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Altruism, moral hazard, and sharecropping

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Abstract: The paper provides a new explanation for the emergence of sharecropping in agriculture. Under the principal--agent moral hazard framework, the choice of the agrarian land lease contracts is discussed from the perspective of behavioural economics. The analyses show that the landlord and the tenant's behaviour patterns play an important role during the course of the contractual choice. Specifically, the combination of altruism and moral hazard can lead to sharecropping, which gives an explanation greatly different from the existing theoretical literature.

Keywords: altruism, behavioural economics, fixed rent contract, moral hazard, sharecropping

Sharecropping and leasing out land for a fixed rent are two widespread forms of lease contracts in practice, however, they have different incentive effects and bring about different eventual equilibrium outcomes. According to Marshall (1920), sharecropping is inefficient because there exists a typical agency problem between the landlord and the tenant, which leads to the suboptimal allocation of resources since the tenant keeps only a portion of the marginal product. Contrastedly, under the fixed rent contract, the tenant has the motivation to maximize the total output because he/she can obtain his/her full marginal product. However, sharecropping is very popular in agriculture in practice (Cheung 1968, 1969a, b; Byres 1983; Bardhan 1984; Garrett and Xu 2003). This phenomenon has greatly puzzled economists and many economic explanations have been put forward.

Cheung (1969a, b) offers an original explanation which is based on transaction costs and risk aversion. Although sharecropping involves higher transaction costs than the fixed rent contract, these costs can at least be compensated by the gains from the risk dispersion. Stiglitz (1974) models Cheung's idea and points out that there is a trade-off between the incentives and insurance which are provided to the tenant by the landlord. Sharecropping can better attain the balance between the incentive provision and risk sharing under some conditions. Braverman and Stiglitz (1982) further argue that under the share contract, the landlord can induce the tenant to behave in the way he/she likes through the interlinking contracts which are related to the land, labour, credit and product markets. Hallagan (1978) abstracts from the moral hazard considerations and shows that the share contract and the fixed rent contract can act as a screening device which is used to distinguish the tenants with different skills or abilities. Allen (1982) stresses that when the quality of land and the ability of tenants are both unobservable, the use of the associated contracts may be desirable. Eswaran and Kotwal (1985) develop a double-sided moral hazard model in which the landlord and the tenant are better in providing different unmarked factor inputs. Sharecropping as a partnership can better deal with this kind of moral hazard problem. Agrawal (1999) further builds a generalized model based on Eswaran and Kotwal (1985), and proves that the optimal contract maximizes output net of the risk-bearing and agency costs. Laffont and Matoussi (1995) highlight the dual role of moral hazard in the course of providing the effort and financial constraints. The tenant's financial constraints may make the fixed rent contract impossible, while sharecropping can flexibly adjust the share that the tenant retains. Ghatak and Pandey (2000) consider a case in which there is a joint moral hazard on the part of the tenant. Under the fixed rent contract, the tenant tends to choose too risky cultivation techniques in the presence of limited liability. The share contract can emerge as a solution to balance the tenant's effort supply and risk choice. Dubois (2002) considers the role of land fertility in the determination of the optimal contract. The contractual choice depends on the trade-off between the possibility of the land overuse and its fertility. Basu (1992) argues that when there is a limited liability clause, the landlord's interest can be harmed less under the share contract than under the fixed rent contract. Sengupta (1997) re-examines

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the framework developed by Basu (1992), and finds that when the tenant has the discretionary power in the choice of different projects and in the meantime the return from a project is also determined by the tenant's effort choice, the landlord prefers to choose the share contract. Ray and Singh (2001) explore the connection between the limited liability, the contractual form and the tenancy ladder, and finds that it is the ex-ante, not the ex post limited liability that can explain the emergence of the share contract. Ray (1999) argues that the share contract can be seen as a form of the strategic delegation in which the landlord obtains all the extra benefit. In summary, the existent literature can be classified into several strands which focus on one or more dimensions of risk sharing, moral hazard, adverse selection, and limited liability (Pi 2013b).

Different from the existing theoretical literature, this paper provides a new explanation for the emergence of the share contract. In a principal-agent moral hazard framework, we incorporate altruism into the formal analysis, and find that the landlord and the tenant's behaviour patterns play an important role in the landlord's choice of the agrarian land lease contracts. Altruism is a very useful concept in behavioural economics. Simon (1993: 160) points out that we should "assign comparable weight to other motives, including altruism and the organizational identifications associated with it." Khalil (2004) argues that there are three rationalistic theories of altruism and three normative theories of altruism. Different theories treat altruism in different ways (see, e.g., Becker 1976; Khalil 2004; Walker 2004), and different studies apply altruism in different environments (see, e.g., Gaube 2006; van der Pol et al. 2012). In this paper, we adopt the Kantian theory, which belongs to the normative theory of altruism, and apply it in explaining the existence of sharecropping. The Kantian theory holds that people tend to act in altruistic ways because it is indispensable for being human, and that the moral utility stemming from a moral self is greatly different from the familiar utility (see, e.g., Sen 1985; Harsanyi 1986). Both the landlord and the tenant exhibit the same type of altruistic behaviour. That is to say, throughout the paper, both the landlord and the tenant's altruistic types are the Kantian altruism. There are two points that should be noted. Firstly, when the tenant shirks, he/she will bear some kind of spiritual and psychological cost. Secondly, the landlord shows sympathy for the tenant when the tenant works hard but fails to achieve a high crop. Specifically, we introduce two parameters to capture the landlord and the tenant's degree of the Kantian altruism. These two parameters play an important role in our analysis, and provide us with insights different from the standard moral hazard model. In a socialized atmosphere, these parameters can become a common knowledge because of the effects of the conventionalized interactions. Our formal analyses show that the combination of altruism and moral hazard can lead to sharecropping.

The motivations of this paper can be stated as follows. Firstly, Sadoulet et al. (1997) support that the relation between the landlord and the tenant plays an important role in providing incentives for cooperative behaviours in sharecropping. Specifically, their Table 3 demonstrates that the number of sharecropper with a kin landlord is 31 in the total amount of 45 observed sharecroppers (i.e., a percentage of 68.9%), and that the number of fixed-rent tenants with a kin landlord is 13 in the total amount of 60 observed fixed-rent tenants (i.e., a percentage of 21.7%). That is to say, when the tenant is kin to the landlord, the landlord tends to choose sharecropping; however, when the tenant is non-kin to the landlord, the landlord tends to choose the fixed rent contract. Although they do not term kinship as altruism in a wide sense, their data manifest that altruism has an influence on the trade-off between the fixed rent contract and the share contract. Secondly, in relation-based societies (e.g., China), the relation plays an important role in economic activities (see, e.g., Pi 2011, 2012). Altruism itself is one of the important dimensions of relation in particular environments. In such societies, altruism in the Kantian sense between the principal and the agent is very common, but the role of altruism is largely neglected by the existent literature on sharecropping.

THE BASIC SETUP

In this section, we follow the Laffont and Martimort's (2002) analytical framework and Itoh's (2004) behavioural contract approach. Itoh (2004) originally develops moral hazard models with other-regarding preferences, but he focuses mainly on the inequity aversion, not on altruism. In the principal-agent game, the landlord is a principal and the tenant is an agent. It is assumed that both the landlord and the tenant are risk-neutral. This assumption can help us remove the effects of the risk-aversion and risk-sharing which

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have been greatly highlighted by the existing theoretical literature. The tenant's effort is unobservable. If the tenant exerts an effort level $e \in \{0,1\}$, the land's added-value (also called crop here) will be $\overline{V}$ with probability $\pi(e)$, and $\underline{V}$ with probability $1-\pi(e)$, where $0 \le \pi(e) \le 1$. When the tenant exerts no effort, his/her effort cost is $\Psi_0 = 0$. When the tenant exerts effort, his/her effort cost is $\Psi_1 = \Psi > 0$. The subscripts 0 and 1 represent $e = 0$ and $e = 1$, respectively. The following mathematical definitions should be noted, $\pi(1) = \pi_1$, $\pi(0) = \pi_0$, $\Delta\pi = \pi_1 - \pi_0 > 0$, $\Delta V = \overline{V} - \underline{V} > 0$.

In order to make our analysis interesting, throughout the paper we assume that $\Psi \le \Delta\pi\Delta V$. Since $\pi_1\overline{V} + (1-\pi_1)\underline{V} \ge \Delta\pi\Delta V$, it implies that $\Psi \le \pi_1\overline{V} + (1-\pi_1)\underline{V}$. At the same time, for the sake of the narrative simplicity, throughout the paper we call Ψ the exertion cost which can be seen as a proxy for the land fertility. That is to say, the more fertile the land is, the less exertion cost is incurred to the tenant.

There are two types of contracts that the landlord can choose from, either a fixed rent contract or a share contract (namely sharecropping).

Firstly, we consider the case of the fixed rent contract. When the landlord and the tenant sign a fixed rent contract, the landlord gets a fixed rent $R \ge 0$.

Secondly, we consider the case of the share contract. When the landlord and the tenant sign a share contract, the landlord gets $1 - \alpha$ proportion and the tenant gets α proportion, where $0 < \alpha < 1$. According to Otsuka et al. (1992), this is a "pure" share contract since the fixed payment is equal to zero, and what is more, it is seen as the most common form of sharecropping tenancy in practice.

The timing of the principal-agent game is as follows.

(1) At $t = 1$, the landlord offers a fixed rent contract or a share contract to the tenant.
(2) At $t = 2$, the tenant rejects or accepts the offered contract.
(3) At $t = 3$, if the offered contract is accepted, the tenant chooses an effort, which is equal to either 1 or 0.
(4) At $t = 4$, the land's added-value is realized.
(5) At $t = 5$, the signed contract is enforced.

In this paper, we consider three interesting cases. The first case is that only the tenant is altruistic, the second case is that only the landlord is altruistic, and the third case is that both the landlord and the tenant are altruistic.

In the standard model (e.g., Laffont and Martimort 2002: 175–177), there is no altruism at all, and the fixed rent contract will dominate the share contract. However, when altruism is introduced into the standard model, the share contract may dominate the fixed rent contract. There is an interaction of moral hazard and altruism when we analyse the above-mentioned three cases. Such an interaction plays a crucial role.

FIXED RENT CONTRACT

Case I: *Only the tenant is altruistic*

In this case, the tenant's degree of the Kantian altruism is ϕ, where $0 < \phi < \Psi$. $\varphi \to 0$ means that the tenant is almost completely selfish, and $\varphi \to \Psi$ denotes the tenant is almost completely altruistic. The larger the value of ϕ is, the more altruistic the tenant is. There are two points about ϕ that should be noted. Firstly, ϕ can be seen as the tenant's compunction for the landlord which is based on the common tacit background. Secondly, ϕ is embodied in the form of a psychological burden, not in the sense of a monetary loss. Thirdly, the mathematical treatment of ϕ is just like the effort cost, which is known by both the landlord and the tenant.

When it is under the fixed rent contract and only the tenant is altruistic, the programming problem will be:

$$\max R$$

$$s.t.\ \pi_1\overline{V} + (1-\pi_1)\underline{V} - R - \Psi \ge \pi_0\overline{V} + (1-\pi_0)\underline{V} - R - \varphi \quad (1)$$

$$\pi_1\overline{V} + (1-\pi_1)\underline{V} - R - \Psi \ge 0 \quad (2)$$

(1) and (2) are the tenant's incentive compatibility and participation constraints, respectively.

Constraint (1) is always satisfied as $\Psi \le \Delta\pi\Delta V$ automatically implies that $\Psi - \varphi \le \Delta\pi\Delta V$. Constraint (2) is binding. Solving this programming problem, we obtain:

$$R^{F*} = \pi_1\overline{V} + (1-\pi_1)\underline{V} - \Psi \quad (3)$$

The superscript F^* stands for the state under the fixed rent contract when only the tenant is altruistic. R^{F*} is the landlord's equilibrium rent.

The landlord's equilibrium utility under the fixed rent contract when only the tenant is altruistic will be:

$$U_L^{F*} = R^{F*} = \pi_1\overline{V} + (1-\pi_1)\underline{V} - \Psi \quad (4)$$

Throughout the paper, the subscript L is used to denote the landlord.

Through comparative statics, we can obtain Lemma 1.

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Lemma 1: When it is under the fixed rent contract and only the tenant is altruistic, $\frac{\partial U_L^{F*}}{\partial \varphi} = 0$.

Proof: See Appendix A.1.

Lemma 1 implies that in this case, the landlord's equilibrium utility does not vary with regard to the tenant's degree of the Kantian altruism. This shows that not all the altruism does good to the receiver which is in accord with the common view that the altruistic act is context-dependent. The reason behind Lemma 1 is that the tenant's incentive compatibility constraint is always satisfied.

Case II: *Only the landlord is altruistic*

In this case, the landlord's degree of the Kantian altruism is K where $0 < K < \Delta\pi\Delta V$. $K \to 0$ means that the landlord is almost completely selfish, and $K \to \Delta\pi\Delta V$ denotes that the landlord is almost completely altruistic. The larger is the value of K, the more altruistic the landlord is. $\Delta\pi\Delta V$ stands for the tenant's unlucky loss when he/she works hard but fails to get a high crop, which is the landlord's maximum degree of pity. There are three points about K that should be noted. Firstly, K is not a reduction of the tenant's rental obligation in the monetary sense, but a psychological burden that is incurred to the landlord when the tenant works hard but fails to achieve a high crop. Secondly, the landlord always receives R under the fixed rent contract (or $1 - \alpha$ proportion under the share contract) no matter whether the crop is high or low and no matter whether the tenant works hard or shirks. However, the landlord will endure a cost of K resulting from his/her Kantian altruism when the tenant exerts his/her full effort but only achieves a low crop. Thirdly, the mathematical treatment of K is similar to φ, which is known by both the landlord and the tenant.

One may ask such a question: Since the tenant's effort is unobservable, how does the landlord suffer when the tenant exerts a high effort and is unlucky? The answer to this question is as follows. The landlord cannot observe the tenant's effort, and his/her aim is to incentivize the tenant to exert a high effort. The landlord knows the tenant's success and failure probabilities when the tenant exerts a high effort. The landlord suffers from the tenant's failure probability when the tenant exerts a high effort. Taking the agent's wage in the standard moral hazard model for example, although the principal cannot observe the agent's effort, he/she can give a high wage to the agent when the agent exerts a high effort and succeeds and a low wage to the agent when the agent exerts a high effort and fails. Here, our logic is similar to that of the wage dependent on effort.

When it is under the fixed rent contract and only the landlord is altruistic, the programming problem will be:

$$\max R - (1-\pi_1)K$$

$$\text{s.t. } \pi_1\bar{V} + (1-\pi_1)\underline{V} - R - \Psi \geq \pi_0\bar{V} + (1-\pi_0)\underline{V} - R \quad (5)$$

$$\pi_1\bar{V} + (1-\pi_1)\underline{V} - R - \Psi \geq 0 \quad (2)$$

(5) and (2) are the tenant's incentive compatibility and participation constraints, respectively.

Constraint (5) is always satisfied as it is equivalent to $\Psi \leq \Delta\pi\Delta V$. Constraint (2) is binding. Solving this programming problem, we obtain:

$$R^{F\#} = \pi_1\bar{V} + (1-\pi_1)\underline{V} - \Psi \quad (6)$$

The superscript $F\#$ stands for the state under the fixed rent contract when only the landlord is altruistic. $R^{F\#}$ is the landlord's equilibrium rent.

The landlord's equilibrium utility under the fixed rent contract when only the landlord is altruistic will be:

$$U_L^{F\#} = R^{F\#} - (1-\pi_1)K$$
$$= \pi_1\bar{V} + (1-\pi_1)\underline{V} - \Psi - (1-\pi_1)K \quad (7)$$

Through the comparative statics, we can obtain Lemma 2.

Lemma 2: When it is under the fixed rent contract and only the landlord is altruistic, $\frac{\partial U_L^{F\#}}{\partial K} \leq 0$.

Proof: See Appendix A.2.

Lemma 2 implies that in this case, the landlord's equilibrium utility is decreasing in the landlord's degree of the Kantian altruism. This shows that the more altruistic the landlord is, the less utility he/she gains from leasing. That is to say, the landlord's sympathy for the tenant is costly.

Case III: *Both the landlord and the tenant are altruistic*

When it is under the fixed rent contract and both the landlord and the tenant are altruistic, the programming problem will be:

$$\max R - (1-\pi_1)K$$

$$s.t.\ \pi_1\bar{V} + (1-\pi_1)\underline{V} - R - \Psi \geq \pi_0\bar{V} + (1-\pi_0)\underline{V} - R - \varphi \quad (1)$$

$$\pi_1\bar{V} + (1-\pi_1)\underline{V} - R - \Psi \geq 0 \quad (2)$$

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Constraint (2) is binding. Solving this programming problem, we obtain:

$$R^{F\wedge} = \pi_1\bar{V} + (1-\pi_1)\underline{V} - \Psi \quad (8)$$

The superscript $F\wedge$ stands for the state under the fixed rent contract when both the landlord and the tenant are altruistic. $R^{F\wedge}$ is the landlord's equilibrium rent.

The landlord's equilibrium utility under the fixed rent contract when both the landlord and the tenant are altruistic will be:

$$U_L^{F\wedge} = R^{F\wedge} - (1-\pi_1)K$$

$$= \pi_1\bar{V} + (1-\pi_1)\underline{V} - \Psi - (1-\pi_1)K \quad (9)$$

Through the comparative statics, we can obtain Lemma 3.

Lemma 3: When it is under the fixed rent contract and both the landlord and the tenant are altruistic, $\frac{\partial U_L^{F\wedge}}{\partial \varphi} = 0$, $\frac{\partial U_L^{F\wedge}}{\partial K} \le 0$.

Proof: See Appendix A.3.

Lemma 3 implies that in this case, the landlord's equilibrium utility does not vary with regard to the tenant's degree of the Kantian altruism, but is decreasing in the landlord's degree of the Kantian altruism. The reason behind Lemma 3 is similar to that behind Lemmas 1 and 2.

SHARE CONTRACT

Case I: *Only the tenant is altruistic*

When it is under the share contract and only the tenant is altruistic, the programming problem will be:

$$\max_{\alpha}(1-\alpha)[\pi_1\bar{V} + (1-\pi_1)\underline{V}]$$

$$s.t.\ \alpha[\pi_1\bar{V} + (1-\pi_1)\underline{V}] - \Psi \ge \alpha[\pi_0\bar{V} + (1-\pi_0)\underline{V}] - \varphi \quad (10)$$

$$\alpha[\pi_1\bar{V} + (1-\pi_1)\underline{V}] - \Psi \ge 0 \quad (11a)$$

$$\alpha[\pi_0\bar{V} + (1-\pi_0)\underline{V}] - \varphi \ge 0 \quad (11b)$$

(10) and (11a, b) are the tenant's incentive compatibility and participation constraints, respectively.

It is easy for us to find that constraint (10) is binding when $\varphi \le \frac{\Psi[\pi_0\bar{V} + (1-\pi_0)\underline{V}]}{\pi_1\bar{V} + (1-\pi_1)\underline{V}}$, and that (11b) is binding when $\varphi > \frac{\Psi[\pi_0\bar{V} + (1-\pi_0)\underline{V}]}{\pi_1\bar{V} + (1-\pi_1)\underline{V}}$.

Solving this programming problem, we obtain:

If $\varphi \le \frac{\Psi[\pi_0\bar{V} + (1-\pi_0)\underline{V}]}{\pi_1\bar{V} + (1-\pi_1)\underline{V}}$, then

$$\alpha^{S*} = \frac{\Psi - \varphi}{\Delta\pi\Delta V} \quad (12)$$

If $\varphi > \frac{\Psi[\pi_0\bar{V} + (1-\pi_0)\underline{V}]}{\pi_1\bar{V} + (1-\pi_1)\underline{V}}$, then

$$\alpha^{S*} = \frac{\varphi}{\pi_0\bar{V} + (1-\pi_0)\underline{V}} \quad (13)$$

The superscript $S*$ stands for second-best state under the share contract when only the tenant is altruistic. α^{S*} is the tenant's equilibrium proportion.

If $\varphi \le \frac{\Psi[\pi_0\bar{V} + (1-\pi_0)\underline{V}]}{\pi_1\bar{V} + (1-\pi_1)\underline{V}}$, then the landlord's equilibrium utility when only the tenant is altruistic will be:

$$U_L^{S*} = \frac{[\Delta\pi\Delta V - (\Psi - \varphi)][\pi_1\bar{V} + (1-\pi_1)\underline{V}]}{\Delta\pi\Delta V} \quad (14)$$

If $\varphi > \frac{\Psi[\pi_0\bar{V} + (1-\pi_0)\underline{V}]}{\pi_1\bar{V} + (1-\pi_1)\underline{V}}$, then the landlord's equilibrium utility when only the tenant is altruistic will be:

$$U_L^{S*} = \frac{[\pi_0\bar{V} + (1-\pi_0)\underline{V} - \varphi][\pi_1\bar{V} + (1-\pi_1)\underline{V}]}{\pi_0\bar{V} + (1-\pi_0)\underline{V}} \quad (15)$$

Through the comparative statics, we can obtain Lemma 4.

Lemma 4: When it is under the share contract and only the tenant is altruistic, if the tenant's degree of the Kantian altruism is sufficiently small, then $\frac{\partial U_L^{S*}}{\partial \varphi} > 0$; however, if the tenant's degree of the Kantian altruism is sufficiently large, then $\frac{\partial U_L^{S*}}{\partial \varphi} < 0$.

Proof: See Appendix A.4.

Lemma 4 implies that in this case the landlord's equilibrium utility is ambiguous with regard to the tenant's degree of the Kantian altruism. The reason behind Lemma 4 is that the existence of the tenant's altruism makes the tenant's participation constraint when he/she shirks more difficult to be satisfied, which may change the landlord's share in two conflicting directions.

Case II: *Only the landlord is altruistic*

When it is under the share contract and only the landlord is altruistic, the programming problem will be:

$$\max_{\alpha}(1-\alpha)[\pi_1\bar{V} + (1-\pi_1)\underline{V}] - \alpha(1-\pi_1)K$$

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$$\text{s.t.}\ \alpha[\pi_1\overline{V}+(1-\pi_1)\underline{V}]-\Psi \geq \alpha[\pi_0\overline{V}+(1-\pi_0)\underline{V}] \quad (16)$$

$$\alpha[\pi_1\overline{V}+(1-\pi_1)\underline{V}]-\Psi \geq 0 \quad (17a)$$

$$\alpha[\pi_0\overline{V}+(1-\pi_0)\underline{V}] \geq 0 \quad (17b)$$

(16) and (17a, b) are the tenant's incentive compatibility and participation constraints, respectively. In fact, the tenant's participation constraint (17b) can be neglected because it is always satisfied. The reason why we set the principal's altruistic cost as $\alpha(1-\pi_1)K$ instead of $(1-\pi_1)K$ is that altruism is other-regarding preferences according its definition.

It is easy for us to find that constraint (16) is binding when $\frac{\Psi}{\Delta\pi\Delta V} \geq \frac{\Psi}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$. It is obvious that $\frac{\Psi}{\Delta\pi\Delta V} \geq \frac{\Psi}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$ is equivalent to $\pi_1\overline{V}+(1-\pi_1)\underline{V} \geq \Delta\pi\Delta V$, which is always satisfied according to the definition of $\Delta\pi\Delta V$.

Solving this programming problem, we obtain:

$$\alpha^{S\#} = \frac{\Psi}{\Delta\pi\Delta V} \quad (18)$$

The superscript $S\#$ stands for the second-best state under the share contract when only the landlord is altruistic. $\alpha^{S\#}$ is the landlord's equilibrium proportion.

The landlord's equilibrium utility when only the landlord is altruistic will be:

$$U_L^{S\#} = \frac{(\Delta\pi\Delta V-\Psi)[\pi_1\overline{V}+(1-\pi_1)\underline{V}]-(1-\pi_1)\Psi K}{\Delta\pi\Delta V} \quad (19)$$

Through the comparative statics, we can obtain Lemma 5.

Lemma 5: When it is under the share contract and only the landlord is altruistic, $\frac{\partial U_L^{S\#}}{\partial K} \leq 0$.

Proof: See Appendix A.5.

In line with Lemma 2, Lemma 5 implies that in this case, the landlord's equilibrium utility is also decreasing in the landlord's degree of the Kantian altruism.

Case III: *Both the landlord and the tenant are altruistic*

When it is under the share contract and both the landlord and the tenant are altruistic, the programming problem will be:

$$\max_{\alpha}(1-\alpha)[\pi_1\overline{V}+(1-\pi_1)\underline{V}]-\alpha(1-\pi_1)K$$

$$s.t.\ \alpha[\pi_1\overline{V}+(1-\pi_1)\underline{V}]-\Psi \geq \alpha[\pi_0\overline{V}+(1-\pi_0)\underline{V}]-\varphi \quad (10)$$

$$\alpha[\pi_1\overline{V}+(1-\pi_1)\underline{V}]-\Psi \geq 0 \quad (11a)$$

$$\alpha[\pi_0\overline{V}+(1-\pi_0)\underline{V}]-\varphi \geq 0 \quad (11b)$$

(10) and (11a, b) are the tenant's incentive compatibility and participation constraints, respectively.

Similarly, we can find that constraint (10) is binding when $\varphi \leq \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, and that (11b) is binding when $\varphi > \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$.

Solving this programming problem, we obtain:

If $\varphi \leq \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then

$$\alpha^{S\wedge} = \frac{\Psi-\varphi}{\Delta\pi\Delta V} \quad (20)$$

If $\varphi > \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then

$$\alpha^{S\wedge} = \frac{\varphi}{\pi_0\overline{V}+(1-\pi_0)\underline{V}} \quad (21)$$

The superscript $S\wedge$ stands for the second-best state under the share contract when both the landlord and the tenant are altruistic. $\alpha^{S\wedge}$ is the tenant's equilibrium proportion.

If $\varphi \leq \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then the landlord's equilibrium utility when both the landlord and the tenant are altruistic will be:

$$U_L^{S\wedge} = \frac{(\Delta\pi\Delta V-\Psi+\varphi)[\pi_1\overline{V}+(1-\pi_1)\underline{V}]-(1-\pi_1)(\Psi-\varphi)K}{\Delta\pi\Delta V} \quad (22)$$

If $\varphi > \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then the landlord's equilibrium utility when both the landlord and the tenant are altruistic will be:

$$U_L^{S\wedge} = \frac{[\pi_0\overline{V}+(1-\pi_0)\underline{V}-\varphi][\pi_1\overline{V}+(1-\pi_1)\underline{V}]-(1-\pi_1)\varphi K}{\pi_0\overline{V}+(1-\pi_0)\underline{V}} \quad (23)$$

Through the comparative statics, we can obtain Lemma 6.

Lemma 6: When it is under the share contract and both the landlord and the tenant are altruistic, if the tenant's degree of the Kantian altruism is sufficiently small, then $\frac{\partial U_L^{S\wedge}}{\partial \varphi} > 0$ and $\frac{\partial U_L^{S\wedge}}{\partial K} \leq 0$; however, if the

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tenant's degree of the Kantian altruism is sufficiently large, then $\frac{\partial U_L^{S\wedge}}{\partial \varphi} < 0$ and $\frac{\partial U_L^{S\wedge}}{\partial K} \leq 0$.

Proof: See Appendix A.6.

It is obvious that Lemma 6 is a combination of Lemmas 4 and 5.

A COMPARATIVE ANALYSIS

In this section, we will conduct a comparative analysis between the outcomes under the fixed rent contract and those under the share contract.

By comparison, it is easy for us to obtain the following three propositions.

Proposition 1: When only the tenant is altruistic, it is optimal for the landlord to choose the fixed rent contract.

Proof: See Appendix B.1.

Proposition 1 implies that under the moral hazard framework when only the tenant is altruistic, no matter whether the tenant's degree of the Kantian altruism is small enough or large enough, the fixed rent contract will dominate the share contract.

Proposition 2: When only the landlord is altruistic, if the landlord's degree of the Kantian altruism is small enough, then it is optimal for the landlord to choose the fixed rent contract; however, if the landlord's degree of the Kantian altruism is large enough, then it is optimal for the landlord to choose the share contract.

Proof: See Appendix B.2.

Proposition 2 implies that under the moral hazard framework, when only the landlord is altruistic, the share contract will dominate the fixed rent contract, when the landlord's degree of Kantian altruism is sufficiently large.

Proposition 3: When both the landlord and the tenant are altruistic, if $\varphi \leq \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$ and $K \leq \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}] - \varphi[\pi_1\overline{V} + (1-\pi_1)\underline{V}]}{(1-\alpha)(1-\pi_1)\Delta\pi\Delta V}$ or if $\varphi > \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$ and $K \leq \frac{\varphi[\pi_1\overline{V} + (1-\pi_1)\underline{V}] - \Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{(1-\alpha)(1-\pi_1)[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}$, then it is optimal for the landlord to choose the fixed rent contract; however, if $\varphi \leq \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$ and $K > \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}] - \varphi[\pi_1\overline{V} + (1-\pi_1)\underline{V}]}{(1-\alpha)(1-\pi_1)\Delta\pi\Delta V}$ or if $\varphi > \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$ and $K > \frac{\varphi[\pi_1\overline{V} + (1-\pi_1)\underline{V}] - \Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{(1-\alpha)(1-\pi_1)[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}$, then it is optimal for the landlord to choose the share contract.

Proof: See Appendix B.3.

Proposition 3 implies that under the moral hazard framework when both the landlord and the tenant are altruistic, no matter whether the tenant's degree of the Kantian altruism is small enough or large enough, if the landlord's degree of the Kantian altruism is sufficiently small, then the fixed rent contract will dominate the share contract; however, if the landlord's degree of the Kantian altruism is sufficiently large, then the share contract will dominate the fixed rent contract.

According to Propositions 1–3, we can find out when the emergence and persistence of sharecropping may happen in the real world from the perspective of behavioural economics. When only the landlord is altruistic, if the landlord has a good enough relationship with his/her tenants, the share contract is an optimal choice for the landlord. When both the landlord and the tenant are altruistic, if the landlord has strong enough kinship ties with his/her tenants, the share contract is a dominant option for the landlord. That is to say, no matter whether only the landlord is altruistic or whether both the landlord and the tenant are altruistic, only if the landlord's degree of the Kantian altruism is large enough, then sharecropping can become prevalent. Sadoulet et al. (1997) provide empirical evidence that supports our theoretical results.

CONCLUSION

In this paper, we provide a new explanation for the emergence of sharecropping in agriculture. Although the trade-off in this paper is similar to the trade-off between incentive provision and insurance provision in the traditional literature, this paper analyses the issue from a greatly different perspective. Our analyses show that the combination of altruism and moral hazard can lead to sharecropping. In the matter of moral hazard in this paper, there are two points that should be noted. Firstly, moral hazard is on the part of the tenant, not on the part of the landlord.

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Secondly, moral hazard is embodied in the choice of effort, not in the choice of technique or project. According to Propositions 1–3, we can find that the landlord and the tenant's behaviour patterns play a key role in determining the emergence of sharecropping.

There are several avenues for a future research. Firstly, the issue of limited liability is completely neglected in our paper. One possible extension is that we can introduce limited liability constraints into the moral hazard problems. Secondly, when the landlord and the tenant are familiar with each other, there is another mechanism that should not be neglected. Sharecropping is adopted, which can be simply due to the fact that the moral hazard problem is less severe because of a better observability of effort. Thirdly, our approach can also be used to analyse some important observed phenomena about contractual arrangements in agriculture. For example, the phenomenon that the fifty-fifty split in sharecropping is very prevalent (see, e.g., Pi 2013a) can be explored from the perspective of altruism.

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APPENDIX A. PROOFS OF LEMMAS 1–6

Appendix A.1. Proof of Lemma 1

From (4), we obtain: $\frac{\partial U_L^{F*}}{\partial \varphi} = 0$

Appendix A.2. Proof of Lemma 2

From (7), we obtain: $\frac{\partial U_L^{F\#}}{\partial K} = -(1-\pi_1) \leq 0$

Appendix A.3. Proof of Lemma 3

From (9), we obtain: $\frac{\partial U_L^{F\wedge}}{\partial \varphi} = 0$, $\frac{\partial U_L^{F\wedge}}{\partial \mu} = -(1-\pi_1) \leq 0$

Appendix A.4. Proof of Lemma 4

When $\varphi \leq \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$, then from (14), we obtain: $\frac{\partial U_L^{S*}}{\partial \varphi} = \frac{\pi_1\overline{V} + (1-\pi_1)\underline{V}}{\Delta\pi\Delta V} > 0$

When $\varphi > \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$, then from (15), we obtain: $\frac{\partial U_L^{S*}}{\partial \varphi} = -\frac{\pi_1\overline{V} + (1-\pi_1)\underline{V}}{\pi_0\overline{V} + (1-\pi_0)\underline{V}} < 0$

Appendix A.5. Proof of Lemma 5

From (19), we obtain: $\frac{\partial U_L^{S\#}}{\partial K} = -\frac{(1-\pi_1)\Psi}{\Delta\pi\Delta V} \leq 0$

Appendix A.6. Proof of Lemma 6

When $\varphi \leq \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$, then from (22), we obtain:

$$\frac{\partial U_L^{S\wedge}}{\partial \varphi} = \frac{\pi_1\overline{V} + (1-\pi_1)\underline{V} + (1-\pi_1)K}{\Delta\pi\Delta V} > 0, \quad \frac{\partial U_L^{S\wedge}}{\partial K} = -\frac{(1-\pi_1)(\Psi-\varphi)}{\Delta\pi\Delta V} \leq 0$$

When $\varphi > \frac{\Psi[\pi_0\overline{V} + (1-\pi_0)\underline{V}]}{\pi_1\overline{V} + (1-\pi_1)\underline{V}}$, then from (23), we obtain:

$$\frac{\partial U_L^{S\wedge}}{\partial \varphi} = -\frac{\pi_1\overline{V} + (1-\pi_1)\underline{V} + (1-\pi_1)K}{\pi_0\overline{V} + (1-\pi_0)\underline{V}} < 0, \quad \frac{\partial U_L^{S\wedge}}{\partial K} = \frac{-(1-\pi_1)\varphi}{\pi_0\overline{V} + (1-\pi_0)\underline{V}} \leq 0$$

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APPENDIX B. PROOFS OF PROPOSITIONS 1–3

Appendix B.1. Proof of Proposition 1

When only the tenant is altruistic, if $\varphi \leq \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then from (4) and (14), we obtain:

$$U_L^{F*} - U_L^{S*} = \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}] - \varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}]}{\Delta\pi\Delta V} \geq 0$$

When only the tenant is altruistic, if $\varphi > \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then from (4) and (15), we obtain:

$$U_L^{F*} - U_L^{S*} = \frac{\varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}]}{\pi_0\overline{V}+(1-\pi_0)\underline{V}} - \Psi > 0$$

Apendix B.2. Proof of Proposition 2

When only the landlord is altruistic, from (7) and (19), we obtain:

$$U_L^{F\#} - U_L^{S\#} = \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\Delta\pi\Delta V} - (1-\frac{\Psi}{\Delta\pi\Delta V})(1-\pi_1)K$$

If $K \leq \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{(1-\pi_1)(\Delta\pi\Delta V-\Psi)}$, then $U_L^{F\#} - U_L^{S\#} \geq 0$

If $K > \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{(1-\pi_1)(\Delta\pi\Delta V-\Psi)}$, then $U_L^{F\#} - U_L^{S\#} < 0$

Appendix B.3. Proof of Proposition 3

When both the landlord and the tenant are altruistic, if $\varphi \leq \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then from (9) and (22), we obtain:

$$U_L^{F\wedge} - U_L^{S\wedge} = \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}] - \varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}]}{\Delta\pi\Delta V} - (1-\frac{\Psi-\varphi}{\Delta\pi\Delta V})(1-\pi_1)K$$

, which is greater than or equal to 0 when $K \leq \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}] - \varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}]}{(1-\pi_1)(\Delta\pi\Delta V-\Psi+\varphi)}$ and less than 0 when $K > \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}] - \varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}]}{(1-\pi_1)(\Delta\pi\Delta V-\Psi+\varphi)}$

When both the landlord and the tenant are altruistic, if $\varphi > \frac{\Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_1\overline{V}+(1-\pi_1)\underline{V}}$, then from (9) and (23), we obtain:

$$U_L^{F\wedge} - U_L^{S\wedge} = \frac{\varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}] - \Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{\pi_0\overline{V}+(1-\pi_0)\underline{V}} - (1-\frac{\varphi}{\pi_0\overline{V}+(1-\pi_0)\underline{V}})(1-\pi_1)K$$

, which is greater than or equal to 0 when $K \leq \frac{\varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}] - \Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{(1-\pi_1)[\pi_0\overline{V}+(1-\pi_0)\underline{V}-\varphi]}$ and less than 0 when $K > \frac{\varphi[\pi_1\overline{V}+(1-\pi_1)\underline{V}] - \Psi[\pi_0\overline{V}+(1-\pi_0)\underline{V}]}{(1-\pi_1)[\pi_0\overline{V}+(1-\pi_0)\underline{V}-\varphi]}$

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