Australian Journal of Agricultural Economics, Vol. 23, No. 2 (August 1979), pp. 116-127.

EXPLAINING VARIATIONS IN SHARE CONTRACTS: LAND QUALITY, POPULATION PRESSURE AND TECHNOLOGICAL CHANGE

JAMES ROUMASSET and WILLIAM JAMES*

Substantial variations in landowner's share under sharecropping arrangements are documented. Partial relationships between landowner's share and land quality and between landowner's share and physiological population density are explained by extensions of the competitive theory of share tenancy. It is shown that high landowner's share can be expected to be associated with high land quality and/or high physiological density. The tendency for increases in population to be associated with increases in landlords' shares can be ameliorated by land-saving technological change.

Introduction

There is a widespread consensus in agricultural development circles currently that 'institutional constraints' have prevented the technological innovations of the 1960s from reaching their full potential in the 1970s. Before condemning traditional economic institutions as impediments to development, we should have a better understanding of what those institutions are and why they persist. We take it for granted, however, that existing knowledge of institutions is insufficient to produce a general theory of socio-economic equilibrium with endogenous institutions. Lacking that, one can proceed inductively to describe and explain specific institutions.

In the present paper we examine the agricultural institution of share tenancy and focus particularly on variations in the landowner's percentage share of the harvest. Our objective is to document patterns relating landowners' shares to certain exogenous variables and to explain those patterns by extending the competitive theory of share tenancy. In the next two sections, we document and explain the partial relationships between landowner share and land quality and between landowner share and physiological population density. In the fourth section the two explanations are combined and additional data are used to provide a preliminary test of the explanatory model. The relationship between landowner share and technological change is discussed in the last section.

* James Roumasset is the Agricultural Development Council visiting professor at the University of the Philippines and associate professor in the Department of Economics at the University of Hawaii. William James is assistant professor in the Department of Economics and Business Administration at the University of Redlands. We are indebted to Yujiro Hayami, John Power and Charles Roumasset for helpful comments on previous drafts. We would also like to thank the National Science Foundation for research support under grant number SOC 76-83845, administered by the University of Hawaii.

Landowner's Share and Land Quality

Preliminary observations of the pattern

It is common to presume that the sharing of output is almost always on a 50:50 basis.[1] Cheung (1969, pp. 56-7), however, cites evidence from China and Taiwan showing not only that landowner shares vary widely, but that they are correlated with the 'fertility of land'.

Some years ago it came to our attention that, in parts of the Philippines, farmers followed an informal classification of rice land into first-class, second-class and third-class land. The classification was based on an implicit agreement regarding the productivity of the land.[2] By a corresponding pact, landowners received 50 per cent of the gross income of first-class land, 40 per cent on second-class land and 30 per cent on third-class land.[3] The same pattern can also be documented by regressing landowner's share (Y) on yield (in 44 kg cavans) per hectare (x_1). [Since inputs are correlated with land quality, yield per hectare provides a rough proxy for productivity (Roumasset 1976, Ch. 4.)] Two sets of data are used. The first set of cross-section data is for 67 share-tenanted farms in two Philippine rice provinces, Laguna and Albay, for the 1971 wet season (Roumasset 1976, Ch. 4, 6). The second data set is for 36 share tenants in the Philippine provinces of Palawan and Pangasinan for the 1971 wet season. The regression estimates for the two equations are given below:

$$\hat{Y} = 0{\cdot}36 + \underset{(3{\cdot}65)}{0{\cdot}0013x_1} \qquad R^2 = 0{\cdot}22$$

$$Y = 0{\cdot}19 + \underset{(3{\cdot}98)}{0{\cdot}0033x_1} \qquad R^2 = 0{\cdot}30$$

Both regressions are significant at the 1 per cent level (t-values in parentheses).

In West Bengal, India where rice farming predominates, a study of sharecropping arrangements in 89 villages bore out the quality-share relationship once again (Rudra 1975). Rudra noted that in the village of Parudanga a 60 per cent landlord's share is observed on superior quality land as a variant of the usual 50:50 division of the crop. The author noted that differences in the output shares, 'sometimes . . . are due to differences in soil quality'.[4] Geertz (1965) also reported that in Java, Indonesia, landowner shares ranged from one-third to one-half and that land quality was one of the major determinants of the landowner shares.

[1] Some authors have even advanced explanations of why sharing rates tend to be 50:50 (see, e.g. Bell and Zusman 1976, and Hurwicz and Shapiro 1978).

[2] Roumasset (1976). Land quality includes not only soil quality, but topography, irrigation and predisposition to damages from pests and weather. An ideal index of land quality is expected profits per hectare per year, given efficient management.

[3] Roumasset (1979). In the barrios where this system was observed, the irrigated land was classified as first class. Second-class land consisted of good rainfed land. Third-class land consisted of rainfed land with additional problems (i.e. soil deficiencies or land containing large boulders). This particular rural institution died out shortly after the Philippine Government accelerated the land reform program in 1972.

[4] Rudra (1975). He warns that his findings do not provide sufficient basis for drawing any conclusions. He notes that an exception to the positive relationship expected between landowner's share and land quality was found.

The quality-share relationship is also in evidence for other crops. Landowners' shares on coconut farms in the Philippines were reported to range from 45 per cent to 90 per cent (Bernal-Torres and Sandoval 1967; Escover 1979). Preliminary results from a survey of coconut farms in the Bicol region of the Philippines indicate that the most common landowner's share is two-thirds, and the second most common share is one-half. The one-half sharing arrangement occurs in areas of below average productivity, especially in the province of Catanduanes where adverse weather conditions, lower soil fertility, and irregular planting combine to keep per hectare yields low.[5]

One can also cite exceptions to the positive association between land quality and landowner share. For example, Bell (1977) found that, for his sample of tenants in Bihar, India, landowners' shares were 50 per cent with few exceptions, despite substantial variation in the inherent productivity of the land. For the purpose of the following sections, however, we assume that a positive correlation between landowner's share and land quality can be commonly observed and that the association is usually not a spurious one.

Explanatory model

Abstracting from uncertainty[6], assume that production per hectare per season, q, can be expressed as a function of labour per hectare, l, i.e.

$$q = f_i(l),$$

where i is an ordinal index of the quality of land, the lower numbers corresponding to the better classes of land.[7] Assume further that there is some level of labour per hectare, l^0, such that additional land is redundant, i.e. its marginal product is zero. We can order types of land according to quality by the following postulates. First, the marginal product of labour will be higher on better quality land if both are farmed at the same level of labour intensity. That is, $i < j$ implies $f'_i(l) > f'(l)$. Second, the marginal product of good quality land cannot become zero at a lower land intensity (higher labour intensity). That is, $l^0_i \leqslant l^0_j$ for $i < j$. Intuitively, if we think of adding successive units of poor quality land to a fixed amount of labour, land will become redundant (i.e. its marginal product will reach zero) either before or at the same time that good quality land will become redundant.

The equilibrium condition is that the marginal products of labour must be equal across farms; otherwise recontracting could increase production without increasing inputs. Thus, we require,

$$f'_i(l^*_i) = f'_j(l^*_j),$$

where l^*_i is the equilibrium labour intensity of the ith land type. This implies that labour intensity varies directly with land quality. These relationships are all illustrated in Figure 1 for three types of land; where w_s is the equilibrium wage and l^*_3, l^*_2 and l^*_1 are the equilibrium labour intensities for each type of land.

[5] In addition, farms operating on a wage basis had the highest yields (Escover 1979). This is consistent with our hypothesised relationship since wage contracts are similar to share contracts with the landowner's share approaching a maximum.

[6] Alternatively $f(l)$ can be regarded as the expected production function.

[7] That is, $i = 1$ corresponds to first-class land, $i = 2$ corresponds to second-class land, and so on.

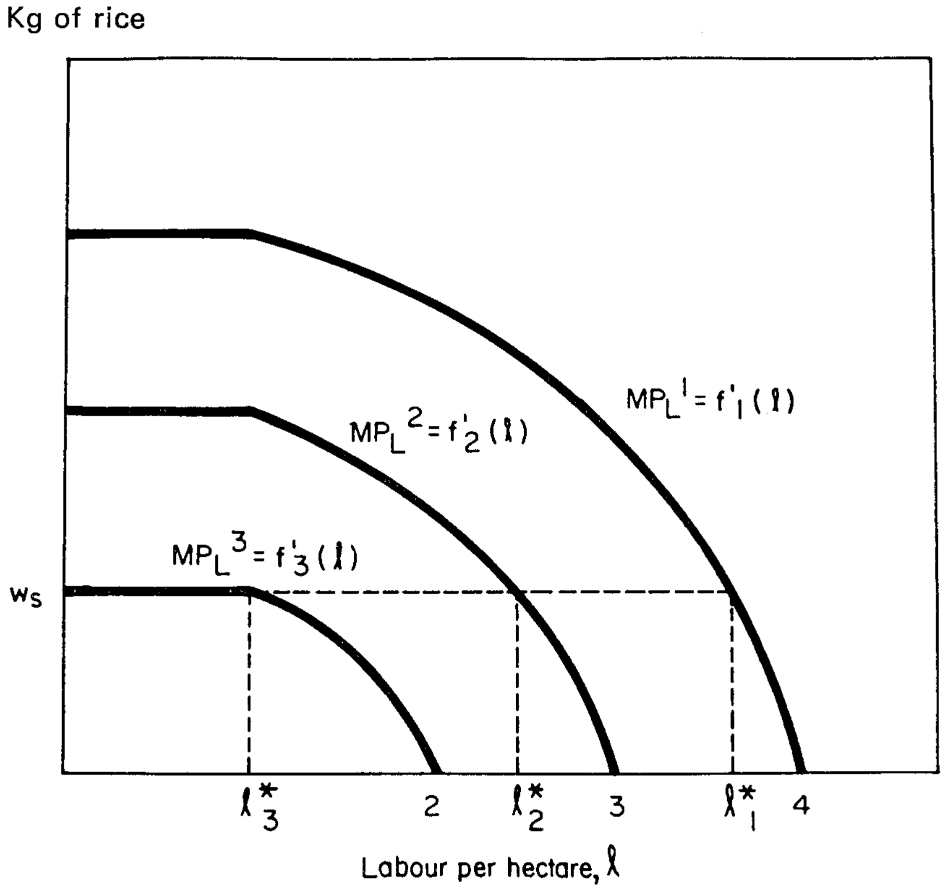

FIGURE 1

The same relationships are illustrated in Figure 2, this time with actual labour, L, on the horizontal axis. $MP_L(H_i)$ denotes the marginal product of labour with H_i units of land type i, where

$$H_i = L'/l^*_i$$

is the number of hectares required to work with land type i and a fixed labour endowment, L', in order to maintain labour intensity at l^*_i.

Figure 2 is derived from Figure 1 as follows. First, define H_1 to be equal to 1. This can be done without loss of generality, e.g. by defining the land unit as H_1. Now, solve for H_2 and H_3 by dividing L' (in this case 4) by l^*_2 and l^*_3, respectively. Now that H_1, H_2 and H_3 are known, the labour intensity for any given point on the horizontal axis can be determined. Next, the marginal product of labour can be read from Figure 1 and transposed to Figure 2. Figure 2 contains only information contained in Figure 1. Therefore, the relationships shown in Figure 2 are implicit in Figure 1.

The important relationships between the curves in Figure 2 are as follows. First, the flat portion of a curve corresponding to a particular quality of land must be longer than the flat portion of the curve of the

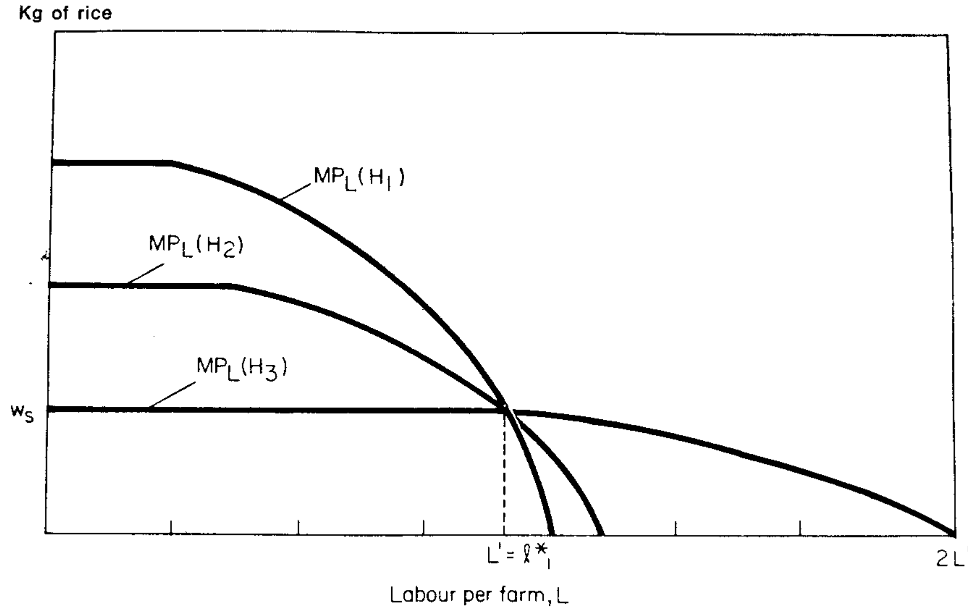

FIGURE 2

marginal product curve of the better quality land. This follows even for the case depicted in Figure 1 where l^0_1, l^0_2 and l^0_3 are all equal. If $l^0_1 < l^0_2 < l^0_3$, the differences in the lengths of the flat portion of Figure 2 will be even more pronounced. The second relationship is that the marginal product curve for a better quality land cuts the corresponding marginal product curve for a poorer quality land from above. These relationships are not a consequence of the particular shape of the curve shown in Figure 1. (The reader may wish to verify this informally by trying to construct an alternative version of Figure 1 such that the corresponding curves in Figure 2 do not have the prescribed relationships.[8])

Since equilibrium labour intensity is higher for better quality land, $H_1 < H_2 < H_3$. Equilibrium rent, R_i, is the area under the $MP_L(H_i)$ curve to the left of L' excluding the area below w_s. Since $MP_L(H_i) >$

[8] An alternative definition of better quality land may be given by the condition that the same output can be produced with less land, less labour or less of both factors, i.e. an improvement in land quality is represented by an inward shift in a given isoquant. The result illustrated in Figure 2, that the marginal product of labour of good quality land cuts the marginal product of poorer quality land from above, continues to hold for this case provided we rule out the rather perverse case wherein poor quality land has a higher elasticity of substitution than good quality land.

If land quality is defined in terms of efficiency units, the stated relationships do not hold (Bell 1977, footnote 4; Warr 1979). Restricting the definition of land quality to an efficiency unit interpretation, however, would be misleading for our present purposes. Two units of medium quality land may be equivalent to one unit of good land for a particular labour intensity, but the same relationship will not hold for other levels of labour. In particular, if labour intensity is sufficiently small so that land is redundant, additional quantity of land cannot make up for poor quality. In general, the amount of poor quality land necessary to produce the same output as a fixed quantity of good quality land rises as labour intensity falls.

$MP_L(H_j)$ for $i < j$ and $L < L'$, then $R_i > R_j$ for $i < j$. That is, rent per worker is higher on the better quality land. Higher rent per worker implies that

$$\frac{R_i/L}{R_i/L + w} > \frac{R_j/L}{R_j/L + w} \text{ for } i < j$$

so that

$$R_i/(R_i + wL) > R_j/(R_j + wL).$$

But $R_i/(R_i + wL)$ is the landowner's proportional share on land type i. Therefore, the landowner's share will be higher on better quality land. This explains the patterns described above.

Our model has a more natural interpretation if we introduce the concept of farm size. For simplicity, assume that total farm labour is a function of household labour.[9] Thus, marginal product of labour becomes a function of household labour. In addition, define L' as average household labour force which works on the farm and H_i as equilibrium farm size for the ith land type and the average sized household. The intuition here is that farm size is endogenous and adjusts in order to equalise the marginal product of labour to its opportunity cost. This is a natural extension of the theory of share tenancy developed by Cheung (1969). The landowner maximises his income, constrained by the condition to pay labour its opportunity cost, by setting farm size and share of output so as to equalise marginal product across farms and so that the marginal product of labour is equal to its opportunity cost.[10] Thus, a family 'farm' is the land cultivated, with the possible assistance of hired labour, by a single household.

The assumptions that $f'_i > f'_j$ and $l^0_i < l^0_j$ are sufficient but not necessary conditions for the result that rent per worker increases with land quality. Weaker sufficient conditions can be developed. The critical assumption is that the marginal product curve is flat below some minimum labour intensity. That is so because, for sufficiently low labour intensities, additional land is redundant. That is, at some point all the possibilities for substituting land for labour, e.g. decreasing planting density, will be exhausted.

This minimum labour intensity condition means that, in Figure 2, labour's marginal product on better quality land must begin above that on inferior land, even though equilibrium farm size is smaller. Now, since the marginal product of labour curve for the smaller quantity of superior land is everywhere above that of inferior land to the left of the equilibrium point, rent per worker and landowner's share must be higher on the superior land.

We can now draw two additional implications from Figure 2. First,

[9] This assumption is useful for expositional simplicity but is not necessary for the general results that farm size and rent per worker are directly related to land quality.

[10] Cheung's model has been criticised by Bardhan and Srinivasan (1971) as one-sided. They argue in effect that the landlord maximising model implies that the landlord has monopoly power. Newbery (1974) and Reid (1976) have shown, however, that Cheung's model of constrained maximisation by landlords is equivalent to the attainment of competitive land rents. Alternatively, maximising landlord income, subject to the constraint of paying labour at least its opportunity cost, is equivalent to maximising labour income subject to paying land its competitive rent.

for family farms, better quality farms will be smaller than poorer quality ones. Second, for better quality land, the higher rent per worker implies a higher rent per farm, even though the farm is smaller.

Landowner's Share and Labour Quantity

Preliminary observations

The preceding section was concerned with the relationship between the quality of one particular factor and output shares. We now turn to the relationship between output shares and the quantity of factors, in particular, the quantity of labour relative to land.

There is limited evidence that there is a rough correlation between landowner shares and physiological population density across countries.[11] In the Philippines, landowner shares of less than 30 per cent or more than 50 per cent have been uncommon (Mangahas et al. 1976). In Bangladesh and Central Java, Indonesia, however, landowner shares of 67 per cent are common and the proportion of contracts with shares less than 50 per cent is small relative to the Philippine case (Geertz 1965; Ali 1979). Since Bangladesh and Central Java are more densely populated than the Philippines, these observations are consistent with the hypothesis that landowner shares are directly related to physiological density.

Even within the Philippines, landowners' shares adjust to regional disparities in labour supply relative to land. In densely settled, low-wage areas, landowners' shares are higher than in areas of low physiological density and relatively higher wages. For example, in recently settled Isabela province landowners usually receive 30 per cent compared to the 50 per cent that was typical in densely settled Ilocos Norte prior to the 1960s, even though both provinces are in the northern, Ilocano-speaking part of the Philippines and average land quality in Isabela is slightly higher. As permanent and seasonal migration to Isabela has reduced wages relative to Ilocos Norte, tenants' shares have also been reduced.[12] Similarly, landowners' shares in Palawan—a province with a low population density and relatively high wages—range from one-tenth to one-third[13], even on good quality land.

The same relationship has also been observed over time. In Bangladesh, especially in the vicinity of Dacca, the shares of some tenants have been reduced from one-half to one-third as population pressure has reduced real wages (Ali 1979). In Java, patron-client relations have been gradually changing in favour of tenants since roughly 1928 when land prices began to rise relative to rents. Between 1868 and 1928, in contrast, when land expansion relative to population growth was

[11] Physiological density is defined as population in a particular area divided by the number of arable hectares in that area.

[12] Lewis (1971) reports a 3 per cent decrease in tenant shares from 1963 to 1970. Recent researchers have found further decreases (e.g. James 1979).

[13] Eder (1974). Part of the explanation for rents as low as 10 or 20 per cent also lies in the fact that the rice farms studied are upland and average yield per hectare (30 cavans) is slightly lower than that under typical lowland conditions. On lowland farms the junior author has found share rents of 30 and 33⅓ per cent to be typical in a current research he is conducting in recently settled areas. Wages for tasks such as transplanting, harvesting and threshing are significantly higher in Palawan than in areas of out-migration such as Ilocos.

still favourable and economic growth was rapid, changes in landowner-tenant relations generally favoured tenants.[14]

Explanatory model: factor prices and factor shares

To explain the relationship between low real wages, high physiological density, and high landowner's share, we postulate that production of rice can be represented by the CES production function:

$$Q = A[\delta H^{-\rho} + (1 - \delta)L^{-\rho}]^{-1/\rho}.$$

Following available empirical evidence we further postulate that $\rho > 0$ even in the long run, i.e. that the elasticity of substitution, σ, is less than one.[15]

Since, according to our hypothesis, factors are paid their marginal products, landowner's share can be written as

$$\frac{H}{Q}\frac{\partial Q}{\partial H} = \frac{\delta}{A^{\rho}}\left(\frac{Q}{H}\right)^{1+\rho}.$$

Now a higher physiological density will tend to be reflected (via factor prices) in a higher labour intensity per hectare of rice land. This implies in turn a higher output per hectare, Q/H, and therefore a higher landowner's share.[16] This explains the association between physiological density, factor prices, and landowner's share.

We can illustrate the relationship between factor prices and landowner's share by again transposing information from Figure 1. Figure 3 shows the marginal products of labour for two quantities of type 1 land. H_{12} is equal to 1 unit as before. H_{11} is sufficiently larger so that labour intensity with 4 units of labour is just sufficient to yield a marginal product of $2w_s$. Thus, H_{11} is the equilibrium farm size for a wage equal to $2w_s$. H_{12} is the equilibrium farm size for wage of w_s. We can now interpret the increasing labour intensity associated with the shift from H_{11} to H_{12} as the equilibrium response of a halving of the real wage. It is now a matter of inspection to observe that landowner's share has increased (roughly from one-fourth to three-fifths).

Combining the Land Quality and Labour Quantity Explanations and a Preliminary Test

In the sections above, two forces have been described which increase landowner's share, namely, land quality and labour quantity (or wages relative to rents). The explanatory models corresponding to these relationships were treated separately for expository convenience. In general, however, we expect that both forces should explain particular movements or differences in landowner's share better than either of the explanatory variables alone.

[14] Ruttan (1978, p. 336), citing evidence from White (1974).

[15] For example, Yotopoulos et al. (1970) using the Indian farm management data for 1957-62 estimated ρ to be equal to 0·349, i.e. $\sigma = 0{\cdot}74$. Yotopoulos and Nugent (1976) cite evidence suggesting that, with the advent of the high yielding varieties, the elasticity of substitution in agriculture is presently lower than during the 1957 to 1962 period. See also Ranade (1977) for supporting evidence for rice production in the Philippines.

[16] Since we are implicitly using 'land' here as a synonym for 'non-labour inputs', the prediction of a higher output per hectare should be interpreted as a higher output per unit of non-labour input or as a lower output per worker.

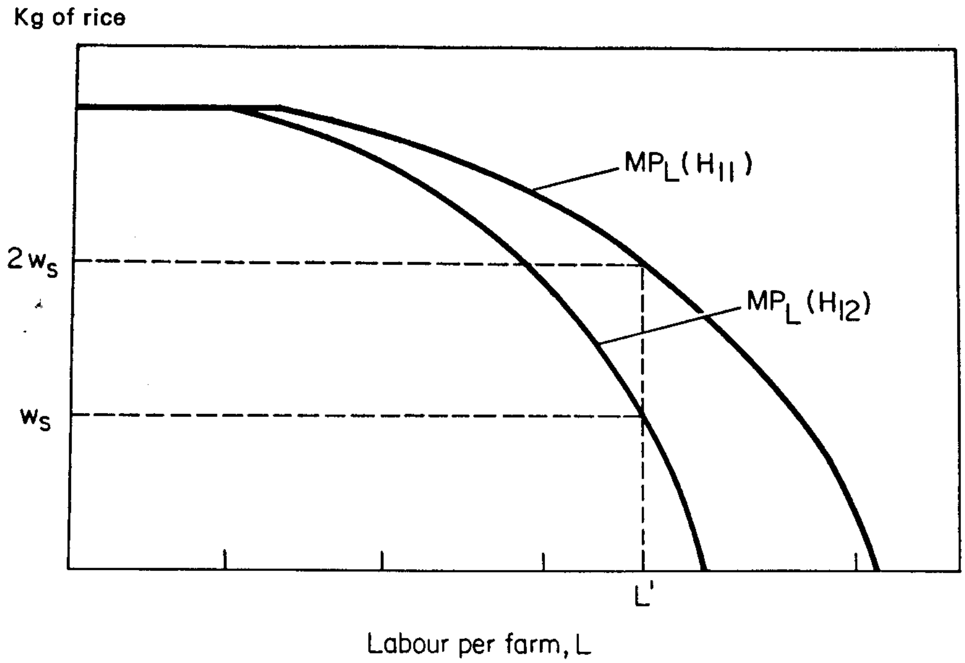

FIGURE 3

Figure 4, which combines Figures 2 and 3, shows the equilibrium landowner shares for two types of land quality and two wage levels. H_{11} corresponds to the good land-quality, high-wage case; H_{12} to good quality, low wages; H_{21} to medium quality, high wages; and H_{22} to medium quality, low wages. One can readily verify that landowner shares tend to rise with both land quality and labour quantity (fall with wages). Roughly, the following landowner shares are implicit in the diagram: H_{11}, 0·25; H_{12}, 0·6; H_{21}, 0 (subsistence land); and H_{22}, 0·4. That is, if land quality is high and wages are low, we predict high landowner shares—low landowner shares for the opposite case. If quality and wages are offsetting, we have no way of knowing which will dominate without knowing the production function.

As a preliminary test of both the land quality and labour quantity hypotheses, therefore, we regressed landowner's share, Y, on average rice yield per hectare (x_1) and physiological density (x_2). The data for this simple test were drawn from the 1971 census for the Philippines. The data used were the provincial averages for the 31 primary rice growing provinces.[17] Physiological density (x_2) was approximated by the ratios of total farm population to total area cultivated. The resulting OLS equation is

$$Y = 0{\cdot}25 + 0{\cdot}0026x_1 + 0{\cdot}0387x_2$$
$$\qquad (3{\cdot}19) \qquad (4{\cdot}90) \qquad R^2 = 0{\cdot}54$$

[17] The provinces selected were those where the proportion of share-tenanted farms to the total number of farms growing primarily rice is greater than or equal to one-half, but less than or equal to one. This allows the inclusion of most major rice producing provinces while excluding provinces where sharecropping was unimportant or primarily used for non-rice crops.

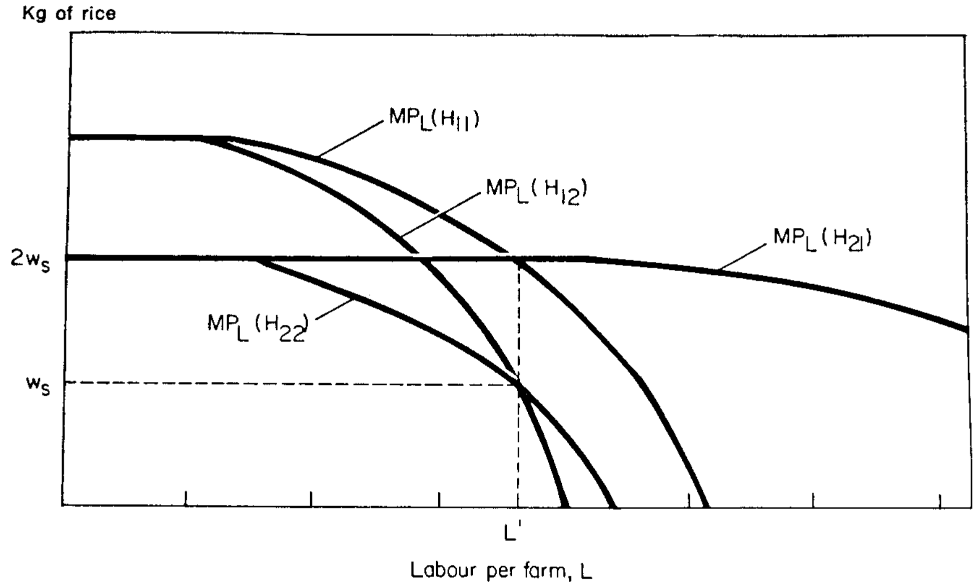

FIGURE 4

The coefficients of both x_1 and x_2 are significant at the 1 per cent level (t-values in parentheses).

Landowner's Share and Technological Change

A paradox arises when we look at the trend of landowner shares in the Philippines. Despite the increase in physiological density and rising land prices relative to wages, landowners' shares have fallen since the introduction of HYV's in 1966.[18] The main factor that helps explain this apparent paradox is that the new rice technology developed at the International Rice Research Institute (IRRI) near Manila has been more suitable for Philippine conditions than to other countries such as Indonesia and Bangladesh (Herdt and Barker 1977).

To see how land-saving technological change such as the development of fertiliser-using, high-yielding varieties will tend to result in a decrease in landowners' shares, consider the Cobb-Douglas function,

$$Q = H^{\alpha} L^{\beta} F^{(1-\alpha-\beta)}$$

where F stands for fertiliser and other chemicals. Now land-saving, fertiliser-using technological change implies that α falls and $(1 - \alpha - \beta)$ rises. Therefore, the landowner's share falls and the 'share' of fertiliser and other chemicals rises. This effect of land-saving technology change on the respective shares of landowners and chemicals occurred even before land reform legislation was aggressively implemented (Herdt and Ranade 1976; Ranade 1977).

In addition, because of the substantial technological change, the Philippines has been moving along an innovation possibility curve,

[18] There was downward pressure on landowner shares even before the vigorous land reform program which began in November 1972.

whose elasticity of substitution is one or more.[19] Returning to the expression above, we see that since $\sigma \geqslant 1$ corresponds to $\rho \leqslant 0$, landowner's share will remain constant or fall slightly with increases in Q/H induced by the rising rent-wage ratio.

Summary and Conclusions

We have illustrated above not only that there are substantial variations in landowners' shares, but that these variations are related to differences to land quality and factor prices. In particular, the tendency for high landowners' shares to be associated with high land quality and/or high physiological density can be explained by extending the competitive bargaining model of share tenancy to allow for variation in land quality and for the elasticity of substitution between land and labour being less than one. The effect of increasing population on landowner's share can be ameliorated by land-saving technological change.

Given the data limitations, the discussion presented above may be best viewed as hypotheses generation. Additional studies are needed to test these hypotheses in more detail. We would expect that such studies would uncover significant exceptions to the simple relationships we have described and that this information would facilitate the further development of a framework for explaining differences in share contracts. While we have focused on landowners' shares in this paper, the explanatory principle that contracts tend to substitute for markets can be used to explain other patterns of agricultural contracts.

There is no doubt that risk sharing, enforcement costs, imperfect information and differences in bargaining power will also help explain other patterns in agricultural contracts.[20] As we have seen, however, even highly simplified and abstract models are useful for explaining the 'stylised facts' about agricultural organisation.

References

Ali, M. (1979), Share tenancy in Bangladesh, M.S. thesis, University of the Philippines, Diliman.

Bardhan, P. K. and Srinivasan, T. N. (1971), 'Cropsharing tenancy in agriculture: a theoretical and empirical analysis', *American Economic Review* 61(1), 48-64.

Bell, C. (1977), 'Alternative theories of sharecropping: some tests using evidence from northeast India', *Journal of Development Studies* 13(4), 317-46.

——— and Zusman, P. (1976), 'A bargaining theoretic approach to cropsharing contracts', *American Economic Review* 66(4), 578-88.

Bernal-Torres, R. and Sandoval, P. R. (1967), 'Landlord participation in the farm business', *The Philippine Agriculturist* 51(1), 65-76.

[19] Ruttan et al. (1978). In response to rising relative prices of land, IRRI and Philippine agencies developed a land-saving technological change, namely the new fertiliser-responsive rice varieties. A rough estimate of the elasticity of substitution for a country wherein appropriate technological change is being generated can be made by fitting a production function across countries. In fitting such a function Hayami and Ruttan (1971) found the elasticity of substitution between land and labour was not significantly different from one. This procedure still underestimates the elasticity of substitution if the technological change not only changes relative output elasticities, but increases output with the same inputs.

[20] To see how the methodology can be extended to include transactions costs and bargaining power, see Roumasset (1978).

Cheung, S. N. S. (1969), *The Theory of Share Tenancy*, University of Chicago Press, Chicago.

Eder, J. (1974), The origin, maintenance and perpetuation of social inequality in a Philippine community, Ph.D. thesis, University of California, Santa Barbara.

Escover, E. (1979), Contracts and coconuts, M.S. thesis, University of the Philippines, Los Baños.

Geertz, C. (1965), *The Social History of an Indonesian Town*, Massachusetts Institute of Technology Press, Cambridge.

Hayami, Y. and Ruttan, V. W. (1971), *Agricultural Development: An International Perspective*, Johns Hopkins University Press, Baltimore.

Herdt, R. and Barker, R. (1977), *Multi-Site Tests Environments and Breeding Strategies for New Rice Technology*, Research Paper No. 7, IRRI, Los Baños.

——— and Ranade, C. G. (1976), *The Impact of New Rice Technology on the Shares of Farm Earnings: Laguna and Central Luzon, Philippines*, Agricultural Economics Department, IRRI, Los Baños.

Hurwicz, L. and Shapiro, L. (1978), 'Incentive structures maximizing residual gain under incomplete information', *The Bell Journal of Economics* 9(1), 180-91.

James, W. E. (1979), An economic analysis of public land settlement alternatives in the Philippines, Ph.D. thesis, University of Hawaii, Honolulu.

Lewis, H. T. (1971), *Ilocano Rice Farmers: A Comparative Study of Two Philippine Barrios*, University of Hawaii Press, Honolulu.

Mangahas, M., Miralao, V. A. and de los Reyes, R. P. (1976), *Tenants, Lessees, and Owners: Welfare Implications of Tenure Change*, Ateneo de Manila University Press, Quezon City, Philippines.

Newbery, D. M. G. (1974), 'Cropsharing tenancy in agriculture: comment', *American Economic Review* 64(6), 1060-66.

Ranade, C. (1977), Distribution of benefits from new agricultural technologies: a study at the farm level, Ph.D. thesis, Cornell University, Ithaca.

Reid, J. D., Jr. (1976), 'Sharecropping and agricultural uncertainty', *Economic Development and Cultural Change* 24(3), 549-76.

Roumasset, J. A. (1976), *Rice and Risk: Decision-Making among Low-Income Farmers*, North-Holland Publishing Company, Amsterdam.

——— (1978), 'The new institutional economics and agricultural organization', *Philippine Economic Journal* 17(37), (in press).

——— (1979), 'Sharecropping, production externalities and the theory of contracts', *American Journal of Agricultural Economics* 61(4), (in press).

Rudra, A. (1975), 'Share-cropping arrangements in West Bengal', *Economic and Political Weekly* 10(30), A58-63.

Ruttan, V. W. (1978), 'Induced institutional change', in H. B. Binswanger and V. W. Ruttan (eds), *Induced Innovation: Technology Institutions and Development*, Johns Hopkins Press, Baltimore, 327-57.

———, Binswanger, H. P., Hayami, Y., Wade, W. W. and Weber, A. (1978), 'Factor productivity and growth: a historical interpretation', in H. P. Binswanger and V. W. Ruttan (eds), *Induced Innovation: Technology Institutions and Development*, Johns Hopkins Press, Baltimore, 44-90.

Warr, P. (1979), 'Share contracts, limited information and production uncertainty', *Australian Economic Papers* (in press).

White, B. (1974), Agricultural Innovation: A Critical Note, Agricultural Economics Survey, Jakarta, mimeo.

Yotopoulos, P., Lau, L. J. and Somel, K. (1970), 'Labor intensity and relative efficiency in Indian agriculture', *Food Research Institute Studies* 9(1), 43-55.

——— and Nugent, J. (1976), *Economics of Development*, Harper and Row, New York.