The Terms of Agricultural Contracts: Theory and Evidence

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Abstract

Standard contract theory predicts that contractual terms between tenants and landlords should reflect the quantity and quality of factor inputs (labor and land), the degree of risk aversion of the parties, and various structural features of the labor market such as alternative wages, turnover rates, and search costs. We examine these theories in the light of data on the terms of contracts, as well as the resulting real returns to labor and land, in contemporary Illinois agriculture. Contrary to standard theory, contractual terms exhibit a very high degree of uniformity in spite of demonstrable variations in underlying fundamentals. In particular, contracts coalesce around certain regional norms that are insensitive to local variations in land quality. A particular implication is that labor on higher quality land captures a sizable portion of the land rent: about one-third of the incremental surplus from farming more productive soils goes to the tenant, even after adjusting for differences in labor quality, riskiness in returns, and security of tenure.

1. Overview

Cropshare tenancy has been a source of controversy in the economics literature since classical times. Aside from debates concerning the relative merits of cropshare versus fixed-rent tenancy, there is the vexing matter of the shares themselves: almost all accounts of cropsharing practices, in both developed and developing countries, find that tenants and landlords divide the crops according to simple fractions, such as one-half, three-fifths, or two-thirds. Futhermore, these shares seem to respond only weakly to observable differences in economic fundamentals, such as differences in land quality, reservation wages, riskiness in returns, and the like. In sum, contracts appear to be too uniform given the degree of heterogeneity in economic fundamentals (Bardhan, 1976; Bardhan and Rudra, 1980, 1981, 1986a, 1986b; Murrell, 1983, Stiglitz, 1989). Is this *conformity effect* an illusion that would go away if we could examine real as opposed to nominal returns? Or is it a genuine effect, and if so, what are its implications for factor returns?

Previous studies of this question have focused for the most part on village-level data in developing countries (see, in addition to the above references, Bliss and Stern, 1982; Bardhan, 1984; Robertson, 1987; Lanjouw and Stern, 1998). Typically these studies find that the nominal shares cluster around a few focal values, and that within each village the shares exhibit a high degree of conformity, whereas among villages the terms may differ substantially. But none of these studies has addressed the crucial issue of whether these peculiarities in the nominal terms flow through to the bottom line and distort the factor returns to labor and capital. In this paper we examine this issue using survey data from Illinois that contains information on net returns to labor and land in addition to nominal contract data.

Our findings can be summarized as follows. First, the terms of share contracts in Illinois show a remarkable degree of uniformity within specific regions of the state. In the north, over 90% of the contracts specify a fifty-fifty division between tenant and landlord, whereas in the south the majority of contracts specify two-thirds for the tenant and about 80% specify either two-thirds or three-fifths. (This north-south line is determined by geological differences and corresponds roughly to the southernmost boundary of the last major glaciation.) Moreover, the observed uniformity in output terms is mirrored in the division of inputs, including seed, fertilizer, and equipment, so one can say that the contracts *as a whole* exhibit substantial uniformity by geographical region.

In a companion paper we propose a dynamic model of custom that helps explain these geographical patterns (Young and Burke, 1999). Here we examine the implications of contractual customs for the economic returns to labor and land. Suppose that the share to labor, s, is fixed by local custom irrespective of differences in land quality. Suppose too that the minimal level of effort and other inputs is fixed by custom.

Then, as land quality rises, the tenant can earn s times the increase in yield without supplying any more inputs. In other words, the fixity of the contract implies that tenants can capture a portion of the rent that would ordinarily go to land. We find that this prediction is strongly confirmed by the Illinois data: net returns to the tenant increase sharply with land quality, even though there is no increase in yield beyond that attributable to the higher land quality by itself.

It may be, of course, that there are hidden costs to the tenant or hidden benefits to the landlord that would justify higher monetary payments to the tenant, in which case we could not say that the tenant is in fact capturing any land rent. One possibility, for example, is that yields on higher quality soils are more variable than on lower quality soils. This would imply that risk-averse tenants have to receive higher expected payments to be willing to farm high-quality soils. In fact, however, the data show that variability in yield *decreases* as land quality increases, which implies that tenants should be paid less on high quality soils, contrary to the actual situation. A second possibility is that higher returns to the tenant result in lower turnover rates, thus reducing transaction costs for the landlord. While the data do not allow us to test this possibility directly, there is evidence that tenant turnover is so low in any event that the cost savings would be minor even if land quality were highly correlated with tenure.

A third possibility is that higher quality tenants migrate to higher quality land. In other words, equilibrium is achieved in the labor market through assortative matching rather than an adjustment in contract terms. If this explanation is to have any force, however, then the higher quality tenants must generate an increase in yields that goes beyond the increase attributable to higher land quality alone, holding other inputs fixed. The evidence strongly suggests that this is not the case; indeed, if anything, there appears to be some slacking off in the quality or quantity of labor input as land quality rises.

Finally, we consider the possibility that the increase in tenant net income is due to spurious correlation effects. It could be, for example, that reservation wages happen to be higher in regions with higher land quality. In this case the return to tenant labor would rise with land quality, but the relationship would be purely spurious. We test for this and other local fixed effects, and find that they do not in fact account for the observed increase in tenant income. Indeed, if anything, the amount of the increase is *even higher* when we control for them.

This apparent paradox is resolved once we realize that the stickiness of local custom is itself a fixed effect. In other words, if local custom is highly uniform in spite of local variation in land quality, then tenants on high quality land are bound to earn higher net returns than those on low quality land. At the same time, customs differ between regions in ways that respond to broad differences in economic fundamentals, such as differences in wage levels or in average land quality. Thus, when we aggregate over regions and do not control for regional fixed effects, the impact of custom on factor returns is somewhat attenuated.

The question remains as to how this kind of behavior can be sustained in a competitive market environment. In fact, it is well-known that non-market clearing wages can arise in repeated principal-agent relationships that are characterized by imperfect monitoring, transaction costs, and specific investments (Shapiro and Stiglitz, 1984; MacLeod and Malcomson, 1989, 1993, 1998). The specific wage premium and the degree of effort needed to avoid dismissal are somewhat indeterminate, however, thus opening the door for the operation of social norms and customs. Once expectations have crystallized around particular levels of effort and reward that are viewed as “usual and customary,” they generate a sense of entitlement that fosters cooperation between principal and agent on the one hand, but that restricts the operation of competitive market-clearing forces on the other. The evidence suggests that, in Illinois agriculture, these customs have a palpable impact on the net returns to labor and land.

2. The Illinois survey data

The data come from two separate survey instruments that were developed at the University of Illinois. One survey instrument reports the terms of cropshare contracts in 1995 for 935 farms scattered around the state (Illinois Cooperative Extension Service, 1995). These data contain considerable detail on the division of each crop grown on the farm (typically corn, soybeans, wheat, and oats), the contractual responsibility for providing inputs such as fertilizers, seed, and equipment, and finally any cash payments or capital contributions. The stated purpose of the survey was to provide information that would enable the extension service to give better advice to local farmers; results were anonymous and thus held no implications for the respondents' taxes.

The second survey instrument was concerned with net returns to tenants and landlords, and was conducted on random samples of farms scattered around the state over the period 1977 to 1994. (The sample was redrawn each year, so it was not a panel study.) These surveys were carried out by the University of Illinois Farm Business Farm Management Association. The survey instrument was designed for the purpose of "monitoring the financial condition of farmers" and "[examining] the costs of production of the major farm commodities in Illinois." The results were aggregated in such a way that individual responses were anonymous, and there is no reason to think that respondents had a systematic motivation to misreport.

The nature of the data places some limitations on the kinds of statistical tests we can employ. Ideally we would like to know both the contract terms and the net economic returns on a large panel of farms whose fortunes we could follow over a period of years. Furthermore, if we knew the exact location of the farms, we could conduct tests of spatial correlation on the contract terms. What we have to work with instead is a highly unbalanced panel of farms on which economic returns are reported over a period of years (1977-94), and another set of farms on which contract terms are reported for a given year (1995). In both cases the locations of farms are identified only by county (in the interests of preserving anonymity), which means that we cannot perform sophisticated tests of spatial correlation.

In spite of these limitations, we can draw some inferences by analyzing the two data sets in tandem. First, the data on economic returns is for farms that operated under cropshare contracts, i.e., it is not contaminated by other contract forms such as cash rent. Second, the 1995 survey shows that contract terms were *nearly constant in large areas of the state, independently of local variation in soil quality*. These terms appear to have been stable in these areas for a long time, and in fact there is a way to check this point. The survey on economic returns allows us to compute the ratio of the tenant's gross income to total gross income on each farm, which is a good proxy for the share that must have been in place on that farm in a particular year. Analysis of these proxy shares shows that their mean and variance in different parts of the state are very close to the 1995 data on actual shares.

How uniform are these share contracts? Illinois is divided into two regions with substantially different geological histories and soil characteristics. In the north (above the dashed line in Figure 1), the land is flat, the topsoil tends to be thick and well-drained, and on average it is highly productive. In the south, the land is hillier, the topsoil is not as thick or well-drained, and on average it is less productive. This north-south division is quite sharply defined, especially in the middle and eastern part of the state, where it corresponds to the southern boundary of the last major glaciation (Mausel, Runge, and Carmer, 1975).

Figure 2 shows the frequency distribution of shares for corn, which is the single most important crop. In the north, about 95% of the cropshare contracts specify equal division, whereas in the south only 14% use equal division; in the south the vast majority of shares are either 3/5 – 2/5 or 2/3 – 1/3. (Here as elsewhere we write the tenant's portion first and the landlord's second.)

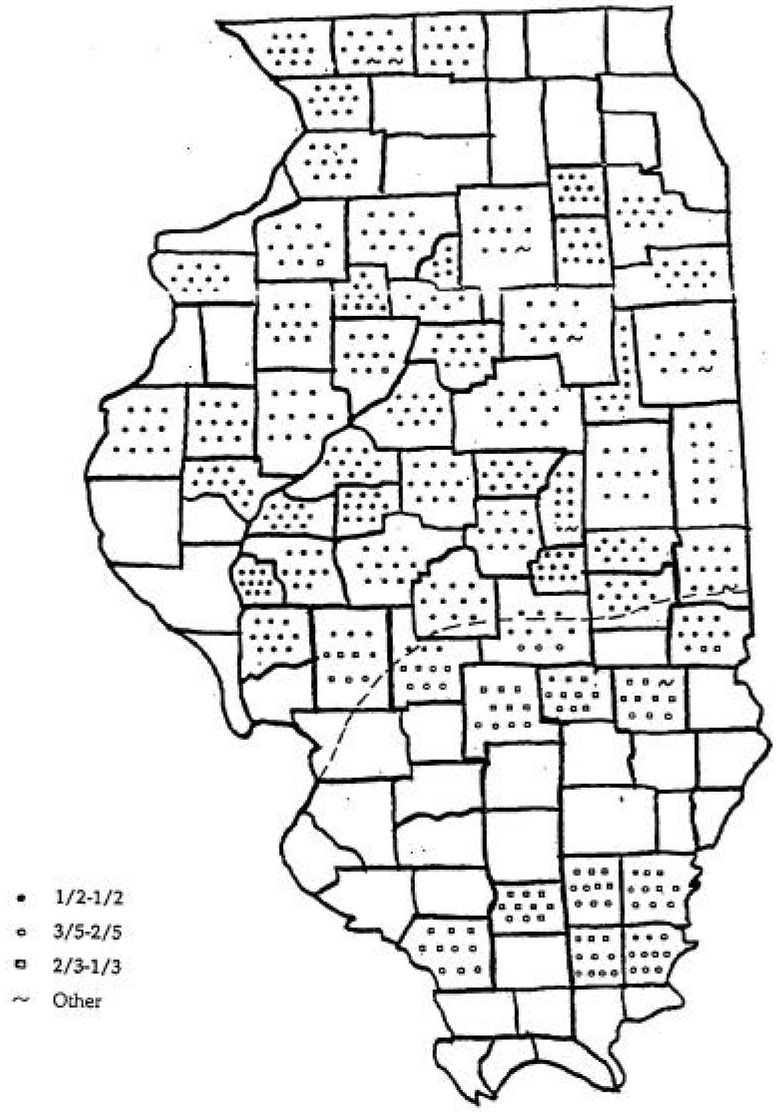

Figure 1. State of Illinois, showing the counties and the geological line separating the northern and southern parts. Blank counties do not have enough data to provide meaningful breakdowns of share frequencies.

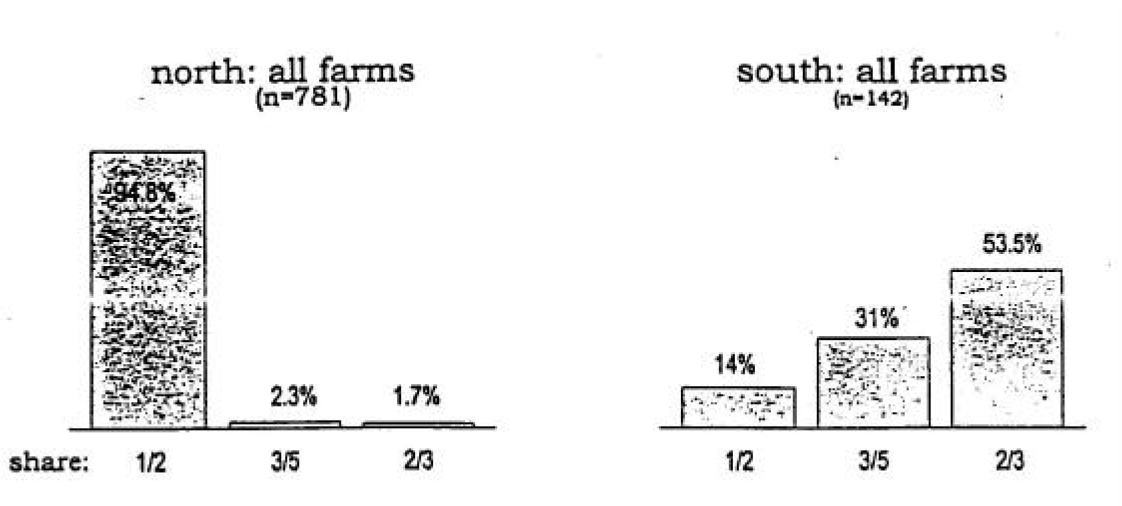

Figure 2. Frequency of corn output share by region.

The high degree of uniformity in corn output shares extends to other terms of the contract. Consider, for example, all contracts in which the tenant gets the same fraction f_0 of *all* of the crops, the tenant provides f_1 of all the major inputs (seed, fertilizer, pesticides), and he provides all mobile farm equipment. Call such a contract (f_0, f_1). In the north, over 86% of the contracts are (1/2, 1/2). In the south, about 39% of the contracts are of the form (3/5, 1) or (2/3, 1); fully 79% of the contracts use either 3/5 or 2/3 as the tenant's share of output and 3/5, 2/3, or 1 as the tenant's share of input. Thus, in the north, the contracts are extremely uniform even after we take into account the side terms. In the south there is less uniformity, but very few among the possible share combinations are actually used. Moreover the tenant's share of gross output is consistently higher than in the north, the difference being between 1/10 and 1/6. This relative inflexibility in contract terms has important implications for the net returns to labor and land, as we shall see in section 4 below.

The data discussed in the preceding paragraphs come from the 1995 survey of contract terms, but how do we know that they apply to the 1977-94 surveys of economic returns? We can infer this with reasonable certainty from the following facts. First, we know (from the 1995 survey) that almost all share contracts apply the same share to all of the outputs. Thus, from the data on economic returns, we can obtain a good estimate of the output share on a given farm by dividing the tenant's gross income by the total gross income. Indeed this would be an exact estimate except for the fact that the tenant and the landlord may sell some of their crops at different times for somewhat different prices. We shall call these the *estimated shares*. In the north, the average estimated share over the period 1977-94 was 0.53 with a standard deviation of 0.07. In the south it was 0.62 with a standard deviation of 0.11. The means and standard deviations for the 1995 frequency distributions are 0.505 (0.027) in the north and 0.62 (0.057) in the south. Given that the estimated shares are bound to vary somewhat from the true shares given the different timing of sales, the estimated shares are quite consistent with the actual distribution of shares in 1995. We summarize these observations as follows:

(i) In the northern part of the state, contract terms exhibit a high degree of uniformity, and the tenant's output share is almost invariably 1/2. In the southern part of the state there is somewhat greater variation in terms, but on about 80% of the farms the tenant's share of output is either 3/5 or 2/3.

3. Soil productivity

The inherent productivity of different soils is measured by a soil rating system devised by agronomists at the University of Illinois in the 1970s (Odell and Ochswald, 1970; Mausel, Runge, and Carmer, 1975; Fehrenbacher et al., 1978). The rating for each farm is reported in *both* of the sample surveys discussed in the preceding section. Soils are classified into named "types" according to their color, texture, moisture content, and chemical composition. On a selected panel of farms with a given soil type, agronomists measure the average output per acre of each of the major crops grown in Illinois--corn, soybeans, wheat, and oats. The inputs are monitored and held to a benchmark level referred to as *basic management practice*. This involves the application of specified fixed amounts of seed, fertilizers, and pesticides, together with standard procedures for tilling, planting, and harvesting. The *basic corn productivity index* of a given soil is the average number of bushels per acre of corn on that soil, holding inputs fixed at these levels. The productivity indexes for soybeans, wheat, and oats are constructed in similar fashion.

Yields have also been measured using a higher-level package of inputs referred to as *high management practice*. This involves more intensive labor, and a higher rate of application of certain fertilizers and pesticides as compared with basic management practice. As before, the level of inputs is held fixed across soil types. The resulting *basic* and *high* soil productivity indexes predict expected differences in yield attributable to differences in land quality, holding other inputs -- including labor quantity and quality -- fixed at two different levels.

The survey data report a soil rating for each farm in the data set. In effect this is an average of the soil indices for the different crops and the different soil types found on that farm. First, one computes the basic soil index for each crop and each type of soil on the farm, weighted by the proportion of the land area it represents. (This information is contained in detailed soil maps that cover the state.) Then the crop indexes are averaged according to the proportions in which they are grown in each region of the state.[1] The result is

[1] In the north the proportions are: corn, .55; soybeans, .35; wheat, .06; oats, .04. In the south the proportions are: corn, .35; soybeans, .45; wheat, .20; oats, .00.

the *soil rating* for the given farm, which is reported in the survey data. Although this index is a weighted average over different crops, field studies show that soybean output is very nearly proportional to corn output on most soils--the ratio being about three bushels of corn per one bushel of soybeans (Mausel, Runge, and Carmer, 1975). Moreover, these two crops account for about 90% of total crop output. Hence, even if a given farm does not grow crops in the assumed proportions, the farm-level soil index will be quite accurate given that most of the land is planted in corn or soybeans.

4. Neoclassical models of factor returns

Classical economists, including Smith, Mill, and Marshall, argued that cropshare tenancy is inherently inefficient compared to straight land rent. The logic is simple: if the tenant gets, say, one-half of any additional output, then he will only provide labor input up to point where marginal output is twice the marginal cost of his labor. The result is an underprovision of labor, and indeed of any input whose cost is borne solely or mainly by the tenant. Although there have been many attempts to test this "Marshallian hypothesis," the results in the literature are rather inconclusive (Hayami and Otsuka, 1993). Furthermore, the argument behind it is, at best, incomplete. First, it ignores the fact that cropshare tenancy reduces the financial risk borne by the tenant, as compared to straight land rent (Stiglitz, 1974). These risks can be substantial due to vagaries in prices and the weather. Second, under cropshare tenancy the landlord is by no means powerless; in principle he could enforce the desired level of labor input under the threat of letting the tenant go (Johnson, 1950; Cheung, 1969; Roumasset and James, 1979; Hayami and Otsuka, 1993). According to this view, cropshare tenancy will be preferred to straight land rent if tenants are risk-averse, and it will sustain the appropriate levels of effort if the landlord is sufficiently vigilant.

Let us examine the implications of this reasoning for the shares that should obtain in equilibrium. Assume for the moment that the amount of labor and nonlabor inputs per acre are fixed at some benchmark level independently of land quality. We can think of this level as corresponding to either basic or high management practice. Assume also, for the sake of argument, that landlords can costlessly monitor their tenants to make sure that the required inputs are in fact being supplied. The contract is terminated if shirking occurs. Let L_0 be the required labor input per acre, and Z_0 the required package of other inputs. Recall that the soil index θ is calibrated so that, when the inputs (L_0, Z_0) are applied, the expected gross yield, in bushels per acre, is $Y = a\theta + b$. Let s be the share of gross output for the tenant, which we shall assume is the same for all crops. Let p be the price per bushel of output. Then gross revenue is $pY = a'\theta + b'$ where $a' = pa$ and $b' = pb$. Let $c_0 = c(Z_0)$ be the cost of the inputs Z_0. Then the tenant's *net* income is

$$psY - c_0 = a's\theta + b's - c_0. \qquad (1)$$

If w is the reservation wage, then we have

$$w = a's\theta + b's - c_0, \quad (2)$$

and the share that yields the net wage to labor is

$$s = (w + c_0)/(a'\theta + b'). \quad (3)$$

In this model, the share s should be an inverse linear function of land quality, assuming that labor and non-labor inputs per acre are fixed at their benchmark levels.

Let us compare this prediction with Figure 3, which plots the tenant's share s versus soil index θ for share contracts in the northern and southern parts of the state in 1995.

In the north, the share scarcely varies at all, even though the soil qualities range from the low 50s to over 100. In the south, there is greater variation and a perceptible negative correlation between soil quality and share. Nevertheless, it cannot be said that the data are well-explained by a continuous, decreasing function as in (3); indeed, as we have seen earlier, only three shares occur with any appreciable frequency: 1/2, 3/5, and 2/3.

One possible explanation for the "quantum" look of the data is that the shares represent a discrete approximation of the equilibrium relationship. But this fails to account for the fact that, in the north, the share is essentially *independent* of soil quality. Indeed, soil quality actually varies more in the north than in the south, yet the share is more uniform. A second difficulty with the discrete approximation theory becomes apparent when we compare the contract terms on soils of similar quality in the north and the south. Consider the shares received on soils with index between 60 and 70 in the two regions. In the south the share on these soils is almost always 3/5 or 2/3, whereas in the north it is almost always 1/2. The average difference in share is on the order of .12, which means that the returns to labor in the south are about .12/.50 or 24% higher in the south than in the north. This would make sense if wages in the north are lower than the south, but in fact the opposite is the case: during the period 1980-94, wages in the agricultural sector were, on average, 5% *higher* in the north than in the south (University of Illinois Farm Business Farm Management Survey, 1977-94).[2] Thus, unless labor quality and/or labor input per acre is much higher in the south than in the north (neither of which is consistent with the evidence), it is difficult to reconcile the data with the model.

[2] Furthermore, the north is substantially more urban than the south, and thus offers more employment opportunities in the non-agricultural sector.

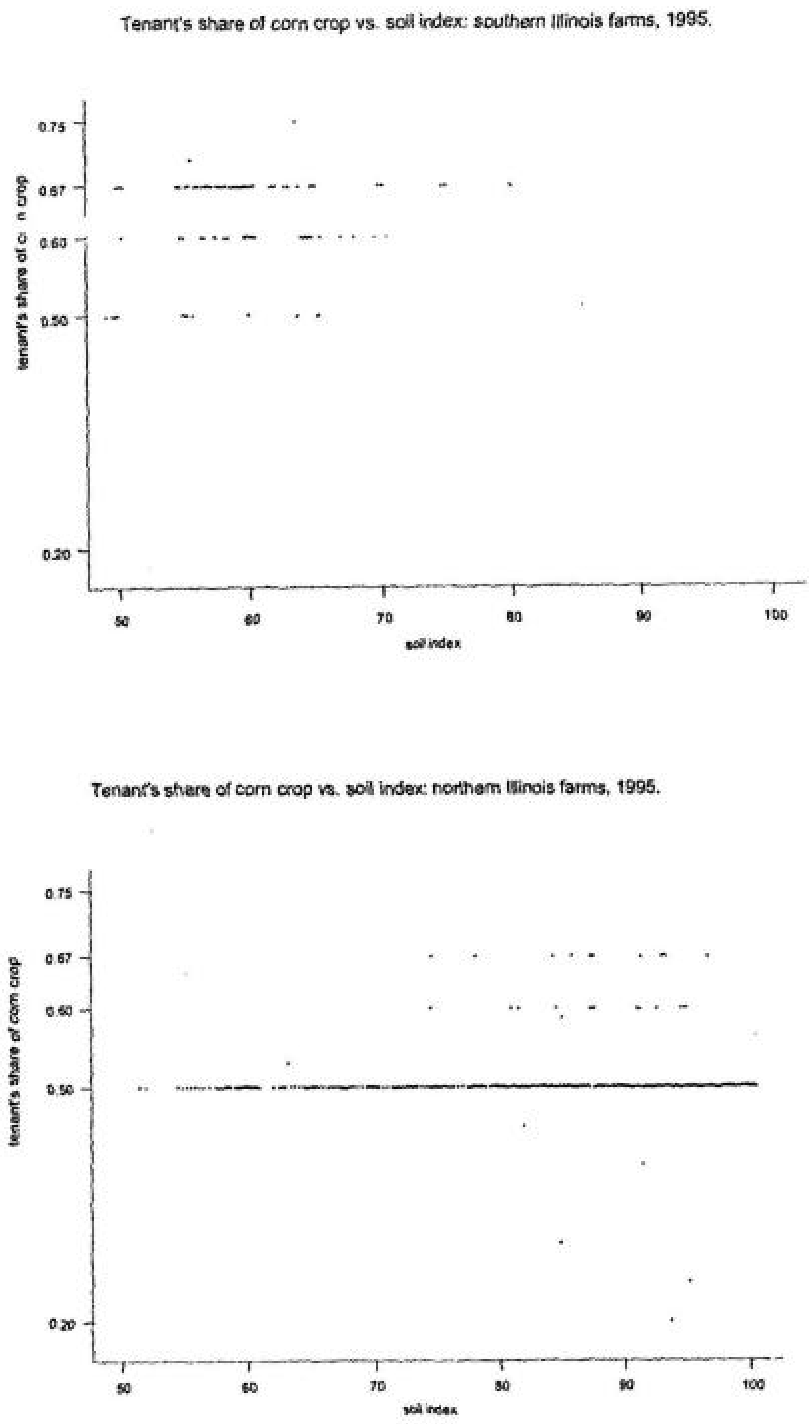

Figure 3. Distribution of shares by soil index in the south (upper panel) and the north (lower panel), Illinois, 1995.

One obvious limitation of the model is that it assumes a fixed level of inputs, when in fact inputs may vary according to the quality of the land. To test this alternative hypothesis, let us assume that a landlord on land of quality θ determines the optimal level of labor input per acre $L(\theta)$ and nonlabor input per acre $Z(\theta)$, and enforces these on the tenant. In other words the landlord costlessly monitors the inputs and dismisses the tenant if the appropriate levels are not forthcoming. As before, the share s is set so that the tenant is indifferent between this contract and earning the reservation wage w.

To examine the implications in more detail, let $Y = f(\theta, L, Z)$ be the expected yield per acre on land of quality θ given inputs L and Z per acre. We assume that f is increasing, weakly concave, and differentiable in all three variables. It also makes sense to suppose that θ complements both L and Z, whereas L and Z are substitutes. Assume that the contract takes the following form: the tenant gets a fixed share s of all outputs and pays a (possibly different) share s' of all inputs. The unit cost of supplying Z is c and the wage is w. Total profit is $f(\theta, L, Z) - wL - cZ$. The optimum inputs $L(\theta)$, $Z(\theta)$ are set by the landlord and satisfy the first-order optimality conditions

$$f_L = w, \quad f_Z = c. \qquad (4)$$

The landlord then sets the shares s, s' so that the tenant earns the reservation wage when he performs according to the target levels $L(\theta)$, $Z(\theta)$:

$$sY(\theta) - s'cZ(\theta) = wL(\theta). \qquad (5)$$

Empirically we know that the share is more or less *independent* of land quality in the northern part of Illinois. Taking this as given, we can ask how output ought to vary with soil quality in order to deliver competitive factor returns to labor and land. Differentiating (5) with respect to θ we then obtain

$$sY'(\theta) - s'c\, Z'(\theta) = w\, L'(\theta). \qquad (6)$$

From (4), the total derivative of Y with respect to θ is

$$Y'(\theta) = f_\theta + wL'(\theta) + c\, Z'(\theta). \qquad (7)$$

Combining (6) and (7) and rearranging we obtain

$$Y'(\theta) = [1/(1 - s)]\, f_\theta + [(1 - s')/(1 - s)]\, cZ'(\theta). \qquad (8)$$

In the north, s = 1/2 and s' is close to unity, because the tenant is fully responsible for farm equipment, which is the major component of all non-labor inputs. Thus, to a good approximation, the following relationship should hold for northern farms:

$$Y'(\theta) = 2f_{\theta}. \qquad (9)$$

In other words, when inputs adjust in response to fixed shares, the increase in output for each one-point increase in soil quality θ should be *twice* as high as it is in a fixed-inputs model. The reason is that the landlord enforces a higher level of labor (and nonlabor) inputs to complement the increase in land quality. Total output per acre therefore rises due to the combined effects of higher land quality and higher inputs. The result is that total output per acre increases much faster than if inputs were fixed and only land quality increased.

Let us now compare these predictions with actual practice in Illinois. From the soil calibration studies, we know the value of f_{θ} for each of the major crops and two different packages of inputs: basic (L_0, Z_0) and high (L_1, Z_1). For example, corn output in bushels per acre, is given by

$$Y_{corn} = 1.05\theta - 1.24 \text{ under basic management,} \qquad (10)$$

$$Y_{corn} = 1.40\theta + 16.0 \text{ under high management.} \qquad (11)$$

Thus

$$f_{\theta}(L_0, Z_0) = 1.05 \text{ and } f_{\theta}(L_1, Z_1) = 1.40. \qquad (12)$$

(Note that this confirms the assumption that θ complements L and Z.)

Figure 4 shows the scatterplot of corn yields per acre on each northern farm in the 1977-94 data set and the OLS estimate of actual yield versus soil index. A comparison of the regression line (11) shows that the absolute level of yield is fairly close to the predicted yield under high management, especially on lower quality soils. This suggests that actual input levels lie somewhere in between the basic and high management benchmarks, and probably are closer to the high end.

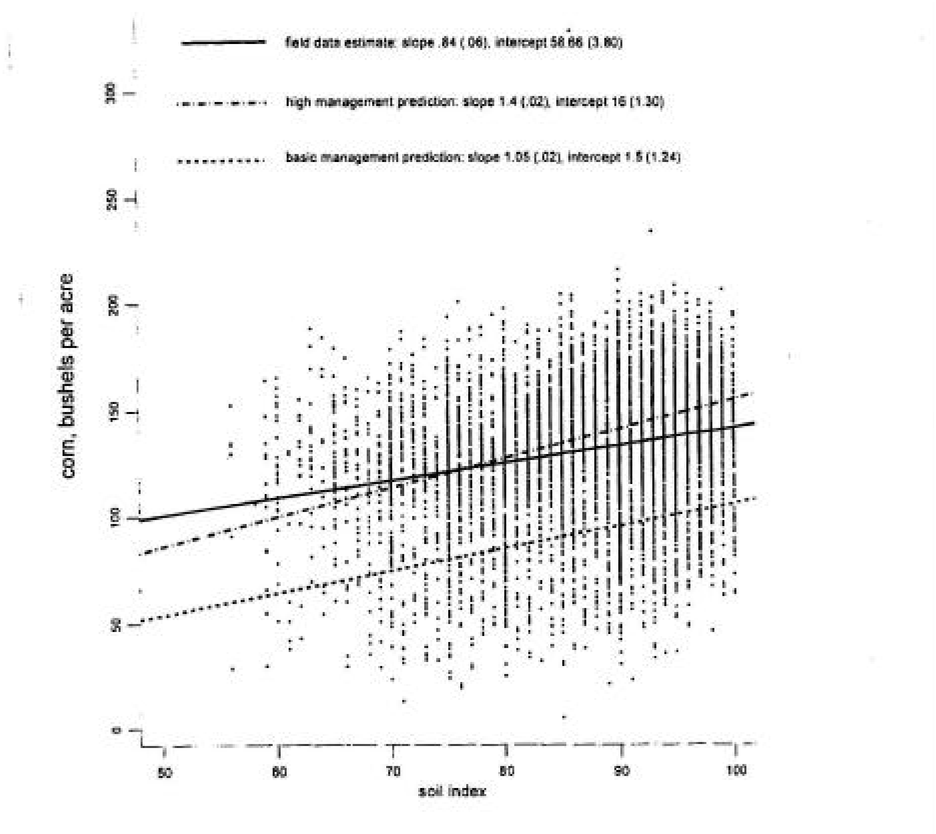

Figure 4. Actual corn yields in northern Illinois, 1977-94, compared with predictions under basic and high management.

The slope of the OLS regression line is an estimate of $Y'(\theta)$, which is the change in output due to the incremental change in θ plus the associated change (if any) in inputs. Because θ complements L and Z, we can infer from the absolute levels of yield that f_θ probably lies between 1.05 and 1.40—the value of f_θ under basic and high management respectively. In fact, however, the estimate of $Y'(\theta)$ -- 0.84 (.04) -- is substantially lower than it is under either high or basic management. This is completely inconsistent with the above model, which predicts that $Y'(\theta)$ should be on the order of $2f_\theta$, that is, between 2.1 and 2.8. In fact, it is also inconsistent with the earlier model in which input levels are assumed to be fixed across soil qualities, since this would suggest a value of $Y'(\theta)$ that is above 1.0.

A similar effect is observed for soybeans, namely, the level of output per acre lies between that predicted by high and basic management, but the rate of increase in output is lower. Moreover, the same effects hold when we carry out the regressions separately for the northern and southern parts of the state.
We summarize these points as follows:

(ii) *the actual level of output per acre lies somewhere between those associated with basic and high management benchmarks for almost all soil qualities;*

(iii) the rate of increase in output per acre as land quality rises is significantly below the rate under basic or high management practices.

Because θ complements other inputs, it follows from (ii) and iii) that labor or nonlabor inputs (or both) are falling as land quality rises.[3] We cannot observe the quantity or quality of labor input, but the data do tell us the costs of other inputs. Let $z(\theta)$ be the cost of all nonlabor inputs supplied by the tenant as a function of soil quality. Then we have the estimated relationship

$$z(\theta) = \underset{(5.61)}{114.38} + \underset{(0.065)}{0.12}\theta + e. \qquad R^2 = .001 \qquad (13)$$

Thus nonlabor inputs increase with soil quality and the level of significance is nearly 95%. We cannot tell, of course, whether this observed increase is a rational response of the tenant to the increased land quality, or whether it is enforced as part of the contract. What we do know is that gross yields rise less rapidly than they would in a fixed inputs model, and thus some input must be decreasing in either quantity or quality. Since the data give a comprehensive account of nonlabor inputs, we are left with the following conclusion:

iv) labor input almost certainly decreases as land quality increases.

Now let us examine the nominal net returns to labor, that is, the returns to the tenant after deducting the cost of nonlabor inputs. Let $y(\theta)$ denote tenant net income on land of quality θ, that is, gross income from the sale of crops less the cost of all nonlabor inputs $z(\theta)$ supplied by the tenant (see Figure 5).

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[3] This does not follow from the underprovision of inputs in the Marshallian sense: inputs could be below the optimal level but still rise in tandem with land quality.

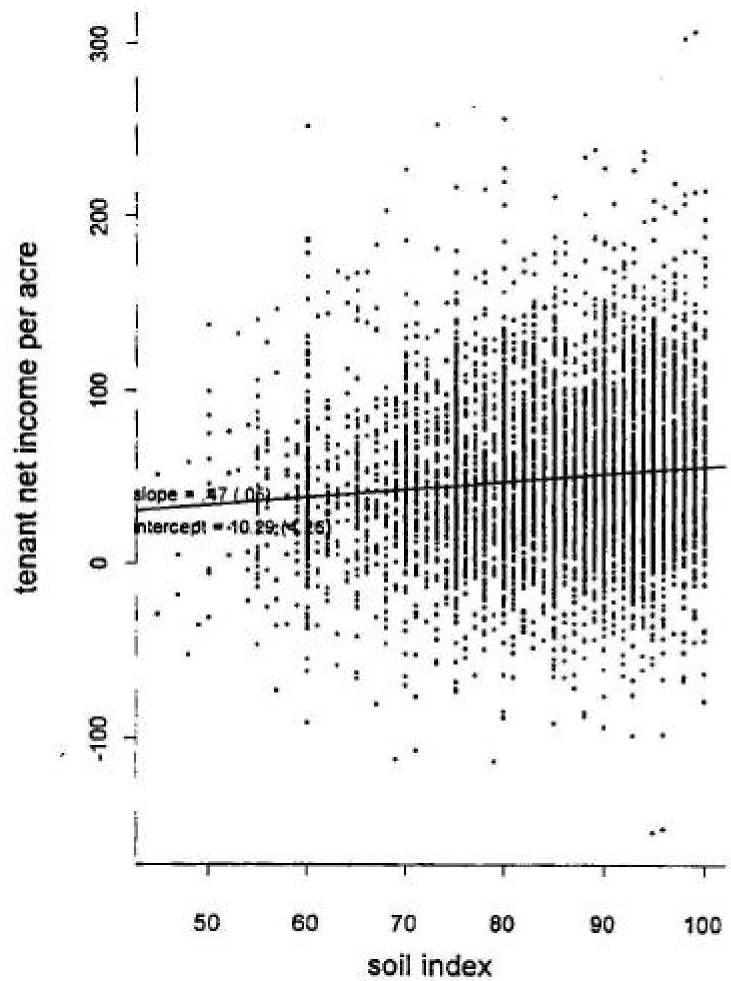

Figure 5. Tenant net income as a function of soil quality. Illinois, 1977-94.

We have the estimated relationship

$$y(\theta) = \underset{(4.26)}{10.29} + \underset{(0.05)}{0.47}\,\theta + e. \qquad R^2 = .01 \qquad (14)$$

In spite of a low R^2, the coefficient on θ is very significantly different from zero; indeed it is higher than 0.37 with 95% confidence. The interpretation is that, for each ten-point increase in land quality, the tenant earns an additional $4.70 per acre per year. The average number of acres farmed by a tenant in 1995 was on the order of 500 acres, which would represent a premium of about $2350 per year for moving up ten points in land quality. As we have just seen, this positive relationship cannot be attributed to increased quantity or quality of labor inputs; rather, it appears to be land rent captured by the tenant. Indeed, to the extent that labor input actually declines as land quality rises, the rate of increase in net income *underestimates* the extent of land rent capture. The effect on the tenant's net income is sizable: for example, on soils of medium quality (soil rating 75), the tenant's net income would be about $46 per acre, whereas if he operate a farm with soil rating 85 his income would be about $50 per acre, a 10% increase with no apparent value-added to the landlord.

It is also instructive to compare the rate of increase in the tenant's net income with the rate of increase in total net income. This measures the incremental share of surplus that the tenant is able to appropriate from the landlord. Let $x(\theta)$ denote total net income per acre, that is, gross revenues from the sale of crops minus the costs of all inputs supplied by tenant and landlord (except the tenant's labor), divided by the number of acres under cultivation. Then we have the following estimated relationship

$$x(\theta) = \underset{(7.42)}{20.55} + \underset{(0.09)}{1.41}\theta + e. \qquad R^2 = .04 \qquad (15)$$

Comparing (14) and (15), we see that tenants appropriate about one-third of the incremental land rent, that is, for each ten-point increase in soil quality, total income per acre increases by $14.10, of which the tenant takes $4.70. This is the incremental net share appropriated by tenant. The *average net share*, $y(\theta)/x(\theta)$, is fairly steady at about 36% across soil types.

5. Alternative explanations of land rent capture

Although we have asserted that the slope in (14) is a measure of land rent capture by tenants, there are reasons why this might not actually be so. One possibility is risk aversion. As Figure 5 shows, tenant income is extremely uncertain; in fact it is *negative* about 9 % of the time. The reason is a combination of price and weather shocks, some of which are local, others of which are regional. On medium quality soils rated 75, mean income is about $49 per acre, and the standard deviation is $44 per acre. If the variance of returns increases with soil quality and tenants are risk averse, it stands to reason that tenant incomes will have to rise with soil quality to compensate for the increased risk. However, a straightforward analysis shows that, if anything, the variance in tenant income *decreases* as soil quality increases. Specifically, when we compute the variance in tenant income, $\sigma^2(\theta)$, for each soil quality level θ, and then regress $\sigma(\theta)$ on θ, we obtain the following relationship:

$$\sigma(\theta) = \underset{(5.95)}{48.36} - \underset{(0.079)}{0.063}\,\theta + e. \qquad R^2 = 0.01 \qquad (16)$$

This is not surprising, since high quality soils tend to be more resistant to variations in the weather: they retain more moisture in dry conditions, and are less likely to flood in wet conditions.

A second possible explanation for the apparent capture of land rent by tenants is that, over time, higher quality tenants migrate to higher quality farms. Just as tenants know the quality of different farms in a given area, so landlords doubtless know the capabilities of different tenants. A landlord on a high-quality farm who has a mediocre tenant might seek out a higher-quality tenant who is presently on a mediocre farm. In deference to custom, the landlord might then offer this prospective tenant the same nominal terms he is presently getting, and both landlord and tenant would be better off. On this view, custom constrains the terms that the parties will agree to, and equilibrium is achieved by an assortative matching of high quality tenants to high quality land.

Plausible as this *sorting hypothesis* may seem *prima facie*, however, it is not corroborated by the data. For if the hypothesis were true, then the observed relationship between yield and soil quality would have a higher slope. The reason is that the soil index was calibrated as a measure of yield holding other inputs fixed. Thus, if the quality of labor input per acre increases with land quality due to sorting, then yields per acre should rise more quickly than when inputs are held fixed. As we have seen, this is not the case.

A third possible explanation is that tenants are more likely to stay with landlords who offer above-normal returns, and the landlord is willing to pay above-normal returns because it reduces transaction costs associated with turnover. Unfortunately the Illinois survey data do not report length of tenure on each farm, and thus we cannot test this hypothesis directly. From another source, however, we do know that average tenure on Illinois farms is about 14 years (Illinois Cooperative Extension Service, 1995 Farm Leasing Survey). This number is large enough that it is unlikely to account for more than a small part of land rent capture, at least on farms of better quality. To see this, let us assume for the sake of argument that tenure is perfectly correlated with land quality. Assume also that the distribution of tenure with respect to quality is not highly skewed. Then tenure on a farm of median quality (soil index 80) would be about 14 years. The maximum length of tenure is probably around 40 years; let us suppose that 40 is the average tenure on soils of quality 100. (This is obviously an overestimate; it could easily be on the order of 20 years.)

The annual turnover rate on soils of quality θ equals the inverse of the expected length of tenure on soils of that quality. The above estimate suggests that the turnover rate on soils of median quality is on the order of 1/14 = 7.1 % annually, while the rate on the best soils is no more than 1/40 = 2.5% annually. How much is the landlord giving up in rent to reduce the probability of losing his tenant from 7.1% per year to 2.5% per year? For a farm of soil quality 100, the premium paid to the tenant compared to a farm of soil quality 80 is approximately \$0.47 x 20 = \$9.40 per acre. Thus for a 500-acre farm the premium is \$4700 per year.

According to the tenure theory, the reason for this payment is to reduce the probability of having to find a new tenant by about 4.6% in any given year. For a risk-neutral landlord this would imply that the expected cost of finding a new tenant is on the order of $4700/.046 = $102,000. (Given the leeway in the above estimates it could easily be as high as $200,000.) This figure seems implausibly high, especially given that tenant labor is abundant, i.e., there are almost always qualified tenants looking for more land to farm in order to spread the fixed costs of their machinery over more acreage. We therefore argue that tenure, while perhaps a factor in the capture of land rent, is probably a minor factor.

Finally, let us turn to the possibility that the increase in tenant income is due to spurious correlation effects. It is conceivable, for example, that regions with highly productive soil also happen to have a high reservation price of labor due to job opportunities in nearby towns. Thus tenants would merely appear to be capturing land rent when in fact local labor markets are correlated with land quality. Moreover, there is reason to believe that this is the case in Illinois, because the north, which has more productive soils on average than the south, is also more urbanized. We can control for wage differences as well as other local fixed effects as follows. Let W_k be a dummy variable for county k, and let us estimate the relationship

$$y(\theta) = \alpha + \beta\theta + \gamma_k W_k + e, \qquad (17)$$

If spurious correlation were responsible for the positive relationship between tenant income and soil quality in (14), we would have $\beta = 0$ (see Figure 6). If it were partly responsible, we would obtain a lower value of β than in (14).

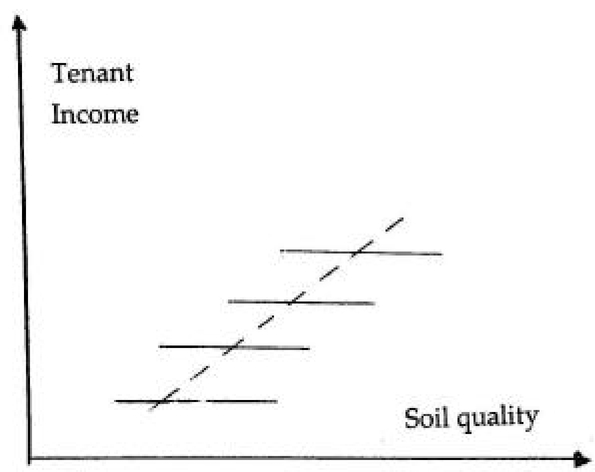

Figure 6. Illustration of the spurious correlation effect: county-level slopes are zero, whereas the state-wide slope is positive.

To avoid sparse data problems, we estimate (17) using only those counties that have at least 80 records each in the 1977-94 data set. (There are 24 such counties.) Controlling for heteroscedasticity and different sample sizes in the different counties, we obtain the estimation

$$\alpha = -2.70\ (-6.803)\ ,\ \beta = 0.618\ (0.078) \qquad (18)$$

Thus the estimate of rent capture when we control for local fixed-effects ($\beta = 0.618$), is significantly higher than when we do not control for them ($\beta = 0.470$). This is rather peculiar, since one would certainly expect *some* attenuation of rent capture at the local level due to greater labor mobility.

The apparent puzzle is resolved once we realize that *differences in local contractual customs are themselves fixed effects*. Suppose, for example, that tenants in one region get 2/3 of output, and that average land quality in this region is relatively low. Suppose that in another region tenants get 1/2 of output because the average land quality there is higher. Then, within each region, tenants on higher quality soil will capture some of the land rent due to the uniformity of local custom, though the rate of capture will differ between the two regions. Since the difference in rates is correlated with differences in soil quality, however, the *overall rate of capture* when the two regions are aggregated is lower than the rate of capture in either region considered alone. Figure 7 illustrates the idea.

We can see this effect at work most clearly when we compare the northern and southern regions of Illinois. Consider a fixed effects model with two components: north-south differences in tenant income, and north-south differences in rate of land rent capture:

$$y = \alpha + \alpha' N + \beta\theta + \beta'\theta N + e. \qquad (19)$$

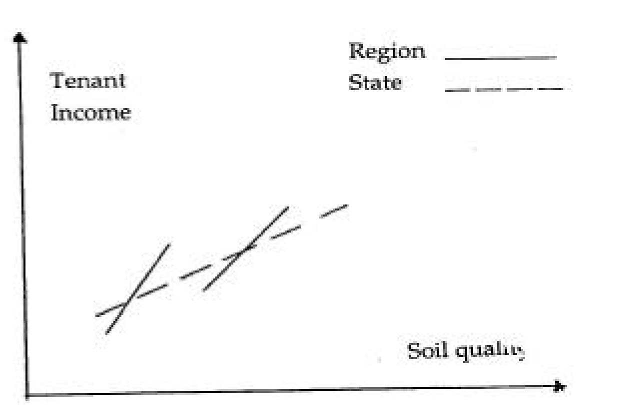

Figure 7. Example showing regional slopes that exceed the state-wide slope.

In equation (19), y represents tenant net income per acre, N is a dummy variable that takes the value 1 if the farm is in the north and 0 if it is in the south, and θ is the soil rating of the farm. The value of α' is the north-south difference in average tenant income, while β' is the north-south difference in the rate at which tenant income increases with soil quality. If the increase in tenant income were due entirely to spurious correlation effects, we would have $\beta' = 0$, but in fact β' differs from zero at the 90% level of significance. The estimated coefficients and their standard errors are as follows: [4]

$$y = -5.918 + 13.845N + 0.702\theta - 0.243\theta N + e, \quad R^2 = .108 \qquad (20)$$
$$\quad (-0.959) \quad (1.478) \quad (7.068) \quad (-1.897)$$

In particular, the capture of land rent is substantially higher in the south than in the north: tenant income per acre increases by $7.02 for each ten-point increase in the soil index on southern farms, whereas it increases by only $4.59 for each ten-point increase on northern farms, or $2.43 less per acre. Given what we already know about the differences in contractual custom between north and south, this should come as no surprise. Namely, we know from section 2 that tenants in the south receive a larger share of gross output than do tenants in the north--about .12 more on average. From the 1977-94 survey data, we find that gross returns per acre increase at the rate of about $21 per ten-point increase in soil quality. Therefore the differential rate of increase between north and south attributable to differences in the customary share should be on the order of 0.12 x 21 = $2.52, which is very close to the observed difference of $2.43. This provides yet another piece of evidence that differences in nominal contractual customs actually do have an impact on net returns to labor and land in different regions.

6. Summary and conclusion

Cropsharing contracts in contemporary Illinois agriculture exhibit many of the same features found in simple agrarian societies: cropsharing is widespread as a contract form, the shares are almost invariably expressed in focal fractions such as halves, fifths, or thirds, and they are *shaped by custom* in the sense that they do not respond much to local differences in economic fundamentals. Nevertheless, customs may differ between localities if there are sufficiently large differences in fundamentals to warrant it. Thus the customary share in southern Illinois is 3/5 or 2/3 for the tenant, whereas in the north, where soils are on average more productive, the custom is 1/2. In short, contractual customs respond to broad regional differences in fundamentals, even though they may be quite insensitive to local differences.

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[4]To control for secular and regional heteroscedasticity, we also estimated the model with errors conditioned on year and region. This did not appreciably change the size or significance of the estimated coefficients.

The existence of local contractual customs permits tenants to capture a portion of the rent that would ordinarily accrue to land. In Illinois, the rate of rent capture is roughly one-third, that is, tenants are able to capture about one-third of the incremental increase in net returns that would accompany an incremental increase in soil quality, holding other inputs fixed. This nominal rent capture does not appear to be a risk premium, nor does it result from increased quality of labor input. Indeed, if anything, these factors work in the opposite direction and suggest that the *real rate* of rent capture is even greater than the nominal rate. While it is conceivable that the premium paid to labor on higher-quality land may induce somewhat lower turnover rates, this does not appear to explain more than a small fraction of the premium.

What then accounts for the ability of tenants to capture land rent in a competitive market setting? We begin by remarking that the phenomenon is not unique to agriculture: a variety of studies suggest that employees in firms may also be able to capture some of the rent that would ordinarily accrue to capital.[5] Broadly speaking, there are two schools of thought about the sources of these rents. One theory, in the new institutional tradition, views rent sharing as an economically rational response to structural labor market features such as monitoring costs, turnover and search costs, and specific investments. (For a recent survey of this literature see Malcomson, 1999.) On this theory, the degree of rent sharing should vary across labor markets according to their respective structural characteristics, as well as across time within a given labor market in response to structural change.

An alternative theory treats rent sharing as a social norm. On this view, certain levels of effort and compensation come to be viewed as fair and appropriate in a given employment setting. The importance of fairness norms is borne out both by survey data on labor practices in firms, as well as by experimental evidence from subjects who negotiate labor contracts in laboratory environments.[6] In the real world such norms tend to emerge organically over time, rather than by conscious design, and we should not expect them to conform to standard models of economic optimality. Once established, however, they acquire psychological force that affects the parties' motivations: adherence to the norm leads to trust and reciprocity, while deviation leads to shirking and loss of morale. Moreover, while the details of the norm may have no economic justification *per se*, its existence serves an important economic purpose by reducing transactions costs in inherently complex bargaining situations (Murrell, 1983; Young, 1994; Malcomson, 1999).

Our own view is that the degree of rent sharing is probably influenced by both of the above factors--exogenous structural features of the labor market as well as endogenously generated norms. In the case of

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[5] See, for example, Dickens and Katz (1987) and Katz and Summers (1989) .

[6] The importance of fairness norms in setting wages is discussed by Blinder and Choi (1990), Bewley (1997), and Cambell and Kamlani (1997). For laboratory experiments on the negotiation of contracts see Fehr, Kirchsteiger, and Riedl (1996), Fehr, Gaechter and Kirchsteiger (1997), Fehr, Kirchler, Weichbold, and Gaechter (1998).

agriculture, where turnover and search costs appear to be relatively low, it seems that the psychological salience of simple fractions plays an especially important role. Specifically, if usage and custom dictate that the tenant gets, say, one-half of the surplus, any attempt by the landlord to offer less will not pay off. Either the offer will be refused outright, or it will be grudgingly accepted and later undermined as a way of getting back at the landlord. The landlord, realizing this possibility, will not make the attempt in the first place; moreover he realizes that he will face the same problem if he tries to negotiate with someone else.

Of course, one might wonder why the parties do not treat *expected income* as the relevant standard of fairness rather than the share. If tenant A on high-quality land is making just as much as tenant B on low quality land, what difference does it make if A's nominal share is lower? One reason is that income is not readily ascertainable, whereas the share is easy to verify. But this cannot be the whole answer. We would argue that people feel entitled psychologically to a portion of the surplus generated by high-surplus relationships. In the ultimatum game, for example, subjects tend to refuse offers when they are low relative to the overall size of the pie (Gueth, Schmittberger, and Schwartz, 1982; Roth, Prasnikar, Okuno-Fugiwara, and Zamir, 1991). This suggests that the relevant standard of comparison is each party's share of the total, not the absolute amounts they receive.[7]

Whether or not one accepts the fairness explanation, the empirical fact remains that tenants do seem to be able to appropriate a substantial portion of land rent in Illinois agriculture. This rent flows directly from the structure of the contract and its insensitivity to local variations in land quality. The nominal rate of capture is one-half or more; the effective rate appears to be at least one-third and may be higher once one takes unobservables such as shirking and risk aversion into account. We conclude that contractual customs operate with powerful effect in modern Illinois agriculture, that they can apparently be sustained in competitive market environments, and that they have important implications for factor returns that are not predicted by conventional market-clearing models.

[7] We note the interesting fact, which is probably coincidental, that the average accepted offer in ultimatum game experiments is often between one-third and two-fifths, which is quite close to the net shares of tenants in Illinois.

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