|}]}{\partial b}$.

and R^*, which indicates that the direct impacts of b and k outweigh the indirect impacts if the direct and indirect impacts are opposite in sign. The indirect impacts of b and k when opposite in sign to the direct impacts are less important because the weighting index ($\frac{|U_{i^*}^{in}|}{|U_{i^*}^{o}|}$) mainly facilitates the comparison between two parties' utility with different preferences. Thus, the combinations of b and k are ruled out if the indirect impacts of b or k are opposite in sign to the corresponding direct impacts.

The direct impacts of k on F^* and R^* dominate the comparative statics with respect to k without further assumptions (see Appendix A5).

$$\frac{\partial F^*}{\partial k} = -\frac{1}{k^2}\alpha(A-\bar{U^{in}})b-(1-\alpha)b(\frac{b(1-k)}{k(1-b)})^{-b}\frac{1}{k^2}\bar{U^o} < 0$$

$$\frac{\partial R^*}{\partial k} = \frac{1}{(1-k)^2}\alpha(A-\bar{U^{in}})(1-b)+(1-\alpha)b(\frac{b(1-k)}{k(1-b)})^{-b}\frac{1}{k-k^2}\bar{U^o} > 0$$

As k increases, F becomes more costly than R to the renting-in. Hence, Δk decreases F^* and increases R^* because the bargaining rule gives less weight to F^* and more weight to R^*.

The comparative statics of F^* and R^* with respect to b are the following.

$$\frac{\partial F^*}{\partial b} = \frac{\alpha(A-\bar{U^{in}})}{k}+\frac{1-\alpha}{k}[\frac{|U_{F^*}^{in}|}{|U_{F^*}^{o}|}(1+b\ln\frac{k(1-b)}{b(1-k)})]\bar{U^o} \tag{7}$$

$$\frac{\partial R^*}{\partial b} = -\frac{\alpha(A-\bar{U^{in}})}{1-k}-\frac{1-\alpha}{1-k}[\frac{|U_{F^*}^{in}|}{|U_{F^*}^{o}|}(1+(b-1)\ln\frac{k(1-b)}{b(1-k)})]\bar{U^o} \tag{8}$$

To have the direct and indirect impacts of b in the same direction, I assume that b and k satisfy ASSUMPTION 3 (see Appendix A5). The combinations of b and k ruled out by ASSUMPTION 3 are at the southeast and northwest corners in Fig 1 (see Appendix A5).

ASSUMPTION 3

$$\text{Condition 1: } 1+b\ln\frac{k(1-b)}{b(1-k)} \geq 0$$

$$\text{Condition 2: } 1+(b-1)\ln\frac{k(1-b)}{b(1-k)} \geq 0$$

With ASSUMPTION 3, $\frac{\partial F^*}{\partial b} > 0$ and $\frac{\partial R^*}{\partial b} < 0$. As b increases, F becomes more valuable than R to the renting-out. Hence, Δb increases F^* and decreases R^*.

The contract curves with respect to b and k are downward-sloping because the impacts of b and k on F^* and R^* are in the opposite direction. Figure 3 visualizes the contract curve with respect to k as an example showing the impacts of b or k on F^* and R^*.

3 Lessons for the Empirical Literature on Contract Design

The solutions of the Nash Bargaining game suggest an empirical structure that should be estimated in an empirical test of the bargaining process. However, this theoretically justified empirical strategy is markedly different from that in existing empirical literature on contract design.[31] I present the empirical strategy justified by my theory, giving insights on the econometric problems associated with the conventional strategies used in the existing empirical contributions. Furthermore, I compare the conventional strategies with the theoretically justified strategy. The comparisons explain seemingly contradictory results on the relationship between the same pair of contractual terms in the existing literature.

3.1 Justifying the Empirical Strategy

The solutions of F^* and R^* (Eqs (1) and (2)) justify using the following empirical system:

$$F^* = g_f(\alpha, b, k, \bar{U^o}, \bar{U^{in}}) \tag{9}$$

$$R^* = g_r(\alpha, b, k, \bar{U^o}, \bar{U^{in}}) \tag{10}$$

However, this empirical system is different from the conventional one that is implicit when there is an interest in estimating the correlation between two contractual terms across contracts (Poppo and Zenger, 2002; Argyres, Bercovita and Mayer, 2007). Many papers study the relationship between contractual terms by regressing one contractual term (C_1) on the other contractual term (C_2) and exogenous variables (Joskow, 1988; Crocker and Masten, 1991; Holstrom and Milgrom, 1994; Brickley, 1999; Poppo and Zenger, 2002; Argyres, Bercovita and Mayer, 2007; Ryall and Sampson, 2009). The conventional empirical strategy is captured in Eqs (11) and (12), where G and H are the exogenous vectors.

$$E(C_1) = a_1 C_2 + \beta \mathbf{G} \tag{11}$$

$$E(C_2) = a_2 C_1 + \theta \mathbf{H} \tag{12}$$

The theoretically justified empirical system, Eqs (9-10), gives insights on empirical strategies from two perspectives. First, F^* and R^* are expressed as functions of the same exogenous variables, but not of each other. The empirical strategy justified by the theory is a system of two separate regressions[32] with the same set of exogenous variables, which is different from the conventional empirical strategy in the aforementioned existing literature (Eqs (11-12)). Hence, the correlation between two contractual terms across agreements, appealing in the empirical literature but questioned in literature reviews (Shelanski and Klein, 1995; Masten

[31] e.g., Joskow (1988); Crocker and Masten (1991); Brickley (1999); Poppo and Zenger (2002); Argyres, Bercovita and Mayer (2007); Ryall and Sampson (2009)

[32] The error terms of F^* and R^* could be correlated, similar to the seemingly uncorrelated regressions. The simultaneous correlation, which is further discussed in the empirical section, does not change the arguments in this section.

and Saussier, 2000; Chiappori and Salanie, 2003; Lafontaine and Slade, 2013), does not reflect causal links between two contractual terms.

Second, Eqs (9) and (10) offers insights into the use of instrumental variables (IVs). Research focused on substitutability and complementarity between two contractual terms (Argyres, Bercovita and Mayer, 2007; Crocker and Masten, 1991; Saussier, 2000; Brickley, 1999) regresses one contractual term on the other and instruments the regressor contractual term by the IVs that are assumed to be uncorrelated with the regressand contractual terms. However, the IVs may be correlated with not only the regressor contractual term but also the regressand (Lafontaine and Slade, 2013). For example, the plausible selection criteria of IVs give rise to contradictory arguments across studies. In Poppo and Zenger (2002), longevity of contractual relationship as an IV is assumed not to be correlated with contractual complexity. However, relationship history explains contractual complexity[33] in Argyres, Bercovita and Mayer (2007).

Indeed, Eqs (9-10) show that, among the five exogenous explanatory variables (α, b, k, $\bar{U^o}$, and $\bar{U^o}$), there is no variable that affects one contractual term but does not affect the other one. If only C_1 is studied and regressed on C_2 (e.g., Joskow (1988)), none of the five variables can be used as an IV for C_2 because these variables are determinants of both C_1 and C_2. If both C_1 and C_2 are studied (e.g., Poppo and Zenger (2002)), none of the five variables can be used to satisfy the order condition because no variable can be excluded from either Eq (11) or (12).

3.2 Conventional Strategies versus the Justified Empirical Strategy

In the existing literature, correlations between contractual terms have been estimated by four types of conventional strategies with common structures. I analyze each conventional strategy when the justified empirical system is Eqs (9-10). The comparisons between the conventional strategies and the justified empirical strategy show that a_1 and a_2, as studied in the literature, are actually functions of the elements of the empirical system that my theory justifies.

The justified empirical system (Eqs (9-10)) can be simplified as Eqs (13-14) by assuming that ε_{1i} and ε_{2i} are independent and normally distributed at zero mean and $corr(\varepsilon_{1i}, \varepsilon_{2i}) = corr(\varepsilon_{1i}, \varepsilon_{2j}) = 0$. For simplicity, x_i and w_i are single variables.

$$F_i = \beta_1 x_i + \theta_1 w_i + \varepsilon_{1i} \tag{13}$$

$$R_i = \beta_2 x_i + \theta_2 w_i + \varepsilon_{2i} \tag{14}$$

To capture the essential elements of the comparative statics, I assume that x_i represents a proxy for α or $\bar{U^m}$ and w_i represents a proxy for b or k. Hence, $\dfrac{\beta_1}{\beta_2} > 0$ because α and $\bar{U^m}$ affect F^* and R^* in the same direction while $\dfrac{\theta_1}{\theta_2} < 0$ because b and k affect F^* and R^* in the opposite direction. There are four possible conventional strategies for estimating a_1 and a_2 in Eqs (11) and (12).

[33] Contractual complexity refers to detailed contingency plan and task description.

3.2.1 No Omitted Exogenous Variables (OLS)

The first situation is that no exogenous explanatory variables are omitted in the corresponding conventional strategy (Eqs (15) and (16)).

$$F_i = a_1 R_i + \kappa_1 x_i + \tau_1 w_i + \mu_{1i} \tag{15}$$

$$R_i = a_2 F_i + \kappa_2 x_i + \tau_2 w_i + \mu_{2i} \tag{16}$$

Regressing Eqs (15) and (16) separately by OLS, the *plims* of the expected values of a_1 and a_2 in Eqs (15) and (16) are zero (see Appendix A6), showing that the correlation between F_i and R_i is insignificantly different from zero conditional on the variances of exogenous variables.

3.2.2 Omitting Exogenous Variables in One Single Equation (OLS)

The second situation is that the corresponding conventional strategy omits one or more exogenous explanatory variables and only a_1 in Eq (11) is of interest. Two possible conventional strategies have been used in the literature. The first strategy is to regress F_i on R_i and on the non-omitted exogenous variables directly (e.g., MacAvoy (1962); Joskow (1988)). Eq (17) is an example of this conventional strategy omitting x_i.

$$F_i = a_1 R_i + \tau_1 w_i + \mu_{1i} \tag{17}$$

The *plim* of the expected value of a_1 is shown below (see Appendix A6). Given that Eqs (13) and (14) are the theoretically justified model, $plim(\hat{a_1})$ in Eq (17) should be equal $\frac{\beta_1}{\beta_2}$. However, the strategy Eq (17) introduces a bias ($\sum \varepsilon_{2i}^2 \sum w_i^2$) in the estimation of a_1 by including R_1 and omitting x_i.[34]

$$plim(\hat{a_1}) = plim\{\frac{\beta_2\beta_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\beta_2^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \varepsilon_{2i}^2 \sum w_i^2}\}$$

The expression of $plim(\hat{a_1})$ shows that the relationship between F_i and R_i is always non-negative if x_i is omitted because β_1 and β_2 have the same sign and $\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2$ is non-negative based on Cauchy-Schwartz inequality. However, if I modify Eq (17) by including R_i and omitting w_i ($F_i = a_1 R_i + \kappa_1 x_i + \mu_{1i}$), $plim(\hat{a_1})$ is the following (see Appendix A6):

$$plim(\hat{a_1}) = plim\{\frac{\theta_2\theta_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\theta_2^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \varepsilon_{2i}^2 \sum x_i^2}\}.$$

By omitting w_i, $plim(\hat{a_1})$ becomes non-positive because θ_1 and θ_2 have different signs and $\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2$ is non-negative. That the sign of $\hat{a_1}$ is affected by the omitted variables could explain the different relationships between the same pair of contractual terms estimated by OLS in the literature. MacAvoy

[34] Chiappori and Salanie (2003), Masten and Saussier (2000), and Lafontaine and Slade (2013) all argue that the simultaneity bias in estimating the complementarity between two contractual terms is the primary econometric challenge facing the research on complementarity.

(1962) shows that the relationship between initial contractual price and the dummy of renegotiation clauses is positive, opposite to his own theoretical prediction. In contrast to MacAvoy (1962), Joskow (1988) shows that the initial contractual price is insignificantly affected by the price renegotiation provisions. Thus, it is possible that MacAvoy (1962) omits a group of variables that jointly affect the two contractual terms in the same direction while the potentially omitted variables in Joskow (1988) may not jointly affect both contractual terms significantly.

3.2.3 Omitting Exogenous Explanatory Variables in One Single Equation (IV)

Some papers, rather than using OLS, instrument the regressor contractual term to remove any simultaneity bias caused by the correlation between the regressor contractual term and the unobserved error term of the regressand contractual term (e.g., Crocker and Masten (1991); Poppo and Zenger (2002)). Eqs (18-19) is an example of estimating a_1 by instrumenting R_i.

$$F_i = a_1 R_i + \tau_1 w_i + \mu_{1i} \tag{18}$$

$$R_i = \beta_2 x_i + \theta_2 w_i + \mu_{2i} \tag{19}$$

The "plausible IV" for Eqs (18-19) is x_i, which is actually an omitted variable in Eq (18) (see Eqs (13) and (14)). In a 2SLS estimation, the estimators of $\hat{a_1}$ and $\hat{\tau_1}$ are as follows (see Appendix A6):

$$plim(\hat{a_1}) = \frac{\beta_1}{\beta_2}$$

$$plim(\hat{\tau_1}) = \frac{\beta_2\theta_1 - \beta_1\theta_2}{\beta_2}.$$

Using x_i as a "plausible IV" for R_i, $plim(\hat{a_1})$ is positive at $\frac{\beta_1}{\beta_2}$. However, if I modify Eqs (18-19) by using w_i as the "plausible IV" as Eqs (20-21), $plim(\hat{a_1})$ changes to negative at $\frac{\theta_1}{\theta_2}$.

$$F_i = a_1 R_i + \kappa_1 x_i + \mu_{1i} \tag{20}$$

$$R_i = \beta_2 x_i + \theta_2 w_i + \mu_{2i} \tag{21}$$

Hence, the sign of $\hat{a_1}$ is affected by the selection of the "plausible IVs" which clarifies the contradictory relationships between the same pair of contractual terms estimated using IVs in the literature. For example, both Corts and Singh (2004) and Poppo and Zenger (2002) use proxies of asset specificity as the IVs for relational governance. Corts and Singh (2004) show that repeated interaction and high-powered formal contracts[35] are substitutes in the offshore drilling industry, which is supported by non-IV results in Kalnins

[35]The high-powered formal contracts refer to fixed-cost contracts.

and Mayer (2004) studying the information technology industry and Gulati (1995) using a multi-industry alliance dataset. In contrast to Corts and Singh (2004), Poppo and Zenger (2002) show that relational governance and contractual complexity are complements in the information service industry, which is consistent with non-IV results in Ryall and Sampson (2009) and Argyres, Bercovita and Mayer (2007) studying the same industry. Thus, the justified empirical system reconciles the contradictory empirical results by distinguishing the IVs that affect F^* and R^* in the same versus opposite directions.

3.2.4 Omitting Exogenous Variables in a Two-Equation System

The fourth situation is to study both a_1 and a_2 in Eq (11) and (12). To study a_1 and a_2, each equation must exclude at least one exogenous variable if the order condition is to be satisfied. The following is an example of omitting x_1 in Eq (22) and omitting w_i in Eq (23). Similar to the previous comparison, the estimators of a_1 and a_2 are also affected by the selection of the excluded variables (see Appendix A6). Ignoring the correlation between μ_1 and μ_2 and estimating the system Eqs (22-23) using 2SLS,[36] omitting x_i in Eq (22) results in a positive $plim(\hat{a_1})$, and omitting w_i in Eq (23) results in a negative $plim(\hat{a_2})$. If w_i is omitted in Eq (22) and x_i is omitted in Eq (23), the signs of $plim(\hat{a_1})$ and $plim(\hat{a_2})$ are reversed.

$$F_i = a_1 R_i + \tau_1 w_i + \mu_{1i} \tag{22}$$

$$R_i = a_2 F_i + \kappa_2 x_i + \mu_{2i} \tag{23}$$

3.2.5 General Lessons for the Literature

The four sets of comparisons between the conventional strategies and the justified empirical strategy consistently show that the relationship between two contractual terms, as a function of the elements in the justified empirical system, is affected by the impact patterns of the omitted exogenous variables (or IVs) on contractual terms. The correlation between two contractual terms, therefore, does not reflect any causality between contractual terms. Not only is the correlation between contractual terms spurious, the correlation, captured by estimators such as $\hat{a_1}$ in Eq (18), is not interpretable without disentangling the elements in the justified empirical system.[37] The interpretation is even more ambiguous when multiple exogenous variables are omitted (or selected as IVs) because the correlation between contractual terms is a sum of positive or negative correlations with respect to each omitted variable (or IV).[38]

[36] Assuming non-trivial correlation between μ_1 and μ_2 does not affect the following argument on the impact of omitted variables on $plim(\hat{a_1})$

[37] Existing transaction-cost and agency theories cannot directly explain the dependency among multiple contract terms. (Saussier, 2000; Brickley, 1999; Lafontaine and Slade, 2013)

[38] For the same reason, the estimators of the coefficients on the exogenous variables (e.g., τ_1 in Eq (18)) are not interpretable either.

4 Data, Empirical Measurements, and Hypotheses

4.1 Data

The data comes from a survey I conducted in Jinghai County of Tianjin Municipality[39] and Feixi County of Anhui Provinces in 2014. I selected Jinghai County[40] to represent agriculture in the North China Plain, one of the most important commercial field crop production areas. I selected Feixi County, located in the middle of Anhui Province with China's north-south dividing line running through it, to represent the agricultural operations of the north and south across all three types of land terrain.[41] Randomly selecting five towns with active land rental markets in these two counties, the survey collected information on 332 land rental contracts from 13 villages (see Figure 4 for the selected locations). The survey included questions on renting-out agents' household characteristics and the degree to which they trust non-strangers vs. strangers in the context of land rental issues, renting-in agents' agricultural production plans, relationships between rental partners, bargaining processes on contractual terms, and contract details.

This data has two advantages over existing datasets on China's rural land rental transactions. First, the survey focuses on rental transactions in mature markets with comparatively homogenous rental attributes. The five selected towns in Jinghai and Feixi are between 13 and 22 miles from the nearest cities, Tianjin and Hefei,[42] respectively. As of 2014, the land rental market in both counties, embedded in comparatively perfect non-agricultural labor markets, had covered more than half of the total farmland endowment, and half of the land rented out was being cultivated by large-scale farms (Li, 2014*a*,*b*). From the perspective of market involvement and post-rental farm size, the survey reflects fast-growing mature markets facilitating large-scale farming.

Second, the survey represents each local market by applying stratified sampling based on market structure along with three-stage cluster sampling based on a three-layer administrative system: town, village, and farmer team. In each local market, all the important renting-in agents with large market shares were surveyed and the rest of the renting-in with comparatively smaller post-rental farms were randomly selected if they jointly occupied a significant proportion of land. The renting-out agents were stratified based on their renting-in partners. Each important renting-in (or group of renting-in) has a pool of renting-out partners. The renting-out were randomly selected from each pool in proportion to the corresponding renting-in's market share. This selection approach guarantees that the data represents, on average, more than 50% of land involved in each local market.

The next two subsections describe the variables used in the analysis. Table 1 gives summary statistics and the definitions of the variables.

[39] A direct-controlled municipality is equivalent to a province but with higher political and economic importance.

[40] Jinghai County is an agricultural county that belonged to Hebei Province before 1973.

[41] Anhui Province is located in the middle of China and encompasses all three types of land terrain (plains, hills, and mountains), as well as the production operations of the north (wheat) and the south (paddy rice). Anhui Province is historically the weathervane of national agricultural policies because of its representativeness of Chinese agriculture.

[42] Hefei is the province capital of Anhui Province

4.2 Empirical Measurements of Contractual Terms

Contractual flexibility is defined as the probability that a renting-out must pay the violation compensation to the renting-in if the renting-out violates the contract. Contractual flexibility is reflected by two dummy variables affecting the likelihood that a judge will declare a contractual violation: contract formality (*FORMAL*) and tenure format (*FIX-TENURE*). First, contract formality, classified as formal or informal, represents the legal enforcement of all contractual provisions including the implementation of violation compensation. A formal contact with higher enforcement is less flexible than an informal contract. Second, the tenure format, classified as fixed or non-fixed tenure, provides the basis for judging whether an ex-post action is a violation or not. Terminating a contract before the end of a specified fixed tenure is more likely to be judged as a violation than the same behavior under a contract with non-fixed tenure. Thus, a fixed-tenure contract is less flexible than the alternative.

Since it is unclear which dummy is more important in affecting contractual flexibility, I create an index of contractual flexibility (*FLEX*), giving an equal weight to each dummy.

$$FLEX = (1 - FORMAL) + (1 - FIXTENURE)$$

Contractual flexibility varies from "no flexibility" to "moderate flexibility" to "high flexibility" as *FLEX* increases from 0 to 2. Among the 332 land rental contracts, 45.58% are formal and fixed-tenure contracts with no flexibility. Among the contracts with at least one flexible term, 35.33% reach "high flexibility" and the rest are "moderately flexible" contracts (see Figure 5). Among the "moderately flexible" contracts, 74.79% are informal with fixed tenure and the rest are formal with non-fixed tenure. The mean of the rental payment (*RENTS*) per mu of land is 463.53 RMB. The average *RENTS* drops from 480.28 RMB at "no flexibility" to 475.25 RMB at "moderate flexibility" to 403.92 RMB at "high flexibility."

4.3 Hypotheses and Empirical Measurements of Explanatory Variables

Each parameter in the theoretical model is a function of several factors either directly measured or proxied in the context of China's rural land rental market. The hypotheses associated with each explanatory variable are determined by (1) the relationships between the explanatory variable and one or more corresponding parameters and (2) the comparative statics with respect to the corresponding parameters. Each explanatory variable that only affects one parameter is matched with one testable hypothesis. The explanatory variables with multiple roles are matched with multiple hypotheses that could offset each other. The impacts of the variables with multiple roles could be identified if and only if the impact through one channel dominates the impacts through other possible channels. The hypotheses of explanatory variables are listed in Table 2 and explained in the following subsections.

4.3.1 Variables for the Comparative Importance the Renting-out Places on Contractual Flexibility (b)

An increase in the comparative importance the renting-out places on contractual flexibility (b) increases contractual flexibility and decreases rental payment. The comparative importance the renting-out places on contractual flexibility increases with the renting-out's expected benefit of contract violation. The vector $\mathbf{W^o}$ contains the variables reflecting b from five factors.

First, the renting-out's expected benefit of contract violation increases in the time interval between the time of potential violation and the end of the expected tenure. A longer time interval induces a greater expected loss associated with labor misallocation, which increases the renting-out's expected benefit of contract violation. However, the measurements of expected tenure and the potential violation are not available. Land smoothing (*LDSMOOTH*) in the renting-in's production plan is a proxy for the expectation of a long tenure. *LDSMOOTH* is an investment for long-term productivity, which is more cost-efficient for the renting-in with a longer expected tenure. Hence, a longer tenure proxied by *LDSMOOTH* is associated with an increase in b.

Second, the renting-out's expected benefit of contract violation increases with the renting-out's likelihood of non-agricultural employment failure. As the probability of non-agricultural employment failure increases, the renting-out are more likely to benefit from flexible contracts. The probability of employment failure is directly measured by whether the renting-out have long-term non-agricultural employment contracts (*LONG NON-AGRI*). A long-term non-agricultural employment contract, compared to a short-term or temporary contract, reduces the renting-out's likelihood of employment failure. Therefore, *LONG NON-AGRI* is associated with a decrease in b.

Third, the renting-out's expected benefit of contract violation increases with the expected profits of household farming after contract violation. Facing unanticipated non-agricultural employment failure, an increase in the expected profits of household production motivates the renting-out to violate the contract. Because they are not directly measurable, the renting-out's household farming profits are proxied by two dummy variables. The first dummy is whether the renting-in plan to replace traditional/original crops with new crops in post-rental production (*CROP CHANGE*). The second dummy is land smoothing (*LDSMOOTH*). Both variables may lead to irreversible changes in land use, which decrease the renting-out's expected benefit of household farming after contract violation. Hence, a change in land use that decreases the renting-out's expected profits of household farming after contract violation decreases b.

Fourth, the transaction cost associated with contract violation decreases the renting-out's expected benefit of contract violation. The transaction cost borne by the renting-out is the cost not specified in the contracts, which includes but is not limited to the cost of informing the renting-in of the violation decision and arranging ex-post negotiation. The transaction cost is measured by the dummy of the renting-in's ownership of enterprises (*ENTERPRISE*). The renting-out violator experiences more difficulties in dealing with the organizational system of an enterprise. Therefore, *ENTERPRISE* is associated with a decrease in b.

Fifth, another type of cost borne by the renting-out that decreases his/her expected benefit of contract

violation is reputation cost in a social network. In a village social network, contract violation may be seen as a signal of not being trustworthy in other aspects of socio-economic life. The reputation cost is proxied by two dummy variables. The first dummy is whether the rental partners are non-strangers (*NON STRANGER*). Reputation cost is higher between non-strangers because the violation is exposed to the social network. Hence, *NON STRANGER* is associated with a decrease in b. The second dummy is the interaction between the *NON STRANGER* and aggregate village-level trust (*AGGR VILL TRUST*), where *AGGR VILL TRUST* is generated by individual trust in non-strangers in land rental issues using the leave-one-out strategy (see Table 1). Given that the renting-in is a non-stranger, an increase in aggregate village-level trust decreases the reputation cost of violation because a village with higher aggregate trust is more likely to forgive the violation rather than become suspicious of the violator. Hence, *NON STRANGER* $\times$ *AGGR VILL TRUST* is associated with an increase in b.

4.3.2 Variables for the Comparative Importance the Renting-in Places on Contractual Flexibility (k)

In contrast to the comparative statics with respect to b, an increase in the comparative importance the renting-in places on contractual flexibility (k) decreases contractual flexibility and increases rental payment. The comparative importance the renting-in places on contractual flexibility is positively affected by the renting-in's expected cost associated with the renting-out's violation.[43] The vector $\mathbf{W^{in}}$ contains the variables reflecting k from three factors.

First, an increase in the time interval between the time of potential violation and the end of the expected tenure increases the renting-in's expected cost associated with contract violation. As this time interval increases, the renting-in's expected loss in agricultural production due to losing the land of the potential violator increases. *LDSMOOTH* is the proxy of this time interval, which is associated with an increase in k.

Second, the renting-in's expected cost of contract violation increases if the probability of the renting-out's non-agricultural employment failure increases. As the violation probability increases, the renting-in is more likely to experience loss in agricultural production. *LONG NON-AGRI* measures the renting-out's probability of non-agricultural employment failure, which is associated with a decrease in k. However, as *LONG NON-AGRI* decreases both b and k, the impacts of *LONG NON-AGRI* on contractual terms through b and k are opposite to each other because the comparative statics with respect to b and k are opposite in sign. Thus, the impact of *LONG NON-AGRI* on contractual terms through k is potentially offset by its opposite impacts through b.

Third, the renting-in's expected cost of contract violation increases in the negative externality of the potential violator's land. As the negative externality from local specificity increases, the renting-in's expected loss on other pieces of land increases. Location specificity is directly measured by whether one piece of land is close to the border of adjacent land (*BORDER*). Land along the borders has lower negative externality than land in the middle because losing the land along the borders may not affect the feasibility of using

[43] An increase in the comparative importance the renting-in places on contractual flexibility k increases the renting-in's marginal cost of contractual flexibility.

mechanized farming on other pieces of land. Location specificity is also proxied by whether the renting-in plan to grow vegetables (*VEGE*). The negative externality from location specificity is lower for vegetable production than for other types of production because the greenhouses used in vegetable production are independent of each other.

4.3.3 Variables for the Renting-out's Comparative Bargaining Power (α)

An increase in the renting-out's bargaining power increases both contractual terms. The bargaining power of the renting-out (α) increases if the renting-out is more capable of dominating the renting-in and decreases if the renting-in is more capable of dominating the renting-out in the bargaining. The vector $\mathbf{X}$ contains the explanatory variables for α.

The renting-in's bargaining power is affected if the renting-in has or wishes to have business dealings with other members of the renting-out's social network. The renting-in is less capable of dominating the bargaining if negotiation failure with one renting-out leads to negotiation failure with other potential rental partners. *AGGR VILL TRUST* measures the social network among the renting-out partners. Since higher *AGGR VILL TRUST* encourages support among the renting-out, it increases the renting-in's difficulty in bargaining with multiple renting-out partners, which decreases the renting-in's bargaining power ($1-\alpha$).

The renting-out's bargaining power is affected by two overlapping systems in a village: the formal bureaucratic system and the informal social network. The renting-out's capacity to dominate the bargaining decreases if any conflicts with the renting-in induce conflicts with the village administration or the elite class[44] who have collective decision rights over land use and other aspects of socio-economic life. The impacts of the bureaucratic system and social network on α are measured by two dummy variables.

The first dummy is whether rental partners negotiated directly (without a third party) in the initial negotiation (*DIRECT COMM*). The third party is normally a villager with high social status either in the bureaucratic system or the social network. Thus, the renting-out is less capable of dominating the bargaining with *NON DIRECT COMM* because the third party is socio-economically tied to the renting-out. The second dummy is the interaction between *ENTERPRISE* and *NON STRANGER*. The renting-out is less capable of dominating the bargaining compared to other alternatives if the non-stranger renting-in owns an enterprise because this renting-in has a high possibility of being in the elite class of the village or in charge of the village administration.

4.3.4 Variables for the Threat Points ($\bar{U^m}$)

An increase in one party's threat point ($\bar{U^m}$) contributes to the likelihood that a contract is favorable to that party. The vector containing the explanatory variables for $\bar{U^m}$ is denoted as $\mathbf{Z^m}$. $\bar{U^o}$ is the renting-out's utility in household production before rentals. Traditionally, the land with the best soil quality is used for grain production (*GRAIN EX-ANTE*). Therefore, *GRAIN EX-ANTE*, associated with a comparatively higher

[44] e.g., family/relatives of members of the village administration or highly educated people.

$\bar{U^o}$, increases both contractual terms. $\bar{U^{in}}$ is the renting-in's utility in agricultural production without the land of the potential violator, which is negatively affected by the externality from location specificity. The two proxies that decrease the externality from location specificity, *BORDER* and $VEGE$, are associated with a higher $\bar{U^{in}}$, and decrease both contractual terms. Meanwhile, *GRAIN EX-ANTE* that indicates high soil quality also associates with a higher $\bar{U^{in}}$.

5 Empirical Analysis

5.1 Empirical Model

Each parameter in the theoretical model is empirically captured by a vector of exogenous explanatory variables (**X**, **W**, and **Z**). Linearizing the relationship between the variables and the corresponding parameters, the empirical model indicated by the theoretical framework is the following:

$$F_{ij} = \beta_0 + \boldsymbol{\beta_1}\mathbf{X_{ij}} + \boldsymbol{\theta_1}\mathbf{W_{ij}} + \boldsymbol{\gamma_1}\mathbf{Z_{ij}} + \mu_{f_j} + \varepsilon_{f_{ij}} \tag{24}$$

$$R_{ij} = \beta_0 + \boldsymbol{\beta_2}\mathbf{X_{ij}} + \boldsymbol{\theta_2}\mathbf{W_{ij}} + \boldsymbol{\gamma_2}\mathbf{Z_{ij}} + \mu_{r_j} + \varepsilon_{r_{ij}}. \tag{25}$$

For a contract i observed in village j, the contractual flexibility F_{ij} and rental payment R_{ij} are explained by the vectors **X**, **W** and **Z**. Eq (24) is an ordered probit model because F_{ij} is discretely measured by the number of flexible contract terms varying from 0 to 2. Eq (25) is linear with R_{ij}, the log of *RENTS*. There are two components in each error term: a village fixed effect (μ_{f_j} or μ_{r_j}) and a normally distributed error ($\varepsilon_{f_{ij}}$ or $\varepsilon_{r_{ij}}$) varied across contracts. The distribution of $\varepsilon_{f_{ij}}$ and $\varepsilon_{r_{ij}}$, $\binom{\varepsilon_{f_{ij}}}{\varepsilon_{r_{ij}}} = \mathcal{N}(\binom{0}{0}, \Sigma)$. The estimation methods depend on the assumptions on $corr(\varepsilon_{f_{ij}}, \varepsilon_{f_{kj}})$, $corr(\varepsilon_{r_{ij}}, \varepsilon_{r_{kj}})$, and $corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}})$, which characterize the covariance matrix Σ.[45]

$corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}})$ is a simultaneous correlation. The assumption on $corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}})$ determines whether the unobserved error term of one contractual term is correlated with the unobserved error term of the other contractual term within a single contract. If $corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}}) = 0$, a system estimation of Eqs (24) and (25) using full information maximum likelihood (FIML) is reduced to a separated maximum likelihood estimation of each equation. If $corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}}) \neq 0$, the empirical model should be estimated by FIML. The FIML estimation of a simultaneous-equation system with an ordered probit model (Eqs (24)) and a linear model (Eq (25)) is implemented by the Stata command *cmp*. With flexibility in model types and allowing mixing of models,[46] the Stata command *cmp* provides consistent SUR estimations for a large class of fully observed, recursive, and mix-process simultaneous-equation systems (Roodman, 2011).

$corr(\varepsilon_{f_{ij}}, \varepsilon_{f_{kj}})$ and $corr(\varepsilon_{r_{ij}}, \varepsilon_{r_{kj}})$ are cross-contract correlations within a village. The assumptions on

[45] I assume that there is no cross-village correlation on contractual terms: $corr(\varepsilon_{f_{ij}}, \varepsilon_{f_{km}}) = corr(\varepsilon_{r_{ij}}, \varepsilon_{r_{km}}) = corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{km}}) = 0$.

[46] Each model is conditional on observation of one dependent variable. A model could be continuous, left/right censored, profit, ordered probit, interval-censored, truncated, or rank-ordered probit. A simultaneous-equation system allows mixing of these models.

$corr(\varepsilon_{f_{ij}}, \varepsilon_{f_{kj}})$ and $corr(\varepsilon_{r_{ij}}, \varepsilon_{r_{kj}})$ depend on whether the unobserved error term of each contractual term is correlated across contracts within a village. I assume that the assumption on $corr(\varepsilon_{f_{ij}}, \varepsilon_{f_{kj}})$ applies to $corr(\varepsilon_{r_{ij}}, \varepsilon_{r_{kj}})$. If $corr(\varepsilon_{f_{ij}}, \varepsilon_{f_{kj}}) \neq 0$, the standard errors of the coefficients should be clustered at the village level. If $corr(\varepsilon_{f_{ij}}, \varepsilon_{f_{kj}}) = 0$, the standard errors could be made robust by the Huber-Eicker-White estimator.

5.2 Empirical Results

Table 3 shows the empirical results under the four possible combinations of assumptions on the covariance matrix Σ. The clustered robust standard errors are greater than the robust standard errors, which suggests a positive cross-contract correlation within a village between $\varepsilon_{f_{ij}}$ and $\varepsilon_{f_{kj}}$ (also $\varepsilon_{r_{ij}}$ and $\varepsilon_{r_{kj}}$). However, although clustered robust standard errors decrease the significance levels of some coefficients, only two coefficients that are significant with the robust standard errors become insignificant at the 10% significance level with the clustered robust standard errors.

Comparing the FIML and separated ML estimation, the coefficients and standard errors are close because the simultaneous correlations with and without clustering are small in magnitude and insignificant both at -0.031. If Eqs (24) and (25) omit the same set of variables that could significantly affect both contractual terms, the $corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}})$ should be significantly different from zero. Hence, a small and insignificant $corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}})$ indicates that this empirical setting does not omit any variables that significantly affect both contractual terms. Since the empirical results across the four possible combinations of assumptions are quite similar, I focus on the empirical results derived from the separated ML estimation.

Tables 4 and 5 present the results of separated ML estimations with robust and clustered robust standard errors respectively. Tables 4 and 5 show that the predictions of the bargaining mechanism are corroborated empirically. Except for two insignificant coefficients at small magnitudes, the signs of all the coefficients are consistent with the corresponding signs predicted by the theory. All the coefficients significant at or below the 10% level further confirm the theoretical predictions. I comment on all pairs of coefficients that are significant in both Eqs (24) and (25) with at least one type of specification.

The variable *LONG NON-AGRI* affects the two contractual terms through two possible channels: the comparative importance the renting-in and renting-out place on contractual flexibility (b and k). However, as the theory predicts, the impacts through the two channels offset each other. The coefficient on *LONG NON-AGRI* is significantly negative in the regression of F_{ij} and significantly positive in the regression of R_{ij}, indicating that the impact of *LONG NON-AGRI* through b outweighs its impact through k. Compared to a short-term or temporary non-agricultural employment contract, *LONG NON-AGRI* increases the probability of having a contract with no flexibility by 0.11 and decreases the probability of having a contract with moderate or high flexibility by 0.03 and 0.08, respectively. *LONG NON-AGRI* increases the rental payment by 7.86%.

Renting-out agents with *LONG NON-AGRI* are more likely than renting-out agents with short-term or temporary non-agricultural employment contracts to be skilled workers with higher incomes. In the rural land rental market, the comparatively richer renting-out agents with *LONG NON-AGRI* obtain higher

rental payments because contractual flexibility is less important to the renting-out with low employment uncertainty. Thus, I conclude that, with heterogeneity in non-agricultural employment uncertainty, the rural land rental market could make the village-level income distribution more unequal.

The coefficients on *NON STRANGER* and *ENTERPRISE* and their interaction show the impact of the renting-in's identity on contract design. The coefficients on *NON STRANGER* and *ENTERPRISE* are negative in the regression of F_{ij} and positive in the regression of R_{ij}. The coefficients on *NON STRANGER* $\times$ *ENTERPRISE* are negative in the regressions of F_{ij} and R_{ij}. Among the four possible identities of the renting-in characterized by *NON STRANGER* and *ENTERPRISE*, a stranger renting-in agent who does not own enterprises (*STRANGER+INDIVIDUAL*) is taken as the baseline in the following comparisons. Table 6 shows the impacts of the renting-in's identity on contractual design.

Compared to the baseline, the *STRANGER+ENTERPRISE* identity increases the probability of having no flexibility by 0.01, decreases the probability of having moderate flexibility and high flexibility by 0.01 and 0.10 respectively and increases the rental payment by 52.30%. The *NON STRANGER+INDIVIDUAL* identity increases the probability of having no flexibility by 0.11, decreases the probability of having moderate or high flexibility by 0.03 and 0.04, respectively, and increases the rental payment by 49.9%. The *NON STRANGER+ENTERPRISE* identity increases the probability of having no flexibility by 0.37, decrease the probability of having moderate or high flexibility by 0.14 and 0.22, respectively, and increases the rental payment by 63.7%.

Agricultural development in post-rental production relies on secure land rental contracts with low flexibility because secure rental contracts encourage the renting-in's investment in long-term soil conservation, technology adoption, and production facilities. Higher rents paid to the renting-out agents in a village increase the average village income, which improves the overall welfare of the village. Hence, the rental contracts with low flexibility and high rental payment are beneficial for agricultural development and village prosperity.

With this argument in mind, Table 6 suggests two progressive conclusions related to village development. First, regardless of *ENTERPRISE*, the contracts with non-strangers are less flexible and have higher rental payments than those with strangers. The non-stranger renting-in are the villagers "who got rich first" (Deng, 1978)[47] with higher capacity in production and business operations. Through the rural land rental market, the more capable non-stranger renting-in agents improve village agricultural productivity and increase the village average income, which according to Deng (1978) could finally achieve village prosperity. Thus, the *NON STRANGER* renting-in agents, reflecting the human capital within a village social network accumulated during the past 30 years of economic reform, profoundly shape village development in the present and future.

[47] In Xiaoping Deng's remarks to the CPC (Communist Party of China) Central Committee at the Central Work Conference in 1978, he stated that if some people got rich first, this would inevitably be an impressive example to their "neighbors" and an impressive support to their "neighbors," which would finally promote village prosperity. This statement was emphasized again in the report of the 1984 Third Plenary Session of the Twelfth Central Committee ("Decisions on National Economic Reforms") and Xiaoping Deng's remarks to the 1985 CPC national congress.

Second, the *NON STRANGER+ENTERPRISE* identity offers the highest rental payment at the lowest flexibility among the four types of the renting-in. Compared to contracts with the *NON STRANGER +INDIVIDUAL*, contracts with the *NON STRANGER+ENTERPRISE* are 35.8 percentage points more likely to be inflexible and 12.9 and 32.1 percentage points less likely to be moderately or highly flexible. Contracts with NON STRANGER+ENTERPRISE also feature 27.7% higher rental payments than those with *NON STRANGER+INDIVIDUAL*. The *NON STRANGER+ENTERPRISE*–who are very likely in the elite class of the village–are potentially richer than the *NON STRANGER +INDIVIDUAL* and have more market experience and more resources in and outside of the village. Hence, the more advanced a non-stranger renting-in is, the more important the role he/she plays in promoting agricultural development and village prosperity, indicating that local entrepreneurship positively affects the agricultural development and prosperity of the village.

The conclusions from the empirical results reveal the relationship between the rural land rental market and the national economic reforms. On the one hand, the villagers who got richer first are organizing more productive farming through the rural land rental market in their hometowns and are promoting village prosperity among their fellow villagers. Thus, the rural land rental market increases the spillover effects of the economic achievements gained from the national reform that started in the late 1970s. On the other hand, due to the separated urban-rural social structure, the rural land rental market potentially increases income inequality among the renting-out, which will influence the direction of the ongoing reform in unifying the urban and rural economies.

Some variables have significant coefficients in the regression of F_{ij} but not in the regression of R_{ij}. This is potentially related to the fact that the village fixed effects reduce the variation of rental payments within a village. However, these variables also reflect the bargaining mechanism. *DIRECT COMM* decreases the probability of having a contract with no flexibility by 0.16, increases the probability of having a contract with moderate or high flexibility by 0.05 and 0.11, respectively. *GRAIN EX-ANTE* decreases the probability of having a contract with no flexibility by 0.20 and increases the probability of having a contract with moderate or high flexibility by 0.06 and 0.14, respectively.

6 Conclusion

The ex-post surplus of a rental transaction is determined by bargaining over contractual flexibility and rental payment. Contractual flexibility captures the trade-off between the renting-in and renting-out's conflicting preferences over the primary uncertainty in ex-post contractual adaptation. The rental payment captures the trade-off in the value of land use right. A rental contract characterized by these two contractual terms is an ex-ante response to the allocation of ex-post surplus. The empirical model justified by the bargaining model clarifies that the correlation between two contractual terms in the empirical literature of contract design does not reflect causality. The estimated correlation is affected by the omitted exogenous variables or the selection of "plausible IVs" in the conventional empirical strategies, which explains the seemingly

inconsistent empirical results in the existing literature.

The empirical results of the variables with multiple roles shed light on future research applying transaction-cost theory. In the setting of transaction-cost theory, the variable *LONG NON-AGRI*, which indicates a less uncertain environment, is expected to reduce contractual flexibility. However, a negative coefficient on *LONG NON-AGRI*, although it supports the transaction-cost theory, is not a direct application of the theory. If two parties respond asymmetrically to one type of uncertainty, the coefficient on uncertainty would be significant if and only if the two parties' offsetting responses to uncertainty are not closely matched. The sign of the coefficient is determined by the side responding more strongly to the uncertainty in magnitude, which potentially explains the empirical contradiction between Levy (1985) and MacMillan, Hambrick and Pennings (1986) on one side and Harrigan (1986) on the other on the effects of uncertainty on integration.

I draw two policy implications from the empirical results. First, the non-stranger renting-in agents pay higher rents to their fellow villagers and obtain less flexible contracts, which is beneficial for post-rental productivity and village prosperity. Thus, policies encouraging local agricultural entrepreneurship and facilitating the production and business operation of the non-stranger renting-in can improve agricultural production and overall welfare at the village level. Second, the potentially increasing income inequality among the renting-out agents is a consequence of the heterogeneity in non-agricultural employment uncertainty. Unifying the separated urban and rural economies by involving rural citizens in the urban social welfare system can tackle this problem fundamentally. These two policy implications have the potential to amplify the impact of the rural land rental market on village development and avoid future income inequality.

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Appendix

A1: Solution of the Nash Bargaining Game

$$\max_{F,R}(F^bR^{1-b}-\bar{U^o})^\alpha(A-kF-(1-k)R-\bar{U^{in}})^{1-\alpha}$$

The first-order conditions for interior solutions as follows:

$$\alpha b(\frac{A-kF-(1-k)R-\bar{U^{in}}}{F^bR^{1-b}-\bar{U^o}})^{1-\alpha}(\frac{R}{F})^{1-b}-(1-\alpha)k(\frac{A-kF-(1-k)R-\bar{U^{in}}}{F^bR^{1-b}-\bar{U^o}})^{-\alpha}=0$$

$$\alpha(1-b)(\frac{A-kF-(1-k)R-\bar{U^{in}}}{F^bR^{1-b}-\bar{U^o}})^{1-\alpha}(\frac{R}{F})^{-b}-(1-\alpha)(1-k)(\frac{A-kF-(1-k)R-\bar{U^{in}}}{F^bR^{1-b}-\bar{U^o}})^{-\alpha}=0$$

By dividing both equations by $(\frac{A-kF-(1-k)R-\bar{U^{in}}}{F^bR^{1-b}-\bar{U^o}})^{-\alpha}$. The first-order conditions are rearranged as follows:

$$\alpha b(\frac{A-kF-(1-k)R-\bar{U^{in}}}{F^bR^{1-b}-\bar{U^o}})(\frac{R}{F})^{1-b}-(1-\alpha)k=0 \tag{26}$$

$$\alpha(1-b)(\frac{A-kF-(1-k)R-\bar{U^{in}}}{F^bR^{-b}-\bar{U^o}})(\frac{R}{F})^{-b}-(1-\alpha)(1-k)=0 \tag{27}$$

From Eqs (26) and (27), $F=\frac{(1-k)b}{k(1-b)}R$. Plugging in $F=\frac{(1-k)b}{k(1-b)}R$ back to Eqs (26) and (27), the interior F^* and R^* are found.

$$F^*=\frac{\alpha(A-\bar{U^{in}})b}{k}+(1-\alpha)(\frac{k(1-b)}{(1-k)b})^{b-1}\bar{U^o} \tag{28}$$

$$R^*=\frac{\alpha(A-\bar{U^{in}})(1-b)}{1-k}+(1-\alpha)(\frac{k(1-b)}{(1-k)b})^{b}\bar{U^o} \tag{29}$$

A2: $\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}=\frac{|U_{i^*}^{in}|}{|U_{i^*}^{o}|}$

Marginal utility of each contractual term in each individual utility function (U_i^{in}):

$$\frac{\partial U^{in}}{\partial F}=-k<0$$

$$\frac{\partial U^{in}}{\partial R}=-(1-k)<0$$

$$\frac{\partial U^{o}}{\partial F}=b(\frac{R}{F})^{1-b}>0$$

$$\frac{\partial U^{o}}{\partial R}=(1-b)(\frac{R}{F})^{-b}>0$$

The ratio of the absolute value of U_i^m between a pair of rental partners at F^* and R^*:

$$\frac{|\frac{\partial U^{in}}{\partial F}|}{|\frac{\partial U^o}{\partial F}|}|_{F=F^*,R=R^*} = \frac{k}{b}(\frac{R^*}{F^*})^{b-1}$$

$$\frac{|\frac{\partial U^{in}}{\partial R}|}{|\frac{\partial U^o}{\partial R}|}|_{F=F^*,R=R^*} = \frac{1-k}{1-b}(\frac{R^*}{F^*})^{b}$$

Since $F^* = \frac{(1-k)b}{k(1-b)}R^*$ at the optimal (see Appendix A1)

$$\frac{|\frac{\partial U^{in}}{\partial F}|}{|\frac{\partial U^o}{\partial F}|}|_{F=F^*,R=R^*} = \frac{k}{b}(\frac{(1-k)b}{k(1-b)})^{1-b} = \frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}$$

$$\frac{|\frac{\partial U^{in}}{\partial R}|}{|\frac{\partial U^o}{\partial R}|}|_{F=F^*,R=R^*} = \frac{1-k}{1-b}(\frac{(1-k)b}{k(1-b)})^{-b} = \frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}$$

I denote $\frac{|\frac{\partial U^m}{\partial i}|}{|\frac{\partial U^n}{\partial i}|}|_{F=F^*,R=R^*}$ as $\frac{|U_{i^*}^m|}{|U_{i^*}^n|}$, where $m = \{in, o\}$ and $i = \{F, R\}$. Hence $\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}} = \frac{|U_{i^*}^{in}|}{|U_{i^*}^o|}$.

A3: F^* and R^* are finite interior solutions

Based on Eqs (3) and (4), F^* and R^* could be infinite if at least one of the following two situations happens: (1) $\frac{b}{k} = \infty$ or $\frac{1-b}{1-k} = \infty$ or (2) $\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}} = \infty$.

(1) $\frac{b}{k} = \infty$ **or** $\frac{1-b}{1-k} = \infty$: If $k \in \{0,1\}$ and $b \in \{0,1\}$, at least one of F^* and R^* is equal to infinity.

(2) $\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}} = \infty$: If $b \in \{0,1\}$, F^* and R^* could equal to infinity.

Thus, to have a finite interior solution, $b \notin \{0,1\}$ and $k \notin \{b,k\}$.

A4: ASSUMPTION 1: $U^m(F^*,R^*) - \bar{U^m} > 0$ if and only if $\frac{A-\bar{U^{in}}}{|U_{i^*}^{in}|} > \frac{\bar{U^o}}{|U_{i^*}^o|}$

The interior solutions achieve the optimality if $A - kF - (1-k)R - \bar{U^{in}} > 0$ and $F^bR^{1-b} - \bar{U^o} > 0$.

The renting-out's Part

$$U^o(F^*,R^*) - \bar{U^o} = \alpha(A - \bar{U^{in}})\frac{b^b(1-b)^{1-b}}{k^b(1-k)^{1-b}} + (1-\alpha)\bar{U^o} - \bar{U^o}$$

$$U^o(F^*,R^*) - \bar{U^o} = \alpha[(A - \bar{U^{in}})\frac{b^b(1-b)^{1-b}}{k^b(1-k)^{1-b}} - \bar{U^o}]$$

Recall from Appendix A2 that $\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}} = \frac{|U_{F^*}^{in}|}{|U_{F^*}^o|} = \frac{|U_{R^*}^{in}|}{|U_{R^*}^o|}$.

Hence, $U^o(F^*,R^*) - \bar{U^o} > 0$ if and only if $(A - \bar{U^{in}})\frac{b^b(1-b)^{1-b}}{k^b(1-k)^{1-b}} - \bar{U^o} > 0$, which is equivalent to $\frac{A-\bar{U^{in}}}{|U^{in}_{i^*}|} > \frac{\bar{U^o}}{|U^o_{i^*}|}$.

The renting-in's Part

$$U^{in}(F^*,R^*) - \bar{U^{in}} = A - [\alpha(A-\bar{U^{in}}) + (1-\alpha)\bar{U^o}\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}] - \bar{U^{in}}$$

$$U^{in}(F^*,R^*) - \bar{U^{in}} = (1-\alpha)[A - \bar{U^{in}} - \bar{U^o}\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}}]$$

Hence, $U^{in}(F^*,R^*) - \bar{U^{in}} > 0$ if and only if $A - \bar{U^{in}} - \bar{U^o}\frac{k^b(1-k)^{1-b}}{b^b(1-b)^{1-b}} > 0$, which is equivalent to $\frac{A-\bar{U^{in}}}{|U^{in}_{i^*}|} > \frac{\bar{U^o}}{|U^o_{i^*}|}$.

Therefore, there exists non-trivial F and R that maximize the joint utility of the renting-in and renting-out if $\frac{A-\bar{U^{in}}}{|U^{in}_{i^*}|} > \frac{\bar{U^o}}{|U^o_{i^*}|}$. To satisfy ASSUMPTION 1, $\frac{|U^o_{i^*}|}{|U^{in}_{i^*}|} \neq 0$, which is equivalent to $b \notin \{0,1\}$.

A5: Direct and Indirect Impacts of b and k and Assumption 3

Direct and Indirect Impacts of b and k

Recall that $U^{in} = A - kF - (1-k)R$ and $U^o = F^b R^{1-b}$. At the interior contract, $F^* = \frac{(1-k)b}{k(1-b)}R^*$. Hence,

$$\frac{\partial U^{in}}{\partial F}|_{F=F^*,R=R^*} = -k < 0$$

$$\frac{\partial U^{in}}{\partial R}|_{F=F^*,R=R^*} = -(1-k) < 0$$

$$\frac{\partial U^o}{\partial F}|_{F=F^*,R=R^*} = b(\frac{R^*}{F^*})^{1-b} = b(\frac{(1-b)k}{b(1-k)})^{1-b} > 0$$

$$\frac{\partial U^o}{\partial R}|_{F=F^*,R=R^*} = (1-b)(\frac{R^*}{F^*})^{-b} = (1-b)(\frac{(1-b)k}{b(1-k)})^{-b} > 0$$

The direct impacts of b and k on b/k and $(1-b)/(1-k)$ are clear in signs.

$$\frac{\partial(\frac{b}{k})}{\partial k} = -\frac{b}{k^2} < 0$$

$$\frac{\partial(\frac{b}{k})}{\partial b} = k > 0$$

$$\frac{\partial(\frac{1-b}{1-k})}{\partial k} = \frac{1-b}{(1-k)^2} > 0$$

$$\frac{\partial(\frac{1-b}{1-k})}{\partial b} = -\frac{1}{1-k} < 0$$

The indirect impacts of k are the following:

$$\frac{\partial(\frac{b}{k}\frac{|\frac{\partial U^{in}}{\partial F}|_{F=F^*,R=R^*|}}{|\frac{\partial U^{o}}{\partial F}|_{F=F^*,R=R^*|}})}{\partial k} = -\frac{(1-b)k^b}{b(1-k)}\frac{b}{k^2} < 0$$

$$\frac{\partial(\frac{1-b}{1-k}\frac{|\frac{\partial U^{in}}{\partial R}|_{F=F^*,R=R^*|}}{|\frac{\partial U^{o}}{\partial R}|_{F=F^*,R=R^*|}})}{\partial k} = -\frac{(1-b)k^b}{b(1-k)}\frac{b}{k-k^2} > 0$$

Thus, the signs of the direct and indirect impacts of k are the same. No further assumptions are required for the comparative statics.

The indirect impacts of b are the following:

$$\frac{\partial(\frac{b}{k}\frac{|\frac{\partial U^{in}}{\partial F}|_{F=F^*,R=R^*|}}{|\frac{\partial U^{o}}{\partial F}|_{F=F^*,R=R^*|}})}{\partial b} = \frac{1}{b}\frac{(1-b)k^{b-1}}{b(1-k)}(1+b\ln\frac{k(1-b)}{b(1-k)}) \lesseqgtr 0$$

$$\frac{\partial(\frac{1-b}{1-k}\frac{|\frac{\partial U^{in}}{\partial R}|_{F=F^*,R=R^*|}}{|\frac{\partial U^{o}}{\partial R}|_{F=F^*,R=R^*|}})}{\partial b} = -\frac{1}{1-b}\frac{(1-b)k^b}{b(1-k)}(1+(b-1)\ln\frac{k(1-b)}{b(1-k)}) \lesseqgtr 0$$

Thus, the signs of the direct and indirect impacts of b could be different. Further assumptions are required for the comparative statics.

Assumption 3

Since the direct impact of b on F^* is positive and the indirect impact of b on R^* is negative, the indirect impacts of b on F^* and R^* follow the same sign if $1+b\ln\frac{k(1-b)}{b(1-k)} \geq 0$ and $1+(b-1)\ln\frac{k(1-b)}{b(1-k)} \leq 0$, which are *Conditions 1 and 2* of Assumption 3.

To satisfy *Condition 1*, as k increases from 0 to 1, the correspondingly ruled out range $[\underline{b},1]$ decreases as the lowest b ($\underline{b}$) ruled out increases, which is the shaded area at the northwest corner of Figure 1. To satisfy *Condition 2*, as k increases from 0 to 1, the correspondingly ruled out range $[0,\bar{b}]$ increases as the highest b ($\bar{b}$) ruled out increases, which is the shaded area at the southeast corner of Figure 1. Figure 1 shows that the combinations of b and k satisfying ASSUMPTIONS 3 are comparatively small in $|b-k|$. Since smaller $|b-k|$ indicates a stronger conflict on each contractual term, the intuition of ASSUMPTIONS 3 is that the direct impact of b is more likely to dominate the comparative statics with respect to b if there is an intensified conflict between rental partners.

Appendix A6: Econometrics Exercise

The empirical models suggested by the theoretical model are the following:

$$F_i = \beta_1 x_i + \theta_1 w_i + \varepsilon_{1i} \tag{30}$$

$$R = \beta_2 x_i + \theta_2 w_i + \varepsilon_{2i} \tag{31}$$

Regress Eqs 30 and 31 separately. The estimators are the following:

$$\hat{\beta}_1 = \frac{\sum w_i^2 \sum x_i F_i - \sum x_i w_i \sum w_i F_i}{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2} \tag{32}$$

$$\hat{\theta}_1 = \frac{\sum x_i^2 \sum w_i F_i - \sum x_i w_i \sum x_i F_i}{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2} \tag{33}$$

$$\hat{\beta}_2 = \frac{\sum w_i^2 \sum x_i R_i - \sum x_i w_i \sum w_i R_i}{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2} \tag{34}$$

$$\hat{\theta}_2 = \frac{\sum x_i^2 \sum w_i R_i - \sum x_i w_i \sum x_i R_i}{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2} \tag{35}$$

No Omitted Exogenous Variables (OLS)

The conventional strategy with no omitted variables is the following:

$$F_i = a_1 R_i + \kappa_1 x_i + \tau_1 w_i + \mu_{1i}$$

I define $K = \begin{bmatrix} R & x & w \end{bmatrix}$. Then $\begin{bmatrix} a_1 \\ \kappa_1 \\ \tau_1 \end{bmatrix} = (K'K)^{-1} K'F$.

Hence, taking $\hat{a_1}$ as an example,

$$\begin{aligned} \hat{a_1} = \frac{1}{det(K'K)} &(\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2) \sum R_i F_i \\ &- (\sum R_i x_i \sum w_i^2 - \sum R_i w_i \sum x_i w_i) \sum x_i F_i \\ &+ (\sum R_i x_i \sum x_i w_i - \sum x_i^2 \sum R_i w_i) \sum w_i F_i \end{aligned}$$

Replacing R_i by $\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}$,

$$plim(\hat{a_1}) = 0$$

Going through similar calculations, the *plim* of κ_1 and τ_1 are the following:

$$plim(\hat{\kappa_1}) = \beta_1; plim(\hat{\tau_1}) = \theta_1$$

Omitting Exogenous Explanatory Variables in One Single Equation (OLS)

The conventional strategy includes R_i but omitting x_i.

$$F_i = a_1 R_i + \tau_1 w_i + \mu_i$$

Hence, the estimated a_1 and τ_1 are the following:

$$\hat{a_1} = \frac{\sum w_i^2 \sum R_i F_i - \sum R_i w_i \sum w_i F_i}{\sum R_i^2 \sum w_i^2 - (\sum R_i w_i)^2} \tag{36}$$

$$\hat{\tau_1} = \frac{R_i^2 \sum w_i F_i - \sum R_i w_i \sum R_i F_i}{\sum R_i^2 \sum w_i^2 - (\sum R_i w_i)^2} \tag{37}$$

Replacing R_i by $\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}$, Eqs 36 and 37 are rearranged as the following:

$$\hat{a_1} = \frac{\sum w_i^2 \sum F_i(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}) - \sum w_i(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}) \sum w_i F_i}{\sum(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i})^2 \sum w_i^2 - [\sum(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}) w_i]^2}$$

$$\hat{\tau_1} = \frac{\sum(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i})^2 \sum w_i F_i - \sum(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}) w_i \sum(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}) F_i}{\sum(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i})^2 \sum w_i^2 - [\sum(\beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}) w_i]^2}$$

Based on Eqs (30) and (31), I substitute $\sum w_i^2 \sum x_i F_i - \sum x_i w_i \sum w_i F_i$ by $\hat{\beta}_1 \{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2\}$ and substitute $\sum x_i^2 \sum w_i F_i - \sum x_i w_i \sum x_i F_i$ by $\hat{\theta}_1 \{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2\}$. Thus,

$$plim(\hat{a_1}) = plim\{\frac{\beta_2 \hat{\beta}_1 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\beta_2^2 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}\} + plim\{\sum \varepsilon_{2i}^2 \sum w_i^2\}$$

$$plim(\hat{\tau_1}) = plim\{\frac{\beta_2 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2](\beta_2 \hat{\theta}_1 - \theta_2 \hat{\beta}_1) + \hat{\beta}_1 \sum \varepsilon_{2i}^2 \sum w_i x_i + \hat{\theta}_1 \sum \varepsilon_{2i}^2 \sum w_i^2}{\beta_2^2 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \varepsilon_{2i}^2 \sum w_i^2}\}$$

The unbiasedness of OLS estimations of Eqs (30) and (31) ensures that

$$plim(\hat{\beta}_1) = \beta_1; plim(\hat{\beta}_2) = \beta_2$$

$$plim(\hat{\theta}_1) = \theta_1; plim(\hat{\theta}_2) = \theta_2$$

Thus, $plim(\hat{a_1})$ and $plim(\hat{\tau_1})$ are as follows:

$$plim(\hat{a_1}) = plim\{\frac{\beta_2 \beta_1 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\beta_2^2 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \varepsilon_{2i}^2 \sum w_i^2}\}$$

$$plim(\hat{\tau_1}) = plim\{\frac{\beta_2 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2](\beta_2 \theta_1 - \theta_2 \beta_1) + \beta_1 \sum \varepsilon_{2i}^2 \sum w_i x_i + \theta_1 \sum \varepsilon_{2i}^2 \sum w_i^2}{\beta_2^2 [\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \varepsilon_{2i}^2 \sum w_i^2}\}$$

If $F_i = a_1 R_i + \kappa_1 x_i + \mu_i$, then

$$plim(\hat{a_1}) = plim\{\frac{\theta_2\theta_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\theta_2^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \varepsilon_{2i}^2 \sum x_i^2}\}$$

Omitting Exogenous Explanatory Variables in One Single Equation (IV)

The conventional strategy of instrumenting R_i by x_i.

$$F_i = a_1 R_i + \tau_1 w_i + \mu_i$$

$$R_i = \beta_2 x_i + \theta_2 w_i + \varepsilon_{2i}$$

Regressing the above two equations in 2SLS is equivalent to replacing the estimated $\hat{R^i}$ in the first equation. Thus, the 2SLS estimator of a_1 and τ_1 are the following:

$$\hat{a_1} = \frac{\sum w_i^2 \sum \hat{R}_i F_i - \sum \hat{R}_i w_i \sum w_i F_i}{\sum \hat{R_i}^2 \sum w_i^2 - (\sum \hat{R}_i w_i)^2} \tag{38}$$

$$\hat{\tau_1} = \frac{\sum \hat{R_i}^2 \sum w_i F_i - \sum \hat{R}_i w_i \sum \hat{R}_i F_i}{\sum \hat{R_i}^2 \sum w_i^2 - (\sum \hat{R}_i w_i)^2} \tag{39}$$

Replacing $\hat{R}_i$ by $\hat{\beta}_2 x_i + \hat{\theta}_2 w_i$, Eqs 38 and 39 are rearranged as following:

$$\hat{a_1} = \frac{\sum w_i^2 \sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i) F_i - \sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i) w_i \sum w_i F_i}{\sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i)^2 \sum w_i^2 - [\sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i) w_i]^2}$$

$$\hat{\tau_1} = \frac{\sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i)^2 \sum w_i F_i - \sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i) w_i \sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i) F_i}{\sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i)^2 \sum w_i^2 - [\sum (\hat{\beta}_2 x_i + \hat{\theta}_2 w_i) w_i]^2}$$

Based on Eqs 3 and 4, I substitute $\sum w_i^2 \sum x_i F_i - \sum x_i w_i \sum w_i F_i$ by $\hat{\beta}_1\{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2\}$ and substitute $\sum x_i^2 \sum w_i F_i - \sum x_i w_i \sum x_i F_i$ by $\hat{\theta}_1\{\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2\}$. Thus,

$$plim(\hat{a_1}) = plim\{\frac{\hat{\beta}_2\hat{\beta}_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\hat{\beta}_2^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}\} = \frac{\beta_1}{\beta_2}$$

$$plim(\hat{\tau_1}) = plim\{\frac{\hat{\beta}_2(\hat{\beta}_2\hat{\theta}_1 - \hat{\beta}_1\hat{\theta}_2)[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\hat{\beta}_2^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}\} = \frac{\beta_2\theta_1 - \beta_1\theta_2}{\beta_2}$$

Omitting Exogenous Explanatory Variables in a Two-Equation System

The conventional strategy with two equations:

$$F_i = \alpha_1 R_i + \tau_1 w_i + \mu_{1i}$$

$$R_i = \alpha_2 F_i + \kappa_2 x_i + \mu_{2i}$$

Taking the regression of F_i as an example, the coefficient matrix estimated by 2SLS $\Psi_F = (\hat{K}'\hat{K})^{-1}\hat{K}'F_i$, where $\hat{K} = \begin{bmatrix} w & x \end{bmatrix} (\begin{bmatrix} w & x \end{bmatrix}' \begin{bmatrix} w & x \end{bmatrix})^{-1} \begin{bmatrix} w & x \end{bmatrix}' \begin{bmatrix} w & R \end{bmatrix}$.

By replacing R_i by $\hat{\beta}_2 x_i + \hat{\theta}_2 w_i + \varepsilon_{2i}$, $\hat{K} = \begin{bmatrix} w & x\hat{\beta}_2 + w\hat{\theta}_2 + \nu_F \end{bmatrix}$,
where $\nu_{Fi} = \dfrac{x_i \sum w_i^2 \sum x_i \varepsilon_{1i} - w_i \sum x_i w_i \sum x_i \varepsilon_{1i} - x_i \sum x_i w_i \sum w_i \varepsilon_{2i} + w_i \sum x_i^2 \sum w_i \varepsilon_{2i}}{\sum w_i^2 \sum x_i^2 - (\sum x_i w_i)^2}$.

Hence, $plim(\hat{a_1})$ is similar to the estimator of a_1 in the OLS estimator in one single equation but replacing the error term ε_1 by ν_F.

$$plim(\hat{a_1}) = plim\{\frac{\beta_2\beta_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\beta_2^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \nu_{Fi}^2 \sum w_i^2}\} > 0$$

Going through a similar calculation,

$$plim(\hat{a_2}) = plim\{\frac{\theta_2\theta_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\theta_1^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \nu_{Fi}^2 \sum x_i^2}\} < 0$$

If the system is changed to the following, the signs of $plim(\hat{a_1})$ and $plim(\hat{a_2})$ reverse.

$$F_i = \alpha_1 R_i + \kappa_1 x_i + \mu_{1i}$$

$$R_i = \alpha_2 F_i + \tau_2 w_i + \mu_{2i}$$

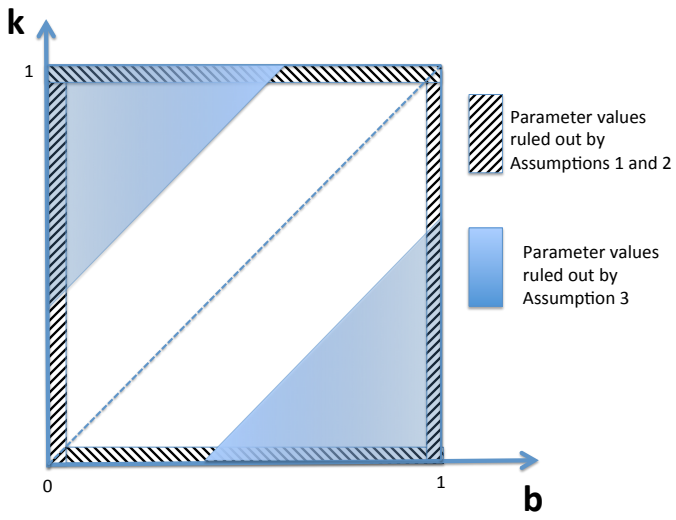
$$plim(\hat{a_1}) = plim\{\frac{\theta_2\theta_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\theta_2^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \nu_{Fi}^2 \sum x_i^2}\} < 0$$

$$plim(\hat{a_2}) = plim\{\frac{\beta_2\beta_1[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2]}{\beta_1^2[\sum x_i^2 \sum w_i^2 - (\sum x_i w_i)^2] + \sum \nu_{Fi}^2 \sum w_i^2}\} > 0$$

Table 1: Summary Statistics

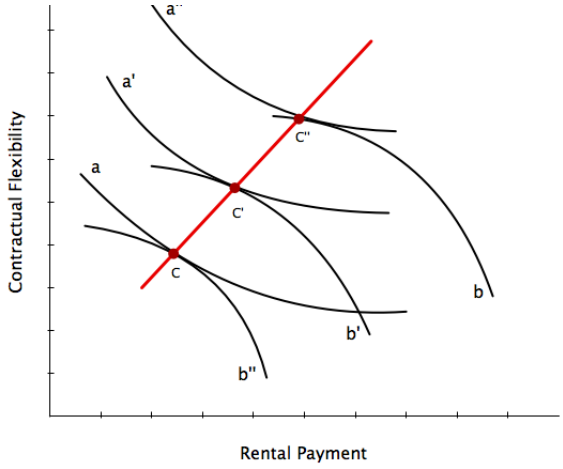
Variables	Definition	Mean	SD
Contractual Terms			
FORMAL	Contractual formality (1=Formal Contract, 0=Informal Contract)	0.536	0.499
FIX TENURE	Tenure format (1=Fixed Tenure, 0=Non-fixed Tenure)	0.714	0.453
RENTS	Rental payment per mu (RMB)	463.53	180.23
Renting-out's Characteristics			
BORDER	Renting-out's household farmland close to the border of an adjacent piece of land (1=Close, 0=Not Close)	0.494	0.501
LONG NON-AGRI	The renting-out has a long-term agricultural employment contract (1=Long-term Contract, 0=Short-term/Temporary Contract)	0.584	0.494
GRAIN EX-ANTE	The renting-out's original crops before rentals are grains (1=Grain, 0=Non Grain)	0.910	0.287
AGGR VILL TRUST	The fraction of the villagers that trust non-strangers more than strangers in land rental issues (leave-one-out strategy)	0.221	0.122
Renting-in's Production Plan			
VEGE	The renting-in's production plan is planting vegetables (1=Vegetable, 0=Non Vegetable)	0.148	0.355
CROP CHANGE	The renting-in's production plan replaces traditional/original crops with new crops (1=Replace, 0=Do Not Replace)	0.352	0.478
LDSMOOTH	Land smoothing in the renting-in's production plan (1=Land Smoothing, 0=No Land Smoothing)	0.642	0.545
Relationship between Rental Partners			
DIRCT COMM	The bargaining between the renting-in and renting-out is a direct communication without the involvement of a third party (1=Direct Communication, 0=Third Party)	0.358	0.480
ENTERPRISE	The renting-in owns an enterprise (1=Enterprise, 0=Individual)	0.569	0.496
NON STRANGER	The renting-in and renting-out are non-strangers (1=Non-strangers, 0=Strangers)	0.470	0.500
Number of Contracts: 332 Number of Villages: 13			

Figure 1: b and k excluded by Assumptions



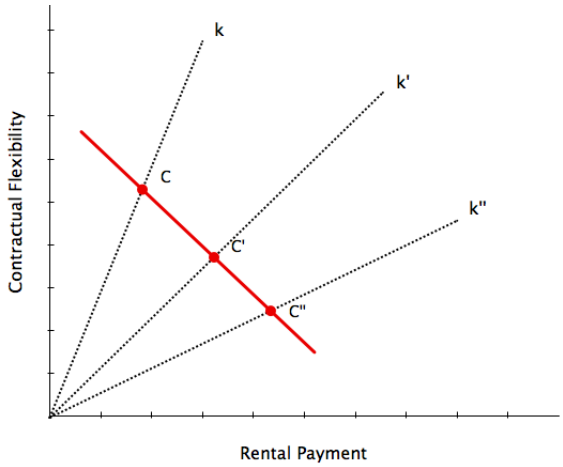
Note: Assumptions 1 and 2 rule out $b \notin \{0,1\}$ and $k \notin \{0,1\}$, which are the shaded area along the borders. Assumption 3 rules out b and k at the northwest (*Condition 1*) and southeast (*Condition 2*) corners.

Figure 2: Contract Curve with respect to Bargaining Power (α)



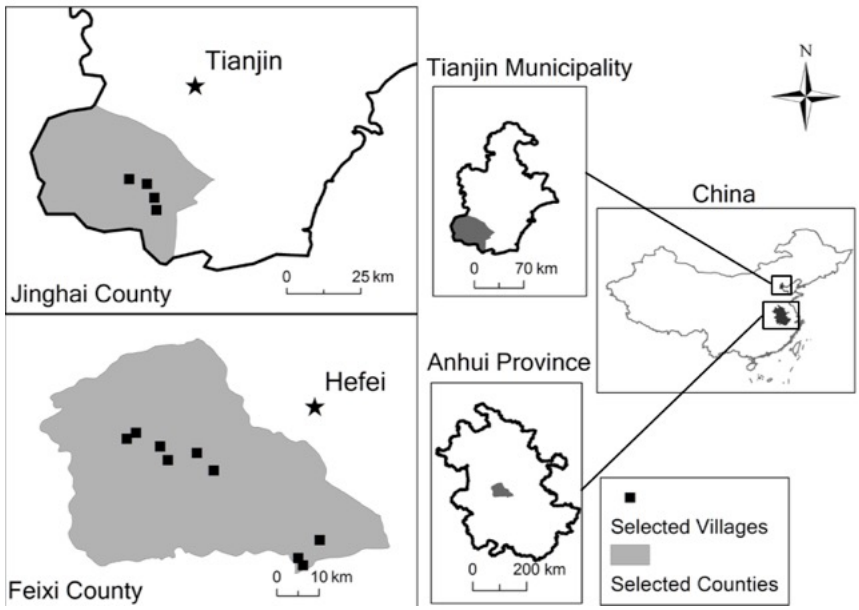
Note: The renting-out's utility increases as the indifference curve moves from a to a''. The renting-in's utility increases as the indifference curve moves from b to b''. The contract moves from C to C'' as the renting-out's bargaining power (α) increases. The contract curve with respect to α is CC'', which is upward sloping.

Figure 3: Contract Curve with respect to the Comparative Importance of the Renting-in Places on Contractual Flexibility (k)



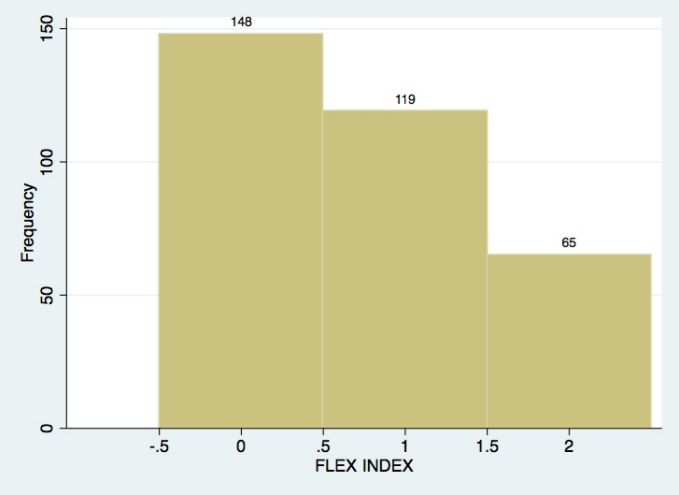
Note: The contract moves from C to C'' as the comparative importance the renting-in places on contractual flexibility increases from k to k''. The contract curve with respect to k is CC'', which is downward sloping.

Figure 4: Survey Locations in Tianjin and Anhui



Note: Four villages were selected in Jinghai County, Tianjin. Nine villages were selected in Feixi County, Anhui

Figure 5: Distribution of Index FLEX



Note: There are 332 contracts. 148 contracts have no flexible term (formal with fixed tenure). 119 contracts have one contractual term, informal with fixed tenure or formal with non-fixed tenure. 65 contracts have two flexible terms, informal with non-fixed tenure.

Table 2: Summary of Predictions

Explanatory Variables	Predictions	
	Flex	Rents
W: Comparative Importance the Renting-out Places on Contractual Flexibility (b)		
CROP CHANGE	-	+
ENTERPRISE	-	+
NON STRANGER	-	+
NON STRANGER $\times$AGGR VILL TRUST	+	-
X: Comparative Bargaining Power of the Renting-out (α)		
AGGR VILL TRUST	+	+
DIRECT COMM	+	+
NON STRANGER $\times$ ENTERPRISE	-	-
Variables with Multiple Roles		
GRAIN EX-ANTE ($\bar{U^o}$ and $\bar{U^{in}}$)	+	+
	-	-
LDSMOOTH (2 channels $\times$ b and k)	-	+
	+	-
	-	+
LONG NON-AGRI (b and k)	-	+
	+	-
BORDER (k and $\bar{U^{in}}$)	+	-
	-	-
VEGE (k and $\bar{U^{in}}$)	+	-
	-	-

Note: The predictions of the coefficients on the explanatory variables are listed based on the comparative statics. "+" represents a positive coefficient and "-" represents a negative coefficient. The explanatory variables with multiple roles are matched with multiple hypotheses.

Table 3: FIML versus Separated Estimation

	Separated ML (robust)		FIML (robust)		Separated ML (clustered)		FILM (clustered)	
Variables	Flex	Log Rents	Flex	Log Rents	Flex	Log Rents	Flex	Log Rents
W: Comparative Importance the Renting-out Places on Contractual Flexibility (b)								
CROP CHANGE	-0.053	0.075	-0.051	0.075	-0.053	0.075	-0.051	0.075
	(0.220)	(0.094)	(0.220)	(0.090)	(0.287)	(0.104)	(0.284)	(0.100)
ENTERPRISE	-0.393	0.421***	-0.391	0.421***	-0.393	0.421**	-0.391	0.421***
	(0.248)	(0.094)	(0.248)	(0.090)	(0.251)	(0.147)	(0.255)	(0.142)
NON STRANGER	-1.167***	0.405**	-1.166***	0.405**	-1.167***	0.405*	-1.166***	0.405**
	(0.332)	(0.172)	(0.333)	(0.166)	(0.408)	(0.188)	(0.408)	(0.181)
NON STRANGER × AGGR VILL TRUST	0.056***	-0.0043	0.056***	-0.004	0.0557***	-0.004	0.056***	-0.004
	(0.014)	(0.005)	(0.014)	(0.005)	(0.011)	(0.003)	(0.011)	(0.003)
X: Comparative Bargaining Power of the Renting-out (α)								
AGGR VILL TRUST	0.031	-0.003	0.031	-0.003	0.031	-0.003	0.031	-0.003
	(0.040)	(0.012)	(0.040)	(0.012)	(0.033)	(0.009)	(0.033)	(0.009)
DIRCT COMM	0.565***	0.080	0.567***	0.080	0.565**	0.080	0.567**	0.080
	(0.163)	(0.052)	(0.163)	(0.0499)	(0.252)	(0.066)	(0.252)	(0.064)
NON STRANGER × ENTERPRISE	-0.922**	-0.333**	-0.923**	-0.333***	-0.922**	-0.333*	-0.923**	-0.333**
	(0.381)	(0.133)	(0.381)	(0.128)	(0.387)	(0.175)	(0.386)	(0.168)
Variables with Multiple Roles								
GRAIN EX-ANTE	0.711***	-0.021	0.711***	-0.021	0.711***	-0.021	0.711***	-0.021
	(0.266)	(0.133)	(0.267)	(0.129)	(0.209)	(0.102)	(0.210)	(0.099)
LDSMOOTH	-0.173	0.066	-0.173	0.066	-0.173	0.066	-0.173	0.066
	(0.147)	(0.068)	(0.147)	(0.065)	(0.167)	(0.079)	(0.167)	(0.076)
LONG NON-AGRI	-0.390***	0.076*	-0.390***	0.076*	-0.390**	0.076	-0.390**	0.076
	(0.148)	(0.044)	(0.148)	(0.043)	(0.164)	(0.056)	(0.164)	(0.054)
BORDER	-0.162	-0.002	-0.161	-0.002	-0.162	-0.002	-0.161	-0.002
	(0.141)	(0.045)	(0.141)	(0.043)	(0.123)	(0.039)	(0.125)	(0.0378)
VEGE	0.311	-0.248**	0.307	-0.248**	0.311	-0.248	0.307	-0.248*
	(0.247)	(0.113)	(0.249)	(0.109)	(0.251)	(0.146)	(0.247)	(0.140)
Constant Cut1	1.240		1.262		1.240		1.262	
	(1.983)		(1.980)		(1.859)		(1.857)	
Constant Cut2	2.681		2.704		2.681		2.704	
	(1.986)		(1.982)		(1.912)		(1.909)	
Constant		6.437***		6.437***		6.437***		6.437***
		(0.648)		(0.624)		(0.447)		(0.431)
$corr(\varepsilon_{f_{ij}}, \varepsilon_{r_{ij}})$			-0.031				-0.031	
Observations	332	332	332	332	332	332	332	332
R-squared/Log Likelihood	-265.313	0.537	-432.08		-265.313	0.537	-432.07	

Note: Robust standard errors (columns 1-4) and robust standard errors clustered at the village level (columns 5-8) in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Theoretical Predictions, Empirical Results, and Average Marginal Effects (robust)

	Predictions		Separated ML (robust)		Average Marginal Effects on Flex		
Explanatory Variables	Flex	Log Rents	Flex	Log Rents	No Flex	Moderate Flex	High Flex
W: Comparative Importance the Renting-out Places on Contractual Flexibility (b)							
CROP CHANGE	-	+	-0.053	0.075	0.015	-0.005	-0.010
			(0.220)	(0.094)	(0.062)	(0.019)	(0.043)
ENTERPRISE	-	+	-0.393	0.421***	0.241***	-0.084***	-0.157***
			(0.248)	(0.094)	(0.046)	(0.018)	(0.039)
NON STRANGER	-	+	-1.167***	0.405**	0.151**	-0.085***	-0.065*
			(0.332)	(0.172)	(0.046)	(0.024)	(0.035)
NON STRANGER × AGGR VILL TRUST	+	-	0.056***	-0.004			
			(0.014)	(0.005)			
X: Comparative Bargaining Power of the Renting-out (α)							
AGGR VILL TRUST	+	+	0.031	-0.003	-0.016	0.006*	0.010
			(0.040)	(0.012)	(0.011)	(0.004)	(0.008)
DIRCT COMM	+	+	0.565***	0.080	-0.158***	0.049***	0.109***
			(0.163)	(0.052)	(0.045)	(0.016)	(0.031)
NON STRANGER × ENTERPRISE	-	-	-0.922**	-0.333**			
			(0.381)	(0.133)			
Variables with Multiple Roles							
GRAIN EX-ANTE			0.711***	-0.021	-0.199***	0.062***	0.137***
			(0.266)	(0.133)	(0.073)	(0.024)	(0.052)
LDSMOOTH			-0.173	0.066	0.048	-0.015	-0.033
			(0.147)	(0.068)	(0.041)	(0.013)	(0.028)
LONG NON-AGRI			-0.390***	0.076*	0.109***	-0.034**	-0.075***
			(0.148)	(0.044)	(0.041)	(0.013)	(0.029)
BORDER			-0.162	-0.002	0.046	-0.014	-0.031
			(0.141)	(0.045)	(0.040)	(0.012)	(0.027)
VEGE			0.311	-0.248**	-0.087	0.027	0.060
			(0.247)	(0.113)	(0.069)	(0.022)	(0.048)
Constant Cut1			1.240				
			(1.983)				
Constant Cut2			2.681				
			(1.986)				
Constant				6.437***			
				(0.648)			
Observations			332	332	332	332	332
R-squared/Log Likelihood			-265.313	0.537			

Note: "+" predicts a positive coefficient and "-" predicts a negative coefficient. Robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Theoretical Predictions, Empirical Results, and Average Marginal Effects (clustered)

	Predictions		Separated ML (clustered)		Average Marginal Effects on Flex		
Explanatory Variables	Flex	Log Rents	Flex	Log Rents	No Flex	Moderate Flex	High Flex
W: Comparative Importance the Renting-out Places on Contractual Flexibility (b)							
CROP CHANGE	-	+	-0.053	0.075	0.015	-0.005	-0.010
			(0.287)	(0.104)	(0.080)	(0.025)	(0.056)
ENTERPRISE	-	+	-0.393	0.421**	0.241***	-0.844*	-0.157**
			(0.251)	(0.147)	(0.061)	(0.022)	(0.046)
NON STRANGER	-	+	-1.167***	0.405*	0.151*	-0.085**	-0.065
			(0.408)	(0.188)	(0.081)	(0.036)	(0.053)
NON STRANGER × AGGR VILL TRUST	+	-	0.056***	-0.004			
			(0.011)	(0.003)			
X: Comparative Bargaining Power of the Renting-out (α)							
AGGR VILL TRUST	+	+	0.031	-0.003	-0.016*	0.006**	0.010*
			(0.033)	(0.009)	(0.009)	(0.003)	(0.006)
DIRCT COMM	+	+	0.565**	0.080	-0.158**	0.049**	0.109**
			(0.252)	(0.066)	(0.066)	(0.021)	(0.046)
NON STRANGER × ENTERPRISE	-	-	-0.922**	-0.333*			
			(0.387)	(0.175)			
Variables with Multiple Roles							
GRAIN EX-ANTE			0.711***	-0.021	-0.199***	0.062***	0.137***
			(0.209)	(0.102)	(0.058)	(0.019)	(0.039)
LDSMOOTH			-0.173	0.066	0.048	-0.015	-0.033
			(0.167)	(0.079)	(0.046)	(0.014)	(0.032)
LONG NON-AGRI			-0.390**	0.076	0.109**	-0.034**	-0.075**
			(0.164)	(0.056)	(0.046)	(0.014)	(0.033)
BORDER			-0.162	-0.002	0.046	-0.014	-0.031
			(0.123)	(0.039)	(0.033)	(0.011)	(0.023)
VEGE			0.311	-0.248	-0.087	0.027	0.060
			(0.251)	(0.146)	(0.071)	(0.022)	(0.049)
Constant Cut1			1.240				
			(1.859)				
Constant Cut2			2.681				
			(1.912)				
Constant				6.437***			
				(0.447)			
Observations			332	332	332	332	332
R-squared/Log Likelihood			-265.313	0.537			

Note: "+" predicts a positive coefficient and "-" predicts a negative coefficient. Robust standard errors clustered at the village level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6: The Renting-in's Identity and Contract Design

Renting-in's Identity	No Flexibility	Moderate Flexibility	High Flexibility	Rental Payment
STRANGER+INDIVIDUAL	baseline	baseline	baseline	baseline
NON STRANGER+INDIVIDUAL	0.008	-0.015	-0.098	0.499
STRANGER+ENTERPRISE	0.114	-0.027	0.035	0.523
NON-STRANGER+ENTERPRISE	0.366	-0.144	-0.223	0.637

Note: The *STRANGER+ENTERPRISE* identity is taken as the baseline in the following comparisons. The impact of the renting-in's identity on contractual flexibility (no flexibility, moderate flexibility, and high flexibility) is shown by the changes in the probability of having certain flexibility. The impact of the renting-in's identity on rental payment is shown by the change in rental payment in percentage.