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Landlords and farmers: implications of disparities in bargaining power for tenancy in agriculture

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Abstract

The equilibrium allocation of owner operated and rental land in the agricultural sector is examined given risk averse agents, risky returns and asset price risk. The model is extended to account for disparities in bargaining power among landlords and farmers. In the absence of disparities, the competitive equilibrium allocation satisfies the general conditions for optimal risk sharing with an adjustment factor similar to the optimal hedge ratio.

Differences in bargaining power result in deviations from the optimal risk sharing conditions. Numerical simulations of tenancy structure are conducted for a developed agricultural economy exposed to various forms of risk. Estimates of parameter values representing the riskiness of returns and asset prices in this study are based on vector auto regressive techniques. The simulations show that a substantial reduction of the rental ratio is obtained in a situation where farmers are equally or more risk averse than landlords. Consequently, the results indicate that the importance of the tenancy institution as a risk sharing mechanism is severely mitigated in the presence of asset price risk, risky returns, relatively risk averse farmers and disparities in bargaining power.

1. Introduction

Economists have for an extended period of time shown a considerable interest in land as a production factor and a store of value (Smith, 1776). In addition, a broad range of literature has discussed the existence of various forms of contractual arrangements between the landlord and the tenant farmer regulating access to agricultural land. The issues have been extensively analyzed in a policy environment existing in less developed countries (LDCs) (Stiglitz, 1974; Reid, 1976). A review of literature (Binswanger et al., 1993) indicates that power and distortions in agricultural land relations have implications for the potential success of land reform and the emergence of functioning land markets. Contributions in the field also involve empirical and theoretical analysis of the situation occurring in an agricultural policy environment typically prevailing in Western Europe and North America (Apland et al., 1984; Chambers and Phipps, 1988).

However, the above literature has not examined the economic implications of vast differences in bargaining power between the landlord and the farmer. This is especially the case when land can be transferred through transactions in the land market and both agents are assumed to be risk averse and face both price and production risk. Furthermore, asset price risk, i.e. recognising the fact that the price of land at a future point of time is uncertain, has not been consid-

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ered in previous analyses of power and distortions in land relations. These issues are of relevance in the context of the ongoing privatisation process in eastern Europe and the former Soviet Union as well for the implementation of foreign assistance programs designed to facilitate land reform (Brooks et al., 1991). The primary objective of this paper is therefore to discuss the implications for land rental arrangements of differences in bargaining power between different categories of agents operating in the markets for rental and owner operated land. Secondly, the objective is to illustrate the argument by conducting some numerical evaluations of the implied tenancy structure given various forms of bargaining power and degrees of absolute risk aversion among the participating agents.

The first section of the paper contains a summary of the farmer's planning problem. This section of the paper draws upon Andersson (1990). The original model is extended to consider the equilibrium rental acreage allocation and the implications of disparities in bargaining power among landowners and farmers. Detailed proofs and derivations are omitted in this presentation. In the final section of the paper some empirical analysis of the various forms of equilibrium allocations are conducted when estimated parameter values for the various forms of risk are introduced.

2. The farmer's problem

The farmer is assumed to maximize expected utility of net wealth accrued from holding rental contracts and/or owner operated land from the beginning to the end of one period of production. The analytical framework is largely based upon portfolio theory as applied by Anderson and Danthine (1983) and Shah and Thakor (1988). The following assumptions apply to the farmer's planning problem.

(1) The farmer maximizes the expected value of a constant absolute risk aversion coefficient (CARA) utility function with coefficient γ.

(2) The maximum number of tillable acres available is $\overline{A}$. The farmer who enters the agricultural sector can choose between a fixed rent contract for x_1 acres or acquiring x_2 acres of land in the open land market.

(3) The return above cash costs per acre denoted is $\tilde{c}$ (where cash rent is not included among cash costs) does not depend upon whether rental or owner operated land is selected. The return is assumed to be normally distributed, $\tilde{c} \approx N(c,\mathrm{Var}(c))$. Furthermore, the net return per acre is assumed not to depend upon the number of acres farmed, $\overline{A}$.

(4) Land can be purchased at a known price of P_0 per acre. The price of land at the time of sale, $\tilde{P}_1$, is random, i.e. $\tilde{P}_1 \approx N(P_1,\mathrm{Var}(P))$.

(5) Land purchases are financed entirely through a loan equivalent to $\$P_0$ per acre. The interest rate, r, is assumed to be known with certainty.

In order to capture the essential elements of the problem the farmer is assumed to choose between owner operator land, a fixed rental contract or a combination of both. Share rental arrangements, assumed not to affect the perceived riskiness of the future price of land $\mathrm{Var}(P)$, are excluded since this contract provision would serve as a supplementary mechanism for managing the riskiness of crop returns (Apland et al., 1984). It is noteworthy to observe that owner operated land, in addition to facing exposure to price and production risk ($\mathrm{Var}(c)$) common for both categories of land, also assumes asset price risk, $\mathrm{Var}(P)$.

The assumption of a constant absolute risk aversion utility function has been employed frequently in previous studies (Feldstein, 1980; Anderson and Danthine, 1983; Shah and Thakor, 1988). Levy and Markowitz (1979) showed in an analysis of US stocks that a mean-variance analysis performed quite well when the coefficient of absolute risk aversion was not extremely high. Given the stipulated assumptions, the farmer's problem is defined by program (1)

$$\begin{aligned}\text{Maximize } & E\left(\tilde{c}x_1 - Rx_1 + \tilde{c}x_2 - rP_0x_2 \right.\\ & \left. + \left(\tilde{P}_1 - P_0\right)x_2\right)\\ & -(\gamma/2)\mathrm{Var}\left(\tilde{c}x_1 - Rx_1 + \tilde{c}x_2\right.\\ & \left. - rP_0x_2 + \left(\tilde{P}_1 - P_0\right)x_2\right) \qquad (1)\end{aligned}$$

subject to

$$x_1 + x_2 \leqslant \overline{A}, \quad x_1, x_2 \geqslant 0$$

Forming the Lagrangean function for Eq. (1) maximizing with respect to x_1, x_2, and λ while assuming an interior solution, the farmer's demand function for rental acreage is shown by Andersson (1990) to be represented by Eq. (2)

$$x_1 = \frac{rP_0 - R + (P_0 - P_1) + \gamma\overline{A}(\mathrm{Var}(P) + \mathrm{Cov}(P,c))}{\gamma(\mathrm{Var}(P))} \tag{2}$$

A comparative statics analysis of Eq. (2) (Andersson, 1990) indicates that the rental acreage x_1 is increasing with increasing covariation between earnings and price of land ($\mathrm{Cov}(P,c)$) and increasing asset price risk ($\mathrm{Var}(P)$). Furthermore, demand for rental acreage is as expected increasing with increasing cost of capital. Hence, expanding the rental acreage serves as a hedge as the economic environment becomes increasingly volatile. In addition, demand for rental acreage as depicted in the portfolio theory framework of Eq. (1), also captures the essential feature of rental arrangements serving as a risk reducing institution even in the absence of potential imperfections in the credit markets.

3. The investor / landlord's planning problem

In this section of the paper the optimal behavior of landlords/investors is examined before the equilibrium allocations in the land and rental markets are analyzed. The planning problem of the landlord/investor is defined by Eq. (4) based upon the following assumptions.

(1) The investor maximizes the expected utility of a CARA utility function with an absolute coefficient of risk aversion of ψ.

(2) The landowner/investor owns a farm of size $\overline{A}$ at $t = 0$. This farm may have been awarded as a result of historical claims to property or provided through an ongoing privatization process. z_1 ha can be rented out at rent R per acre and sold at time $t = 1$ for P_1. The future price of land is a random variable distributed as $\tilde{P}_1 \approx N(P_1, \mathrm{Var}(P))$. z_2 acres can be sold at time $t = 0$ and the proceeds are invested in bonds earning $b \times 100\%$ interest maturing at $t = 1$. Transaction costs are assumed to be zero. Furthermore, the landowner in this stylized model is assumed not to actively farm the land owing to managerial and geographic reasons.

(3) The landlord/investor initially perceives that he/she is 'sufficiently small' so that his/her actions do not affect prevailing market price P_0 and R and thus he/she takes them as given. Subsequently, this assumption is to be revoked.

The assumption of zero transaction costs implies that land can be sold freely without incurring any legal restrictions, penalties or deductions associated with the transaction. However, in some instances legal provisions have been introduced in order to restrict sales of land during a transition period (Csaki and Lerman, 1993). Existence of transaction costs would in general tend to mitigate the benefits of selling off the land at the beginning of the planning period. Given the above assumptions, the landlord/investor's expected change in wealth is defined by Eq. (3)

$$W_L = Rz_1 + P_1 z_1 + P_0(1+b)z_2 \tag{3}$$

Consequently, the variance of wealth is $\mathrm{Var}(P)z_1^2$ since the rent is assumed to be known at $t = 0$. Now defining the investor/landlord's problem incorporating the constraint $z_1 + z_2 \leqslant \overline{A}$, yields the optimization program depicted in Eq. (4)

$$\underset{(z_1 z_2)}{\text{Maximize}} \; Rz_1 + P_1 z_1 + P_0(1+b)z_2 - \psi/2\mathrm{Var}(P)z_1^2 \tag{4}$$

Subject to

$$z_1 z_2 \leqslant \overline{A}, \quad z_1, z_2 \geqslant 0$$

Given that the objective function is strictly concave and the constraint function is convex and assuming an interior solution the supply of land to the rental market made available by the investor/landlord is equal to Eq. (5)

$$z_1 = \frac{R + (P_1 - P_0) - bP_0}{\psi\mathrm{Var}(P)} \tag{5}$$

From Eq. (5) it can be observed that the supply of rental land is inversely related to the riskiness of the future value of land. The intuition is

that in order for investors to supply rental land, they must be willing to retain the asset over an additional time period. Furthermore, as expected a positive change in the expected level of capital gains, $(P_1 - P_0)$, increases the supply of rental land. The reason is that a higher level of expected capital gains increases the total expected return of retaining the investment in land for yet another time period. Hence, a strategy of retaining invested capital in land for another time period, versus selling off land and investing the proceeds in bonds, becomes more favorable. Finally, from Eq. (5) it is apparent that an increasing level of absolute risk aversion among landlords/owners will reduce the supply of rental land. The phenomenon is due to the fact if the landlord/owner is relatively risk averse, he/she will be less inclined to hold on to the land for another time period and thereby face exposure towards asset price risk.

4. Market equilibrium

This section of the paper applies a partial equilibrium framework and some basic contractual theory to examine the market equilibrium properties for owner operated and rental land. The question is posed to what extent the optimal behavior of investors/landlords affect the equilibrium allocation of rental acreage in the economy. Or expressed in other terms: would it even be feasible to achieve a functioning agricultural economy based on solely rental and/or owner operated land? The issue is pertinent with respect to the ongoing privatization process in eastern European countries where the policies may frequently be directed towards creating an agricultural economy with a substantial emphasis on creating owner operated land for producers (Brooks and Lerman, 1993; Binswanger et al., 1993).

The model structure closely resembles Reid (1976) and Stiglitz (1974) where the tenancy issue is analyzed from both the landlord/investor's perspective and that of the farmer. However, neither Stiglitz (1974), nor Reid (1976) considers the possibility of a land transfer between the landowner and the farmer. In addition, land price risk is not taken into account in their analysis. The equilibrium conditions are based upon the following simplifying assumptions about the nature of the markets.

(1) There exist m identical landowners/investors, each owning $\overline{A}$ of land.

(2) There exist n identical farmers/operators that are 'destined' to farm the land. They are the only agents in the economy that will operate the land through either a rental and/or a ownership arrangement. For each of the farmers the maximum farm size is $\overline{A}$.

(3) In the simplest case the numbers of farmers and landlords/investors are assumed to be identical, i.e. $m = n$.

(4) The landlords and the farmers have identical expectations about future prices of land, P_1, as well as the uncertainty surrounding the price, i.e. Var(P) are identical.

(5) In market equilibrium the supply of rental land is equal to the demand for rental land, that is $x_1 = z_1$. Furthermore, the demand for owner operated land is equal to the acreage of land that the landlords/investors are willing to sell. Hence, we have $x_2 = z_2$ and the constraints functions are satisfied with equality.

In the maximization problem for the landlord/investor the reservation utility for the landlord is ensured through the introduction of the riskless asset that yields $b \times 100\%$. In the model market clearing is handled analogously to Reid's model (1976) where demand and supply of rental land are equated. Since the rental market clears, it follows that owner operated land and land sold at $t = 0$ are also equated since no land is assumed to be left idle in equilibrium. $\overline{A}$ is further assumed to represent a 'sufficiently small' farm. The demand function for rental land (2) and the supply of rental land (5) in the agricultural economy are equated using assumption (5). The fixed rent per acre in equilibrium is obtained as $R^{*\mathrm{I}}$ in Eq. (6). Substituting $R^{*\mathrm{I}}$ into Eq. (5) yields the rental acreage in equilibrium $x_1^{*\mathrm{I}}$ according to Eq. (7)

$$R^{*\mathrm{I}} = (P_0 - P_1) + \frac{\gamma}{\gamma + \psi} P_0 b + \frac{\psi}{\gamma + \psi}\{P_0 r + \gamma \overline{A}[\mathrm{Var}(P) + \mathrm{Cov}(P,c)]\} \quad (6)$$

It may be noted that in the presence of perfect capital markets, i.e. r = b and either landlords or farmers are risk neutral, then Eq. (6) collapses to

$$P_0 = \frac{R + P_1}{(1 + r)}$$

Hence, P_0 is the present value of an asset at time $t = 0$ that generates a revenue of R and P_1 at time $t = 1$ discounted by the investors discount rate of $(r + 1)$. This is the general formula implied by asset pricing theory (Lucas, 1978).

Imperfections in the credit markets are considered by introducing a wedge between the lending and borrowing rates, $(r - b)$. In general, it may be argued that the borrowing rate exceeds the lending rate, i.e. $r > b$

$$x_1^{*\mathrm{I}} = \frac{P_0(r - b)}{(\gamma + \psi)\mathrm{Var}(P)} + \frac{\gamma}{\gamma + \psi}\overline{\mathrm{A}}\left(1 + \frac{\mathrm{Cov}(P,c)}{\mathrm{Var}(P)}\right) \quad (7)$$

In the presence of perfect capital markets, i.e. $r = b$, Eq. (7) simplifies to Eq. (8)

$$x_1^* = \frac{\gamma}{\gamma + \psi}\overline{\mathrm{A}}\left(1 + \frac{\mathrm{Cov}(P,c)}{\mathrm{Var}(P)}\right) \quad (8)$$

The result, according to Eq. (8), is an interesting result commonly obtained in finance literature, see for example Shah and Thakor (1988). The result in Eq. (8) demonstrates that the risk associated with the future price of land and agricultural earnings is shared between the landlord/investor and the farmer in inverse proportion to their absolute coefficients of risk aversion adjusted for an 'adjustment factor', $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$. The investor/landlord retains his/her ownership of x_1^* acres which are rented by the farmer. The farmer's share of the acreage is the inverse proportion, i.e. $\gamma/\gamma + \psi$, which is commonly referred to as the risk sharing ratio (Shah and Thakor, 1988). The explanation is that for the section of land that is rented out the landlord/investor assumes the price risk up until $t = 1$, when he/she can sell the asset in the open market. In this case there exist three sources of risk: land price risk and price and production risk, i.e. $\mathrm{Var}(c)$. Consequently an 'adjustment factor' $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$ similar to the 'optimal hedge ratio' frequently derived in the economic literature analyzing futures markets (Myers and Thompson, 1989), is introduced in the expression for the optimal rental acreage. Given that the covariance between land price and earnings in the agricultural sector is positive, the rental acreage in equilibrium will increase as the covariance increases. Furthermore, the importance of this adjustment factor is accentuated as farmers become increasingly risk averse relative to landlords.

Existence of imperfections in the credit markets causes the equilibrium rental acreage $x_1^{*\mathrm{I}}$ to increase since

$$\frac{P_0(r - b)}{(\gamma + \psi)\mathrm{Var}(P)} > 0$$

From Eq. (7) it may also be noticed that the increase in rental acreage originating from credit market imperfections is decreasing with increasing riskiness of the future price of land ($\mathrm{Var}(P)$). In addition, $\mathrm{P_0(r - b)}/(\gamma + \psi)\mathrm{Var(P)}$ is decreasing with the absolute coefficient of risk aversion of the farmer/landlord.

5. Implications of disparities in bargaining power

5.1. Fixed rental rates control

The previous results according to Eqs. (7) and (8) represent the competitive equilibrium allocation. Both agents are assumed to take prevailing market prices as given not to be affected by their or other agents' actions when they solve their respective optimization problems. This section of the paper introduces disparities in bargaining power through the assumption of Stackelberg behavior in the markets for owner operated and rental land (Varian, 1992). The farmer is assumed to be the follower and he/she still maximizes program (1). The landlord/investor is assumed to be the leader and maximizes his/her objective function given the farmer's best response. In the first case of the analyses the landlord/investor is

assumed to maximize the objective function choosing the level of fixed rent while taking P_0 as given. The assumption of the landlord/investor taking the price of land as given may be justified since his/her relative power is potentially more accentuated in terms of setting the fixed rent, rather than determining the price of land in any possible transaction involving land. The landlord's planning problem is then defined by Eq. (9)

$$\begin{aligned}\underset{(R,\mu)}{\text{Maximize}}\ & H(x_1^f, x_2^f, \mu) \\ &= Rx_1^f + P_1 x_1^f + P_0(1+b)x_2^f \\ &\quad - \psi/2\,\mathrm{Var}(P)x_1^{f2} + \mu(\overline{A} - x_1^f - x_2^f) \end{aligned} \tag{9}$$

x_1^f and x_2^f denote the farmer's solution to program (1) where he/she takes prevailing prices of land and rental rates as given. x_1^f is defined by Eq. (2). Using the assumption of no idle land then, $x_2^f = \overline{A} - x_1^f$. A first order necessary condition for maximizing program (9) yields after simplifications

$$\begin{aligned}\frac{\partial H}{\partial R} &= -R + (P_0 - P_1) + \frac{P_0(r + b + r(\psi/\gamma))}{\left(2 + \frac{\psi}{\gamma}\right)} \\ &\quad + \frac{(\gamma + \psi)\overline{A}}{\left(2 + \frac{\psi}{\gamma}\right)}(\mathrm{Var}(P) + \mathrm{Cov}(P,c)) = 0 \end{aligned} \tag{10}$$

The equilibrium rent $R^{*\mathrm{S(R)I}}$ is established as

$$\begin{aligned}R^{*\mathrm{S(R)I}} &= (P_0 - P_1) + \frac{P_0(r + b + r(\psi/\gamma))}{\left(2 + \frac{\psi}{\gamma}\right)} \\ &\quad + \frac{(\gamma + \psi)\overline{A}(\mathrm{Var}(P) + \mathrm{Cov}(P,c))}{\left(2 + \frac{\psi}{\gamma}\right)} \end{aligned} \tag{11}$$

Incorporating the assumption of no idle land and substituting Eq. (11) into Eq. (2), yields the rental acreage in equilibrium according to Eq. (12). The equilibrium allocation is denoted $x_1^{*\mathrm{S(R)I}}$ to account for a Stackelberg equilibrium with imperfect capital markets where the landlord chooses the fixed rent per acre

$$\begin{aligned}x_1^{*\mathrm{S(R)I}} &= \frac{P_0(r-b)}{(2\gamma + \psi)\mathrm{Var}(P)} \\ &\quad + \frac{\gamma\overline{A}}{(2\gamma + \psi)}\left(1 + \frac{\mathrm{Cov}(P,c)}{\mathrm{Var}(P)}\right) \end{aligned} \tag{12}$$

The interesting feature of the Stackelberg equilibrium is that the farmer's risk aversion coefficient affects the optimal allocation of rental and owner operated land in a similar manner to the competitive equilibrium solution. Existence of imperfections in the credit markets, i.e. $r > b$, increases the acreage of rented land. As in the competitive equilibrium case, an increase in the riskiness of land price mitigates the effect of credit market imperfections upon the tenancy structure. Furthermore, Eq. (12) implies that for low levels of the landlord's risk aversion coefficient relative to the farmer's ($\psi \ll \gamma$), a low level of $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$ and perfect capital markets ($r = b$), then the rental acreage will account for approximately 50% of the total acreage of agricultural land. If the landlords and farmers are equally risk averse, that is, $\gamma = \psi$, the covariance is sufficiently small and credit markets are perfect, then the rental acreage in equilibrium is approximately 33%. This assertion follows directly from a numerical evaluation of Eq. (12). From Eqs. (7) and (12) it also follows that the rental acreage in Stackelberg equilibrium is always less than the rental acreage in competitive equilibrium. This follows since

$$x_1^{*\mathrm{S(R)I}}/x_1^{*\mathrm{I}} = (\gamma + \psi)/(2\gamma + \psi) < 1.0$$
$$\nabla\ \gamma, \psi > 0$$

It is noteworthy to observe that this result holds irrespective of whether imperfections prevail in the credit markets. The difference in rental acreage is further accentuated if the farmer is highly risk averse. A Stackelberg equilibrium where the landlord has a relatively stronger bargaining position, therefore, reduces the use of rental markets in agriculture. Consequently, the optimal risk sharing result, $\gamma/(\gamma + \psi)$, breaks down but the landlord compensates him/herself

for the reduction of rented acreage by increasing the rent per acre. Given that the landlord/investor can operate in an institutional environment where he/she has the bargaining strength to set the rent, then the landlord can reduce his/her risk exposure to asset price risk and simultaneously receive a higher rent. It can be formally demonstrated that, by subtracting Eq. (6) from Eq. (11)

$$\begin{aligned}&(R^{*(\mathrm{R})\mathrm{I}} - R^{*\mathrm{I}}) > 0\\ &\Leftrightarrow P_0(\gamma^2(r-b))\\ &\quad + \gamma^3\overline{\mathrm{A}}(\mathrm{Var}(P) + \mathrm{Cov}(P,c))\\ &\quad > 0\end{aligned}$$

Since $r \geq b$, $\gamma > 0$, Cov(P, c) by assumption and $\overline{\mathrm{A}}$, Var(P) > 0 then it follows that $R^{*(\mathrm{R})\mathrm{I}} > R^{*\mathrm{I}}$. In contrast, the farmer assumes a higher level of asset price risk exposure owing to a higher proportion of owner operated land.

5.2. Fixed rental rates and asset price control

Now, assume that the bargaining position of the landlords/investors is further accentuated. In addition to setting the fixed rent R, the landlord is also able to set the price P_0 at which transactions of land occur. This may characterize a situation with dominant landowners in a geographically limited area with a multitude of farms where the landowner is able to stipulate the conditions of transactions occurring in the land market. The assumption, implying extreme disparities in bargaining power between landlords and farmers, is atypical for the situation facing agriculture in developed countries. Nevertheless, it is of interest to examine the robustness of the model for a situation quite different from the original problem. Given the newly added assumptions, the landlord/investor solves the following problem

$$\begin{aligned}&\underset{(R,P_0,\mu)}{\text{Maximize}}\ H(x_1^f, x_2^f, \mu)\\ &= Rx_1^f + P_1x_1^f + P_0(1+b)x_2^f\\ &\quad - \psi/2\mathrm{Var}(P)x_1^{f2} + \mu(\overline{\mathrm{A}} - x_1^f - x_2^f)\end{aligned} \tag{13}$$

By solving program (13) in a similar manner as program (9) a closed form solution for the Stackelberg equilibrium allocation is obtained. Define $I^f = (1+b)/(1+r)$, i.e. a measure of imperfections in the credit market. Furthermore, define $K = \overline{\mathrm{A}}(\mathrm{Var}(P) + \mathrm{Cov}(P,c))$. Then, first order necessary conditions for maximizing program (13) with respect to R and P_0 assuming no idle land yield

$$\begin{aligned}\frac{\partial H}{\partial R} &= -R + (P_0 - P_1) + \frac{P_0(r + b + r(\psi/\gamma))}{\left(2 + \dfrac{\psi}{\gamma}\right)}\\ &\quad + \frac{(\gamma+\psi)K}{\left(2 + \dfrac{\psi}{\gamma}\right)} = 0\end{aligned} \tag{14}$$

$$\begin{aligned}\frac{\partial H}{\partial P_0} &= (R + P_1)(1 + I^f + (\psi/\gamma)) - P_0(2(1+b)\\ &\quad + (1+r)(\psi/\gamma)) + I^f\overline{\mathrm{A}}\gamma\mathrm{Var}(P)\\ &\quad - K(I^f\gamma + \psi) = 0\end{aligned} \tag{15}$$

Equating (14) and (15), solving for the equilibrium rent and substituting into Eq. (1) yields the equilibrium acreage, denoted $x_1^{*\mathrm{S(R,P)I}}$ to account for credit imperfections, as a function of parameter values and land price according to Eq. (16)

$$\begin{aligned}x_1^{*\mathrm{S(R,P)I}} &= \frac{P_0[(r-b) + (r - r \times I^f) + (1 - I^f)]}{[\gamma(3 + I^f) + 2\psi]\mathrm{Var}(P)}\\ &\quad + \frac{\gamma\overline{\mathrm{A}}}{\gamma(3 + I^f) + 2\psi}\\ &\quad \times \left((2 + I^f) + 2\frac{\mathrm{Cov}(P,c)}{\mathrm{Var}(P)}\right)\end{aligned} \tag{16}$$

If capital markets are perfect, i.e. $r = b$ and $I^f = 1$ then Eq. (16) simplifies to

$$x_1^{*\mathrm{S(R,P)}} = \frac{3\gamma\overline{\mathrm{A}}}{4\gamma + 2\psi} + \frac{\gamma\overline{\mathrm{A}}}{2\gamma + \psi}\left(\frac{\mathrm{Cov}(P,c)}{\mathrm{Var}(P)}\right) \tag{17}$$

The similarity between Eqs. (17) and (12) is noticeable. As in the case where the landlord only chooses the fixed rent, the equilibrium allocation depends upon the magnitude of asset price risk and the covariation of agricultural earnings and asset prices and the coefficients of absolute risk aversion. As in the case where the landlord

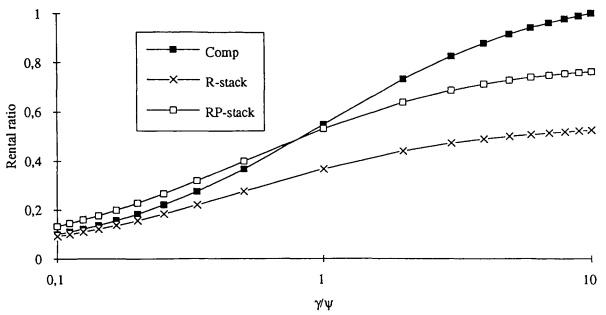

Fig. 1. Comparison of rental ratios given differences in bargaining power and coefficient of absolute risk aversion in the presence of perfect credit markets ($r = b$). Comp, x_1^* competitive equilibrium allocation; R-stack, $x_1^{*S(R)}$ allocation; RP-stack, $x_1^{*S(R,P)}$ allocation.

solely controls the rent, an 'adjustment factor' is introduced in the presence of imperfect capital markets, resulting in an increase of the rental acreage. When the landlord's market power is further enhanced, the rental acreage in equilibrium increases relative to the situation where the landlord solely controls the rent. The assertion follows straightforward for the case where $r = b$ by Eq. (18)

$$\frac{3\gamma\bar{A}}{4\gamma + 2\psi} > \frac{\gamma\bar{A}}{2\gamma + \psi} \tag{18}$$

Furthermore, given that the farmer is more risk averse than the landlord and for $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$ small, it can be shown that the rental acreage in Stackelberg equilibrium, $x_1^{*S(R,P)}$ is less than the competitive equilibrium allocation. This result follows since

$$\frac{3\gamma\bar{A}}{4\gamma + 2\psi} < \frac{\gamma\bar{A}}{\gamma + \psi} \quad \text{for } \gamma > \psi$$

If the landlord is more risk averse than the farmer the reverse result occurs. In both cases, the optimal risk sharing result breaks down. It is noticeable that in a situation where the farmer is more risk averse than the landlord, and consequently would benefit relatively more from risk sharing provided by rental markets, the Stackelberg equilibrium solutions, $x_1^{*S(R)}$ and $x_1^{*S(R,P)}$, reduce the access to these markets. The farmer is worse off since the landlord can exercise his/her market power through the markets for rental and owner operated land, thereby reducing the farmer's access to rental land. It is only in a situation where the farmer's and the landlord's risk aversion coefficients coincide and for $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$ small, that the Stackelberg allocation $x_1^{*S(R,P)}$ is close to the optimal risk sharing ratio result for competitive markets. The intuition is that since the equally risk averse landlord/investor is the leader dictating the prices in both markets, he/she has to provide the farmer with a balanced risk adjusted cost for rental land as well as owner operated land. Thereby, the landlord facilitates the use of both forms of property rights institutions.

6. Simulations

6.1. Data

Some of the equilibrium allocations become complex, especially in the presence of credit market imperfections. Consequently, numerical evaluations of the various equilibrium allocations are conducted. In Fig. 1 simulations for the case of perfect capital markets are illustrated. Numerical evaluations for the benchmark case of imperfect capital markets are shown in Fig. 2. A sensitivity analysis is conducted in order to examine how the tenancy ratio ($x_1^{*O}/\bar{A}$) depends upon the relative magnitudes of the farmer's risk aversion coefficients versus the landlord's (i.e. γ/ψ).

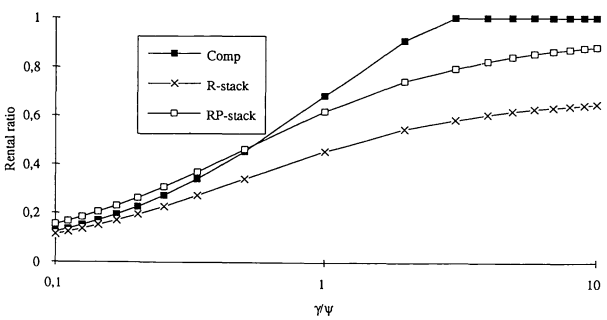

Fig. 2. Comparison of rental ratios given differences in bargaining power and coefficient of absolute risk aversion when credit markets are imperfect ($r > b$). Comp, x_1^{*I} competitive equilibrium allocation; R-stack, $x_1^{*S(R)I}$ allocation; RP-stack, $x_1^{*S(R,P)I}$ allocation.

An estimate of the ratio $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$ amounting to 0.10 is obtained from the covariance matrix of conditional 1 year ahead forecasting errors utilizing a vector auto regressive system (Andersson, 1989) including variables such as asset prices, real interest rates, crop returns for corn and soybeans, government payments etc. (A sensitivity analysis was conducted in order to examine the stability of the results with respect to variations in the estimated ratio $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$. The results of the simulations were only marginally affected by changes in this ratio.) Annual data for the referred system variables were collected for the state of Minnesota over the period 1933–1984. The system was estimated with a lag length of three. The ratio $\mathrm{Cov}(P,c)/\mathrm{Var}(P)$ was estimated from the matrix of forecasting errors on the premise that corn and soybeans are grown in equal proportions (Southwestern Minnesota Farm Business Management Association, 1985). Hence, in this paper the state of Minnesota, for illustrative purposes, represents the production and price risk as well as asset price risk that farmers face in a relatively deregulated agricultural economy in developed countries where family/privately operated farms dominate.

Parameter values for $(r-b)$, I^f and $(r-r\times I^f)$ were estimated based on the average real interest rate on US Treasury bonds and the real interest rate on long term commercial bank loans over the period 1980–1990 (US Department of Agriculture, 1994). Estimated values amounted to 0.0286, 0.9734 and 0.0008. Initial price of land, P_0, amounted to \$1601 acre (Andersson, 1989). An estimate of farm size $\overline{A}$ was obtained as the average farm size of 521.4 acres in southwestern and southeastern Minnesota. Finally, the base value for the absolute coefficient of risk aversion, $\gamma = 0.0000756$, was obtained from a study of risk aversion among farmers in Minnesota (Wilson and Eidman, 1983).

6.2. Results

As expected, the simulations show that the competitive allocation, where no disparities in bargaining power are assumed, yields a low tenancy ratio if the farmer is characterized by a low level of absolute risk aversion relative to the landlord/investor ($\gamma \ll \psi$). It is also noticeable that the discrepancy between the Stackelberg allocations and the competitive allocation is increasing with increasing degree of risk aversion of the farmer versus the landlord. Fig. 1 reveals that if the farmer is highly risk averse the presence of disparities in bargaining power results in a rather substantial deviation from the competitive equilibrium allocation. In the event that the farmer is characterized by a relatively low level of risk aversion (i.e. $\gamma = 0.00000756$) relative to the landlord/investor ($\psi = 0.0000756$) there exist only minor differences between the allocations exhibited in Fig. 1.

In Fig. 2 the tenancy ratios are displayed for the case of imperfect capital markets. As expected, the tenancy ratios increase when market imperfections are introduced. If the farmer is highly risk averse relative to the landlord, a corner solution ($x_2^{*\,\mathrm{I}} = 0$) is obtained for the competitive allocation. In order to examine the Ceteris Paribus impact of imperfections in the capital markets, the difference between the tenancy ratios are examined in Fig. 3. Fig. 3 reveals that imperfections in the capital market have a relatively minor impact upon the equilibrium ratios if landlords are substantially more risk averse than farmers. This conclusion is relatively robust, irrespective of whether or not disparities in bargaining power exist. If both parties are equally risk

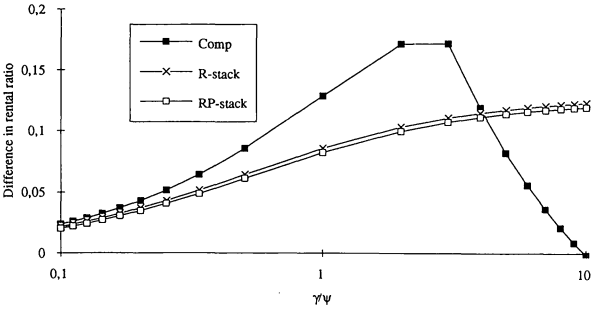

Fig. 3. Comparison of differences in rental ratios given differences in bargaining power, coefficient of absolute risk aversion and credit market conditions. Comp, difference in $x_1^{*\,\mathrm{I}}$ and x_1^* equilibrium allocations; R-stack, difference in $x_1^{*\,\mathrm{S(R)I}}$ and $x_1^{*\,\mathrm{S(R)}}$ allocations; RP-stack, difference in $x_1^{*\,\mathrm{S(R,P)I}}$ and $x_1^{*\,\mathrm{S(R,P)}}$ allocations.

averse, then imperfections in the capital markets tend to increase the tenancy ratio with 0.08–0.13 units. In general, rather minor differences can be observed between the two allocations representing disparities in bargaining power. This result is not surprising and can be inferred from an examination of the first terms of Eqs. (12) and (13).

Finally, if the landlord is risk neutral and if the covariance between land price and earnings (Cov(P,c)) is small, then the rental acreage will amount to 75% of all land. This follows from a numerical evaluation of Eq. (17). A Stackelberg equilibrium, where a close to risk neutral landlord/investor controls both the rental rate and the price of land in prospective transfers, represents an institutional system with a remarkable relative influence of the owner. In other words, an agricultural structure would prevail where the major portion of land is farmed as rental land. This is quite the contrary to what can be observed in the US and European rental markets (Grossman and Brussard, 1992). The empirical evidence from these markets therefore provide little support in favor of the existence of extreme differences in bargaining power as implied by a Stackelberg equilibrium where the landlord controls asset prices as well as rental rates (the $x_1^{*\,S(R,P)I}$ allocation).

7. Conclusion

The analysis has demonstrated that in the presence of disparities in bargaining power between farmers and landlords, the traditional role of tenancy as a risk diversifying/sharing mechanism in the agricultural sector breaks down. The problem is compounded in a situation characterized by a high degree of risk aversion among farmers relative to landlords. In the situation depicted, the issues pertaining to possible explanations for differences in risk aversion (Tauer, 1986) among different categories of actors in the land and rental markets warrants additional attention. This is especially the case if farmers are believed to be highly risk averse.

A key conclusion is therefore that the introduction of policies designed to facilitate the emergence of functioning land and rental markets in developed countries (DCs) as well as LDCs as part of a land reform and/or privatization process therefore ought to be preceded by careful examination of potential imperfections in land and rental markets with respect to bargaining power.

Not surprisingly, the analysis has demonstrated that in the presence of imperfect capital markets, the use of rental arrangements tends to increase in the agricultural sector. If privatization programs are introduced with the explicit objective of facilitating the emergence of owner operated family farms, this policy may obviously be hampered by the mentioned imperfections (Csaki and Lerman, 1993; Hristova and Maddock, 1993). The analysis shows that even in the presence of numerically modest values measuring the degree of imperfections, the impacts are far from negligible. Furthermore, empirical evidence from land reform and restructuring in Russia indicates that as of 1 January 1993, only 10% of the land was registered in the private sector (Brooks and Lerman, 1993) while 90% was registered in collective form. Recent studies indicate a considerable use of rental arrangements since 63% of the state and collective farms in Russia use some form of rental contracts with farmers/producers (Csaki and Lerman, 1993).

Obviously, simulations based upon the derived models support the notion that there may be substantial problems associated with introducing land polices designed to strongly favor privatization and/or owner operated farms as indicated by Brooks and Lerman (1993) and Csaki and Brooks (1993). These problems are drastically compounded if the prospective owner operators are highly risk averse relative to the individuals/affiliations of individuals that control land either as state property or through collective ownership and the latter category is characterized by close to risk neutral behavior. The theoretical as well as empirical results indicate that in the situation depicted, private farmers would prefer to rent a major share of land (Brooks and Lerman, 1993). This tendency is accentuated if both parties act on perfectly competitive land and rental markets. If, however, owners of land are able to exercise bargaining power by controlling the fixed rent,

then the use of rental land would decrease. Owners would compensate themselves by charging a higher fixed rent, thereby implicitly forcing farmers to 'unwillingly' assume some of the asset price risk.

Finally, Petit and Brooks (1994) argue: 'prominent among these are secure property rights, including rights to mortgage and sell land. Rights to buy and sell land freely are uniformly lacking in post-communist societies.' (p. 484). Hence, this analysis demonstrates both theoretical and empirical support of the importance of a functioning institutional system that defines property rights in the agricultural sector. Property rights ought to be defined in such a manner that participants in the land and rental markets are able to freely choose a well balanced portfolio of owner operated and rented land.

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