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LAND AND LIVESTOCK CONTRACTING IN
AGRICULTURE: A PRINCIPAL-AGENT
PERSPECTIVE

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Abstract

The seemingly disparate literatures on land tenancy and on the contract production of livestock actually have much in common. Here, they are examined together within a simple principal-agent framework. The core of this framework and a central issue in much writing on these agricultural contracts is the trade-off between smaller risk-bearing costs and better incentives for farmer effort, for the revelation of information and for innovation. The relative importance of risk and incentive in explaining the design and use of land tenancy and livestock production contracts remains a key topic for research.

JEL classification: L14, Q12, Q15

Keywords: Land, Livestock, Contracts, Agriculture

1. Introduction

Contractual arrangements in agriculture have attracted research interest along several different lines. One primary focus is land tenancy. The causes and consequences of sharecropping, land rental, and owner-operator farming inform a long, active, and widely-known stream of research (surveys include Newberry and Stiglitz, 1979; Binswanger and Rosenzweig, 1984; Otsuka and Hayami, 1989; Singh, 1989; and Otsuka, Hiroyuki and Hayami, 1992).

A second important focus is more recent and less widely-known, arising out of the changing organization of livestock production in the United States (Shelden, 1996 provides an overview). Traditionally, livestock producers have bred and raised animals for sale in auction markets. Beginning with broiler chickens in the 1950s, followed by turkeys, and now spreading to swine, a new form of contract production has come to dominate (see Knoeber, 1989 and Menard, 1996 for a description of broilers; and Martin, 1994 for swine). Increasingly, 'growers' raise animals under contract for large 'integrator' firms. Under this new arrangement, an integrator firm provides young animals (chicks, poults, feeder pigs), feed, medicine and

advice to contract growers. Growers provide housing, utilities, labor and management. Animals are kept by growers until maturity, but are owned by the integrator firm. At maturity, animals are collected by the integrator and transported to slaughter and processing plants. For broilers and turkeys, the breeding of chicks (poults), mixing of feed, and slaughtering and processing are all typically done by the integrator firm. For swine, integrators mix feed but only sometimes breed pigs and only rarely operate packing plants. These contracts share some features with contracts that have been used for several decades to organize the production of fruits and vegetables for processing (see Reimund, Martin and Moore, 1981; Knoeber, 1983). Reasons for the advent of contract production and the nature of its effects are important emerging research topics.

The issues in land tenancy and in contract production are similar. Examining these two related research streams is the purpose of this survey. A simple principal-agent framework is used to organize the discussion, and the primary focus is choice of contract form. This approach narrows the range of issues discussed. An abstract setting in which a single principal contracts with a single agent and in which only the agent's actions are of concern provides the background for much of the survey. Attention is paid to situations where a single principal contracts with multiple agents, but the possibility that the actions of the principal (as well as those of the agent) matter is generally ignored (Reid, 1977; Eswaran and Kotwal, 1985; Allen and Lueck, 1993; Battacharyya and Lafontaine, 1995 all examine this double moral hazard case). Collective contracts which unite farmers into cooperatives are also ignored. Finally, the effects that varying institutions (largely governmental) have on contract choice receive scant attention. This is appropriate for the discussion of livestock contracting which is largely restricted to activity in the United States, but is a defect in the discussion of land contracting which, while emphasizing the United States experience, is intended to be substantially broader.

2. Framework

2.1 Overview

All contracts are formed because the parties involved expect to benefit. In the agricultural context, a focus is often the source of these benefits. One strain of literature emphasizes the stochastic nature of prices and production outcomes facing farmers and views contracts as a vehicle to shift (or share) risk. In this strain, the important benefit of contract production and marketing, as well as sharecropping or other land tenure arrangements, is the reduction in risk-bearing costs. Another strain emphasizes efficiencies in the organization of production. Here, the important benefit of contracts is

the reduction of transaction and production costs afforded by specialization and the incentives that contracts provide for effort, revelation of information, and innovation.

The literature emphasizing the benefits from shifting risk presumes impediments to trading risks directly, as in insurance markets, which limit risk-shifting opportunities for participants in agriculture. Agricultural contracting offers a second-best technique to reallocate the risks of farming and processing. In this literature, the effects of contract design on behavior, except those that follow directly from changing the riskiness of producer or buyer profit functions, are often ignored. But shifting the risk of production outcomes to others also reduces the incentive to achieve better outcomes, since (part of) the gain to better outcomes inures to others. Indeed, if all risk is shifted, as when a farmer is simply paid a wage unrelated to his effort, the farmer is left with no incentive to work hard or to make good, but difficult, decisions. The reason is that the costs of such actions are borne by the farmer and all gains go to the employer. Where these incentive effects are recognized, they are treated as a cost which limits the extent to which agricultural contracts can be used to shift risk.

The literature emphasizing production efficiencies takes the opposite approach. Here, agricultural contracts are often analyzed presuming risk neutrality, explicitly ignoring any risk-bearing effects that they may have. The focus is how contract design affects the incentives of farmers (and processors) and so ultimately the costs of production. Where risk is considered, it is treated as a cost of providing better incentives. For example, tying a farmer's income more closely to production outcomes provides incentive to improve these production outcomes but also forces him to bear more risk. Here, the farmer's aversion to risk limits the extent to which incentives can be improved.

While these two strains of literature differ in emphasis, they overlap in their attention to the trade-off between the reduction in the costs of risk bearing and the provision of better incentives. This trade-off is the core of the principal-agent problem and provides a useful framework from which to view the literature on agricultural contracting.

2.2 Principal-Agent Formulation

Consider a farmer (agent) acting for a landlord (principal). The farmer provides an input, effort, that contributes to output. Denote effort as a and output as X , where $X(a)$ and $X' > 0$. The farmer's income, I , depends upon the contract that he faces and in general form is written $I = \alpha X + \beta a + \delta$, where α and β are rewards to greater output and effort respectively. Here, the farmer's income depends upon output, his effort, and the parameter, δ , which is a fixed payment and can be thought of as a non-contingent wage. If

both $\alpha = 0$ and $\beta = 0$, the farmer's income is unrelated to his behavior and so he has no incentive to provide effort. To induce effort, the contract can provide either $\alpha > 0$, $\beta > 0$ or both. If $\alpha = 0$ and $\beta > 0$, the farmer is rewarded on the basis of his effort only. This is an incentive wage payment. If $\alpha > 0$ and $\beta = 0$, the farmer is rewarded on the basis of his output only. This is a cropshare or piece rate payment. If $\alpha = 1$, $\beta = 0$, and $\delta < 0$, the farmer receives all output and has a negative fixed payment. This is a land rental contract.

Why might one form of contract be preferred to others? If providing incentive to the farmer is all that matters, any level of effort can be induced using a positive α , a positive β , or a combination of the two. None seems to have an advantage over others. Differences arise when the costs of using X or a reward to the farmer are considered. These costs take two forms. One is risk-bearing cost; the other is monitoring cost.

Monitoring costs arise because it is necessary to measure. If the farmer's reward is based on output, X must be measured. If the farmer's reward is based on effort (input), a must be measured. In many circumstances, monitoring costs will be less when reward is based on output for two reasons. First, the physical nature of output often allows easier measurement. This will be the case where output is less subject to variation in quality and has fewer dimensions than effort. Second, it will typically be true that output must be measured for purposes of sale whether or not it is the basis for farmer reward. If so, and if no additional measurement is necessary to reward the farmer (additional measurement would be required if, for example, the crop was not of uniform quality and the farmer's reward was a portion of the crop itself), the relevant monitoring cost is zero when output is used as the basis for farmer payment. The high cost of measuring effort also makes it likely that an imperfect measure will be used. So, measuring effort likely will be both more costly than measuring output and less precise. The degree of imprecision depends upon the cost of refining measurement. As a consequence, we can think (roughly) of the choice of how to reward a farmer as that between a precise measure of output, X and an imprecise estimator of effort, \hat{a} . Since \hat{a} is an estimator of a , it measures effort with error. Importantly, this introduces risk into the farmer's reward. Using \hat{a} as the basis for rewarding a farmer, then, entails two disadvantages relative to using X . Measurement costs are greater and the farmer is forced to bear the risk of errors in the measure of his effort. For this, a risk-averse farmer must be compensated. It seems that rewards based on output will provide incentive more cheaply than rewards based on effort.

But, so far, the important cost of reward based on output has been ignored. Output, while increasing in effort, has a large random component. Weather, pest infestations, and many other exogenous forces have marked effects on X . Rewards based on output may be quite risky, and bearing this

risk is costly. The relative cost of rewards based on output depends upon the size of these risk-bearing costs (costs of measuring output are presumed to be zero) compared to the sum of monitoring costs and smaller risk-bearing costs associated with rewards based upon an estimator of effort, \hat{a} .

To see how this affects the form of contract used, consider several extreme cases. First, if the farmer is risk neutral (so, risk-bearing costs are zero) and measuring effort is costly, incentive can be provided most cheaply by rewards based on X . A land rent contract with $\alpha = 1$, $\beta = 0$, and $\delta < 0$ seems optimal. Second, if the farmer is risk averse and monitoring costs are zero (effort can be measured without error at no cost), incentive can be provided most cheaply by rewards based on effort. An incentive wage contract with $\alpha = 0$ and $\beta > 0$ seems optimal. Third, if the farmer is risk neutral and monitoring costs are zero, a land rent contract, an incentive wage contract, and combinations of cropshare and incentive wage contracts (where $0 < \alpha < 1$ and $\beta > 0$) all work equally well. Finally, the most interesting case is that where the farmer is risk averse (so risk costs matter) and monitoring costs are positive. Here, there is a trade-off. Effort can be maintained by increasing α and decreasing β or the reverse. Optimality requires raising α until the additional risk-bearing costs just offset the savings in monitoring costs from the corresponding reduction in β . Models focusing on this trade-off between incentive and risk costs include Stiglitz (1974) and Warr (1978).

3. Risk Shifting as the Motivation for Contracts

3.1 Sharecropping

Drawing especially on early work by Johnson (1950), Cheung (1968, 1969) characterizes sharecropping as motivated by gains from risk shifting. Johnson notes that an exogenously imposed sharecropping contract ($0 < \alpha < 1$ and $\beta = 0$) provides too little incentive for the farmer to provide effort since he receives only a fraction (α) of the gain and incurs all of the cost, but Johnson also argues that competition works to eliminate insufficient effort. Landlord and tenant will contract not only over the share of output each receives but also over the required effort of the tenant. If effort is insufficient, the lease will not be renewed. Essentially, a is assumed to be easily observable (monitoring cost is zero), so a minimum level of a can be written into the contract. Recently, Banerji and Rashid (1996) have argued that tournaments in which a tenant farmer's output is compared to that of other tenants provide one mechanism for the landlord to deduce the farmer's effort. With effort observable, competition forces the farmer to provide the contractual minimum. Cheung (1968) extends Johnson's argument by explicitly assuming that transaction costs are zero. With this assumption,

any contract (cropshare, lease, wage) provides appropriate incentive for effort. Cheung argues that sharecropping is used because it provides for risk sharing. Apland, Barnes and Justice (1984) and Petersson and Andersson (1996) adopt this framework and, ignoring any incentive effects, attempt to estimate the risk-sharing benefits from cropshare contracts for sample farms in the United States and Sweden respectively.

A difficulty with Cheung's argument, however, is that sharecropping is not universal. If sharecropping is equivalent to other contracts in incentive and superior in risk sharing, why are other contracts also used? Cheung's (1969) answer is that transaction (monitoring and contracting) costs are not always zero. This allows a trade-off between risk sharing and incentive, a trade-off that may be unfavorable to cropshare contracts.

Stiglitz (1974) and Newberry (1977) also treat risk sharing as the motivation for cropshare contracts and develop conditions under which these contracts provide efficient incentives. In addition, both authors along with Reid (1976) show that where monitoring is costless and risk enters through stochastic output, sharecropping is unnecessary to shift risk. A mixture of rental and wage contracts can duplicate the risk shifting effected by a cropshare contract. These results and a general unwillingness to accept that monitoring costs are zero, has led to substantial criticism of risk sharing as the primary motivation for sharecropping (see especially Jaynes, 1984). In an interesting twist, Reid (1973, 1976) argues that risk considerations motivate sharecropping, but through *risk reduction* not *risk sharing*. Cropshare contracts provide superior incentives to adapt to post contractual changes in the environment and so to dampen the effect of nature on output, reducing risk itself.

3.2 Livestock Contracts

Even more so than cropshare contracts, livestock production contracts are viewed as motivated by risk sharing. Kliebenstein and Lawrence (1995, p. 1215) state that 'the primary reason (that growers enter swine production contracts) is risk reduction'. Similarly, Johnson and Foster (1994) ignore any incentive effects and evaluate the desirability of swine production contracts to growers in terms of the risks that growers must bear. Knoeber and Thurman (1995), while not arguing that risk sharing necessarily motivates contracting in broilers, estimate the extent of risk shifting afforded by contract production. This is substantial. Martin (1994) makes similar estimates for swine production. But here, the extent of risk shifting is not as pronounced.

Although livestock production contracts do provide considerable risk shifting, and although observers and participants claim that this is the most important motivation for such contracts, no studies have tested for a link between risk and the incidence of such contracts. A number of tests have

been conducted for cropshare contracts. If risk shifting is important, cropshare contracts should be observed where yields are most uncertain. Higgs (1973) finds weak evidence consistent with this implication for corn and cotton in the early twentieth century in the southern United States. Rao (1971) finds opposing evidence for Indian farms. More recently, Allen and Lueck (1992b, 1996), for farms, and Leffler and Rucker (1991), for timberland, find no relation between risk and the nature of contracts chosen.

4. Incentive as the Motivation for Contracts

4.1 Sharecropping

Focusing on Cheung's (1969) assertion that transactions costs (monitoring and contracting costs) are important in explaining the incidence of contracts, another stream of literature emphasizes incentives to explain sharecropping. Higgs (1974), Alston and Higgs (1982) and Alston, Datta and Nugent (1984), while not denying the potential importance of risk sharing, argue that differences in supervision costs (costs of measuring a) help explain variation in the extent of sharecropping for crops that have similar yield variability. Where it is more costly to measure a , sharecropping, or basing farmer rewards on X , becomes more likely. All three papers find evidence consistent with this prediction using historical data for the southern United States. Evidence for India is presented in Datta, O'Hara and Nugent (1986).

Bell and Zusman (1976) and Stiglitz (1988) also emphasize difficulties in monitoring farmer effort as a rationale for sharecropping. Where measuring effort is expensive (so minimum a cannot be fixed by contract), a share contract, with $\alpha > 0$, provides incentive but only by imposing risk on the farmer. Trading off the loss from too little incentive against that from too great risk bearing defines the optimal share contract. If capital as well as labor is allowed as an argument in the production function, and if these inputs are complementary, introducing a link to credit into a cropshare contract may be desirable. Providing subsidized credit to a sharecropper will induce greater use of capital and so greater labor productivity and hence more effort (this may not be true if tenants also work off the farm; see Subramanian, 1995). So, the common occurrence of interlinked credit and cropshare contracts may have its origin in the difficulty of providing incentives for effort (see Braverman and Stiglitz, 1982, 1986; Mitra, 1983).

Murrell (1983), Eswaran and Kotwal (1985), and Chew (1991) all ignore risk costs and focus on contracting costs to explain sharecropping, but the strongest statement of the primacy of incentives (the irrelevancy of risk sharing) is in Allen and Lueck (1992b, 1993, 1995, 1996). Assuming risk neutrality, they construct a framework in which measurement and

enforcement costs dictate the form of contract chosen. They use this framework to explain both the choice between cropshare contracts and others and the choice of input and output shares when cropshare contracts are used. Using data for farms in Nebraska and South Dakota, they provide evidence that is consistent with the importance of these measurement costs and the unimportance of risk-bearing costs in explaining contract choice.

4.2 Livestock Contracts

The literature on livestock contracts never ignores risk but only sometimes treats risk sharing as an end in itself. Sheldon (1996) adopts a principal-agent framework to characterize contracts as providing incentive for effort by rewarding growers on the basis of output, X , but at the cost of imposing risk on growers. Knoeber (1989) also treats incentive as primary, but argues that the design of broiler production contracts can be explained partly as intended to provide this incentive while minimizing the risk borne by growers. Reducing the risk cost of providing incentive allows for higher powered incentives. An interesting feature of broiler production contracts is that growers are rewarded based upon relative performance where performance is measured largely by feed conversion, the effectiveness with which feed is used to produce meat (effort, or a , is not measured). A grower's pay rises as his performance improves, not absolutely but relative to the performance of other growers. This scheme, which is like a tournament, shifts risks which are common to all growers (weather, feed mix, chick genetics) to the integrator company (on relative performance payments, see Lazear and Rosen, 1981 and Holmström, 1982). Common shocks, like bad weather, reduce all growers' absolute performance but leave each grower's payment unchanged if relative performance is unaffected. For example, a contract that rewards a grower based upon his output relative to the average of other growers, uses $X_i - \bar{X}/n$ to measure grower i 's performance. If bad weather affects each grower identically, each grower's X will move in lock-step, leaving grower i 's relative performance unchanged. Where substantial variation in absolute performance is common to all growers, contracts such as those used in the broiler industry can provide incentive to growers with less risk-bearing cost than contracts rewarding absolute performance. Knoeber and Thurman (1994) test a number of hypotheses arising out of the theory of tournaments using broiler production data.

In addition to incentive for effort, livestock production contracts may be designed to alleviate another incentive problem. This is the hold-up problem discussed by Klein, Crawford and Alchian (1978). When production requires investing in an asset that is specialized to a particular trading partner, any deal made prior to investing in the specialized asset may not be enforceable once the investment is made. The non-investing party has an

incentive to use his newly created bargaining power (the cost of the specialized asset cannot be recouped elsewhere) by demanding more favorable terms. Production contracts that require both parties to invest in assets specialized to the other (or an exchange of hostages as described by Williamson, 1983), as is the case where growers invest in animal houses and integrators invest in breeding facilities, feed mills, and processing plants, help to alleviate the hold-up problem. This role for livestock production contracts is emphasized by Knoeber (1989), Frank and Henderson (1992), Barry, Sonka and Lajili (1992) and Sporleder (1992).

5. Selection as a Motivation for Contracts

Even with no concern for risk or farmer effort, asymmetric information may motivate the design of contracts. Where farmers differ in ability, it may be important to choose farmers to match productive circumstances. For example, for climates and crops where adaptability (decision making) is crucial, more able farmers are desired. Where rote response is sufficient, less able farmers are suitable. If only farmers know their own ability and if farmers are heterogeneous, the design of contracts may act to induce farmers to self-select into appropriate matches. Hallagan (1978) explains the simultaneous use of wage, share and rental contracts as a response to this selection problem where entrepreneurial ability is important. Where low entrepreneurial ability is sufficient, landowners will offer (low) wage contracts. Where high ability is necessary, landowners will offer (high) land rental contracts. Where intermediate ability is appropriate, share contracts will be offered. Those with the highest entrepreneurial ability will be willing to accept only the rental contract; those with the least ability will be willing to accept only the wage contract; and those with intermediate ability will be willing to accept only the cropshare contract. A similar argument, but viewing ability more generally, is developed by Newberry and Stiglitz (1979). Brown and Atkinson (1981) provide a test of this selection hypothesis by examining cropshare contracts in Indiana. They argue that where entrepreneurial ability is more important, the farmer's share will be greater (this is closer to a rental contract), and test by examining the scope of farmer decision making across contracts with varying farmer shares. They find evidence that as the scope of decision making increases (ability becomes more important), farmer shares increase as well, consistent with the selection hypothesis.

Allen (1982) argues that where it is only farmer ability that is asymmetrically known, wage and cropshare contracts are unnecessary to induce selection. If farmers have all decision-making authority, as is the case with rental contracts, they will sort themselves correctly. However, Allen

(1982, 1985) also offers two reasons why share contracts may occur for selection purposes. First, if landowners wish to maintain some decision-making authority, as would be the case if in addition to asymmetric knowledge of farmer ability there is also asymmetric knowledge about land quality (landowners alone know the quality of their holdings), sharecropping may arise. Second, if contracts must be self-enforcing (courts cannot be counted on), sharecropping may arise. Since both rental and cropshare contracts necessarily imply a loan of land to the farmer until the crop is harvested, both are subject to farmer default. Default entails absconding with the entire crop or not paying the agreed upon rent. If landowners can learn farmer abilities by observing the size of the harvest, an equilibrium may arise where farmers of low ability select wage contracts, farmers of high ability select share contracts and are later rewarded for performance (not absconding) with larger plots (and so more income). Share contracts, then, provide a self-enforcing mechanism to induce selection.

There may be a similar role for selection in livestock production contracts. These contracts require growers to build expensive animal houses, with little salvage value. Growers of high ability likely will find this investment profitable; those with low ability likely will not. Knoeber (1989, p. 280) notes that broiler companies (integrators) claim that an important reason for the use of contract growers is the refusal of high-quality growers to work for wages. That is, contract production selects for high-quality growers. The likely reason for the importance of high-quality growers is that suggested by Hallagan (1978); the rapid technological change which characterizes the broiler industry requires growers of high entrepreneurial ability.

6. Innovation and Contract Form

Is there a link between innovation and contract form? Bhaduri (1973) claims that sharecropping retards innovation, but the case is not clear. Since a share contract divides the gains from innovation (like the gains from farmer effort) between landlord and tenant, neither seems to have sufficient incentive to innovate. But if transaction costs do not interfere, Cheung's (1968) argument for the efficiency of share contracting applies equally to effort and to innovation. As long as contracts can be adapted easily, extant share contracts should have little influence on the incentive to adopt new technologies. Transaction costs aside, then, there should be no relation between the form of contracts (cropshare, lease, wage) and innovation. But transaction costs may matter. Newberry (1975) argues that innovation may both increase output and make it more difficult to provide incentive to tenant farmers (require more resources devoted to measuring a in order to assure

that effort does not fall below that agreed upon or greater risk-bearing costs for the tenant if the (now, less precise) original measure of a is still used). If this is the case, innovations that would be undertaken with rental contracts may sometimes be foregone with share contracts. This transaction costs argument suggests less innovation with sharecropping.

Empirical evidence, at least in developing countries, shows no relation between innovation and contract form. Parthasarathy and Prasad (1974) find no effect of share tenancy on the adoption of high yield varieties of rice in an Indian village. Ruttan (1977) summarizes research showing no persistent lag among sharecroppers in the adoption of new varieties of rice and wheat in Asia during the Green Revolution of the 1960s and 1970s. Similarly, Feder, Just and Zilberman (1985) conclude that no clear relation exists between tenancy and the adoption of agricultural innovations.

These empirical findings are not surprising. If sharecropping's effect on innovation were substantial, contracts that better facilitate innovation should replace share contracts. Interestingly, there appears to be a *positive* relation between the pace of technological innovation and contract production in livestock industries. Improvements in feed conversion in the United States have been most rapid and most persistent for broilers and turkeys where contract production dominates, recently rapid for hogs where contract production is increasing, and relatively slow for cattle where contract production is less significant (Knoeber, 1989). Similarly, adoption of new breeding technologies seems positively related to (contract) integration in livestock production (Johnson, 1995). This suggests that contracts may facilitate innovation. Knoeber (1989) provides an explanation for broilers. Here, decisions to adopt innovations (new genetics, and so on) are made by the integrator companies. Also, broiler contracts compensate growers based upon relative performance. These contracts serve two complementary purposes. First, they protect growers from the risk associated with innovation experiments. Innovations may raise or lower absolute performance, but have little effect on relative performance. So growers will not resist innovation. Second, these contracts automatically shift all of the gains from innovation (increases in absolute performance) to the integrator company. As a result, those making adoption decisions face the full costs and benefits of these decisions without the necessity to rewrite contracts (no additional contracting costs are incurred). The form of broiler production contracts seems particularly well adapted to an environment of rapid and persistent technological change.

7. Contracts and Performance

An important issue in the land tenancy literature but not in that on livestock contracting is the relation between contract form and performance. The primary concern is that sharecroppers who receive only a portion of the gains from effort will have too little incentive and perform poorly. Bardhan and Srinivasan (1971) model this effect. To the extent that contracts are imposed exogenously (or perhaps contractual choice is constrained politically), this concern may be warranted. If sharecrop contracts are imposed where rental or owner operation is optimal, sharecroppers should perform worse than renters or owner-operators and the cross-sectional relation between sharecropping and performance should be negative. But if contracts are chosen endogenously, share contracts (like others) should be chosen where they are most effective (Lucas, 1979; Rao, 1971; Morooka and Hayami, 1989; Chew, 1993; Tunali, 1993; and especially Otsuka, Hiroyuki and Hayami, 1992, pp. 2005-2008). Here, sharecroppers should perform no better nor worse than other farmers. As a consequence, there should be no cross-sectional relation between sharecropping (or other contract form) and performance (for a statement of this argument applied to the ownership structure of corporations and firm performance, see Demsetz and Lehn, 1985; for a test, see Agrawal and Knoeber, 1996). Any empirical relation is either spurious or results from failing to control for those features of the environment that make sharecropping (or rental, or owner operation) optimal.

Empirical evidence is largely consistent with optimal (unhindered) contract choice. Bell (1977) and Shaban (1987) are exceptional in offering evidence of poorer performance by sharecroppers in India. Laffont and Matoussi (1995) also find evidence of poorer performance in Tunisia but do so within an explicit framework in which exogenously imposed credit constraints on farmers induce sharecropping. Most studies find no such effect. Rao (1971), Truran and Fox (1979) and Nabi (1986) are more typical in finding no performance difference for sharecroppers. Cropshare contracts appear to exist where they are optimal.

8. Next Steps

A substantial portion of the literature on sharecropping has focused on its use and its effects in developing countries. This is appropriate both because these countries are more agrarian than their western counterparts and because sharecropping seems more dominant here. But sharecropping remains important in developed countries. For some crops and some areas, sharecropping is the primary form of contracting. For example, in the

United States during the late 1980s, cropshare contracts were a large percentage of all lease contracts in the midwest where grain crops dominate (more than 50 percent in Kansas, Illinois, and Indiana; more than 40 percent in Iowa and Missouri). An important question is whether the function of sharecropping is the same in both developing and developed economies. The generally lesser use of cropshare contracts (relative to rental or wage contracts) in developed economies offers a clue. What is it about the development of markets that might lead to a decline in sharecropping? One possible answer is that with better markets also comes less risk or at least better ways to shift risk. More extensive agricultural markets reduce the effects that local conditions have on prices and so may reduce the risk associated with farming (depending upon the correlation of output among local farmers and the correlation between local output and price). But even if this is not the case, better insurance markets provide alternatives to sharecropping as ways to share risk. More developed markets reduce (or perhaps eliminate) the risk-shifting motivation for sharecropping. This may account for sharecropping's lesser importance in developed countries. But more extensive markets and the anonymity that they allow also will affect measurement costs and so, in turn, the incentive motivation for share contracts. These changes in measurement costs, then, also may account for the lesser importance of sharecropping in developed countries (and for the variation in the importance of sharecropping across crops and regions).

Both arguments are made by Otsuka, Kikuchi and Hayami (1986) to explain the lesser use of share contracts (relative to rental contracts) for drivers of jeepney (taxi cabs) in urban as opposed to rural areas of the Philippines. The 'thicker' urban market is less risky than rural markets making urban share contracts less desirable on risk-sharing grounds. But also tight-knit communities in rural areas (relative to the anonymity of urban areas) reduce the cost of monitoring drivers. Low effort by drivers is known more readily by owners in rural areas. So, measurement costs are relatively high in urban areas, again making share contracts less desirable. Similar arguments may explain the lesser use of cropshare contracts in more developed countries. If so, more active crop insurance markets (or more extensive government disaster payments) should coincide with lesser use of share contracts. Similarly, lesser migration (tighter knit communities) should coincide with greater use of cropshare contracts.

Little role for risk considerations in contract choice in developed countries is consistent with the claim of Allen and Lueck (1996) who argue that transaction costs determine contract use in modern United States farming. Examining more carefully the nature of measurement and enforcement costs seems a fruitful approach to studying agricultural contracts. Allen and Lueck (1992a) do this to explain the length of farmland

contracts and whether their form is oral or written. In related work (Allen and Lueck, 1997), they also address a very interesting puzzle, the continued dominance of family farms in the face of growing corporatism in other sectors of the economy. Once again, measurement costs are key. Family farms eliminate the need for measurement of effort since family farmers are residual claimants. But family farms also restrict the possibilities for specialization. Where measurement of effort is difficult and specialization unimportant, family farms should dominate. Where measurement of effort is easier and gains from specialization greater, partnerships and corporations should be important. Allen and Lueck treat (Mother) nature as determining measurement and specialization costs. Where production has a larger random element, the costs of measuring effort are greater. Where seasonality is less, specialization gains are more important. This implies that family farms will be more likely where nature (weather, pests, and so on) is a more important determinant of output and for more seasonal crops. Allen and Lueck also provide some confirming evidence. That nature and seasonality are more important for agriculture than for other industries is consistent with the continued dominance of family farms. Further, the importance of corporate firms in broiler production is ascribed to the elimination of nature's role in much of the production process. Finally, the relative importance of family farms in British Columbia and Louisiana is explained by the extent of seasonality (more seasonal crops are more likely to be grown on family farms) and the degree to which nature influences output (weakly, irrigated crops, where rainfall is less important, are less likely to be grown on family farms).

Similarly, despite much opposing commentary, risk costs may not be the primary motivation for the livestock production contracts increasingly used in the United States. Focusing on measurement and enforcement costs seems a fruitful avenue. Interesting puzzles are differences in the extent of contract use and the design of contracts across varieties of livestock. In the United States, contract production dominates for broilers and turkeys, is important for eggs (although vertically integrated companies are also important and some auction markets exist), is increasingly important for hogs (but still accounts for less than 25 percent of hog production), and is unimportant for cattle. No attempt has been made to explain this pattern. Additionally, broiler contracts reward growers based on relative performance; turkey contracts sometimes do and sometimes do not; and hog contracts almost never do. Contract producers of hogs receive bonuses if they meet absolute (fixed) performance standards. Tsoulouhas and Vukina (1997) suggest a risk-related explanation for this variation in contract form. Concern with bankruptcy risk precludes the use of relative performance compensation for contract producers of swine where integrators are predominately closely-held and where price volatility is large. In contrast, the predominance of publicly

traded integrators in the broiler industry coupled with lesser price volatility allows the use of relative performance compensation for contract producers of broilers. But, there also may be a measurement cost explanation of this phenomenon. Relative performance is a less noisy measure than absolute performance whenever common shocks to performance (for example bad weather that affects all growers) are large and comparison growers are many. The reason is that relative performance differences-out the noise introduced by common shocks from a grower's performance but also introduces the idiosyncratic variation from other growers' performance (other growers' performance is the benchmark). If the first effect dominates, relative performance is a less noisy measure. The noise added by the idiosyncratic variation in other growers' performance is reduced when there are more of these other growers since the individual variations balance out (Hölmstrom, 1982). The number of other growers and their similarity, then, determine whether or not relative performance contracts are desirable (Knoeber, 1989 and Martin, 1994). Much remains to be done to explain the ongoing revolution in the contractual organization of livestock production.

Bibliography on Land and Livestock Contracting in Agriculture (5920)

- Agrawal, Anup and Knoeber, Charles R. (1996), 'Firm Performance and Mechanisms To Control Agency Problems Between Managers and Shareholders', **31** *Journal of Financial and Quantitative Analysis*, 377-397.
- Allen, Douglas W. and Lueck, Dean (1992a), 'The "Back Forty" on a Handshake: Specific Assets, Reputation, and the Structure of Farmland Contracts', **8** *Journal of Law, Economics, and Organization*, 366-376.
- Allen, Douglas W. and Lueck, Dean (1992b), 'Contract Choice in Modern Agriculture: Cash Rent versus Cropshare', **35** *Journal of Law and Economics*, 397-426.
- Allen, Douglas W. and Lueck, Dean (1993), 'Transaction Costs and the Design of Cropshare Contracts', **24** *Rand Journal of Economics*, 78-100.
- Allen, Douglas W. and Lueck, Dean (1995), 'Risk Preferences and the Economics of Contracts', **85** *American Economic Review*, 447-451.
- Allen, Douglas W. and Dean Lueck (1996), 'Risk-Sharing and Agricultural Contracts', North Carolina, Department of Agricultural and Resource Economics, North Carolina State University.
- Allen, Douglas W. and Lueck, Dean (1997), *The Nature of the Farm*, North Carolina, Department of Agricultural and Resource Economics, North Carolina State University.
- Allen, Franklin (1982), 'On Share Contracts and Screening', **13** *Bell Journal of Economics*, 541-547.
- Allen, Franklin (1985), 'On the Fixed Nature of Sharecropping Contracts', **95** *Economic Journal*, 30-48.

- Alston, Lee J. and Higgs, Robert (1982), 'Contractual Mix in Southern Agriculture since the Civil War: Facts, Hypotheses, and Tests', **42** *Journal of Economic History*, 327-353.
- Alston, Lee J., Datta, Samar K. and Nugent, Jeffrey B. (1984), 'Tenancy Choice in a Competitive Framework with Transactions Costs', **92** *Journal of Political Economy*, 1121-1133.
- Anderson, Terry L. and Lueck, Dean (1992), 'Land Tenure and Agricultural Productivity on Indian Reservations', **35** *Journal of Law and Economics*, 427-454.
- Apland, Jeffrey, Barnes, Robert B. and Justice, Fred (1984), 'The Farm Lease: An Analysis of Owner-Tenant and Landlord Preferences under Risk', **66** *American Journal of Agricultural Economics*, 376-384.
- Banerji, Sanjay and Rashid, Salim (1996), 'Tournaments and Sharecropping', **63** *Economica*, 343-352.
- Bardhan, Pranab K. and Srinivasan, T.N. (1971), 'Cropsharing Tenancy in Agriculture: A Theoretical and Empirical Analysis', **61** *American Economic Review*, 48-64.
- Bardhan, Pranab K. and Srinivasan, T.N. (1974), 'Cropsharing Tenancy in Agriculture: Comment', **64** *American Economic Review*, 1067-1069.
- Barry, Peter J., Sonka, Steven T. and Lajili, Kaouther (1992), 'Vertical Coordination, Financial Structure, and the Changing Theory of the Firm', **74** *American Journal of Agricultural Economics*, 1219-1225.
- Battacharyya, Sugato and Lafontaine, Francine (1995), 'Double-Sided Moral Hazard and the Nature of Share Contracts', **26** *Rand Journal of Economics*, 761-781.
- Bell, Clive (1977), 'Alternative Theories of Sharecropping: Some Tests Using Evidence from Northeast India', **13** *Journal of Development Studies*, 317-346.
- Bell, Clive and Zusman, Pinhas (1976), 'A Bargaining Theoretic Approach to Cropsharing Contracts', **66** *American Economic Review*, 578-588.
- Benson, Bruce L. and Faminow, Merle D. (1984), 'Rent Seeking and Supply Management in Canada', **32** *Canadian Journal of Agricultural Economics*, 548-558.
- Benson, Bruce L., Faminow, Merle D., Marquis, Milton H. and Sauer, Douglas G. (1994a), 'Intra-National Effects of a Countervailing Duty on the U.S./Canadian Hog Market', **16** *Review of Agricultural Economics*, 187-201.
- Benson, Bruce L., Faminow, Merle D., Marquis, Milton H. and Sauer, Douglas G. (1994b), 'The Impact of Provincial Marketing Boards on Price Relations and Pricing Dynamics in the North American Slaughter Hog Market', **26** *Applied Economics*, 677-688.
- Bhaduri, Amit (1973), 'Agricultural Backwardness under Semifeudalism', **83** *Economic Journal*, 120-137.
- Binswanger, Hans P. and Rosenzweig, Mark R. (1984), 'Contractual Arrangements, Employment, and Wages in Rural Labor Markets: A Critical Review', in Binswanger, Hans P. and Rosenzweig, Mark R. (eds), *Contractual Arrangements. Employment, and Wages in Rural Labor Markets in Asia*, New Haven, Yale University Press, 1-40.
- Braverman, Avishay and Stiglitz, Joseph E. (1982), 'Sharecropping and the Interlinking of Agrarian Markets', **72** *American Economic Review*, 695-715.
- Braverman, Avishay and Stiglitz, Joseph E. (1986), 'Cost-Sharing Arrangements under Sharecropping: Moral Hazard, Incentive Flexibility, and Risk', **68** *American Journal of Agricultural Economics*, 642-652.

- Brown, Donald J. and Atkinson, J.H. (1981), 'Cash and Share Renting: An Empirical Test of the Link between Entrepreneurial Ability and Contractual Choice', **12** *Bell Journal of Economics*, 296-299.
- Campbell, H.F. and Lindner, R.K. (1990), 'The Production of Fishing Effort and the Economic Performance of Licence Limitation Programs', **66** *Land Economics*, 56-66.
- Caputo, Michael R. and Lynch, Lori (1993), 'A Nonparametric Efficiency Analysis of California Cotton Ginning Cooperatives', **18** *Journal of Agricultural and Resource Economics*, 251-265.
- Centner, Terence J. (1993), 'The U.S.'s Organic Foods Production Act: Does the Small-Farmer Exception Breach the U.S.'s Obligations Under GATT?', **28** *Tulsa Law Journal*, 715-722.
- Cheung, Steven N.S. (1968), 'Private Property Rights and Share Cropping', **76** *Journal of Political Economy*, 1107-1122.
- Cheung, Steven N.S. (1969a), *A Theory of Share Tenancy*, Chicago, IL, University of Chicago Press, 188 p.
- Cheung, Steven N.S. (1969b), 'Transaction Costs, Risk Aversion and the Choice of Contractual Arrangements', **12** *Journal of Law and Economics*, 23-42.
- Chew, Tek-Ann (1991), 'Share Contracts in Malaysian Rubber Smallholdings', **67** *Land Economics*, 85-98.
- Chew, Tek-Ann (1993), 'The Transactional Framework of Sharecropping: Further Implications', **41** *Canadian Journal of Agricultural Economics*, 209-221.
- Coelho, Philip R.P. and McClure, James E. (1987), 'Barriers to Entry in the Market for Stud Services: Government and "Non-Profit" Institutions in Collusion', **25** *Economic Inquiry*, 659-670.
- Datta, Samar K., O'Hara, Donald J. and Nugent, Jeffrey B. (1986), 'Choice of Agricultural Tenancy in the Presence of Transaction Costs', **62** *Land Economics*, 145-158.
- Demsetz, Harold and Lehn, Kenneth (1985), 'The Structure of Corporate Ownership: Causes and Consequences', **93** *Journal of Political Economy*, 1155-1177.
- Eswaran, Mukesh and Kotwal, Ashok (1985), 'A Theory of Contractual Structure in Agriculture', **75** *American Economic Review*, 352-367.
- Feder, Gershon, Just, Richard E. and Zilberman, David (1985), 'Adoption of Agricultural Innovations in Developing Countries: A Survey', **33** *Economic Development and Cultural Change*, 255-298.
- Frank, Stuart D. and Henderson, Dennis R. (1992), 'Transaction Costs as Determinants of Vertical Coordination in the U.S. Food Industries', **74** *American Journal of Agricultural Economics*, 941-950.
- Hallagan, William S. (1978a), 'Self-Selection by Contractual Choice and the Theory of Sharecropping', **9** *Bell Journal of Economics*, 344-354.
- Hallagan, William S. (1978b), 'Share Contracting for California Gold', **15** *Explorations in Economic History*, 196-210.
- Helmberger, Peter G. and Hoos, Sidney (1965), *Cooperative Bargaining in Agriculture*, California, University of California Division of Agricultural Sciences.
- Higgs, Robert (1973), 'Race, Tenure, and Resource Allocation in Southern Agriculture', **33** *Journal of Economic History*, 149-169.

- Higgs, Robert (1974), 'Patterns of Farm Rental in the Georgia Cotton Belt, 1880-1900', **34** *Journal of Economic History*, 468-482.
- Holmström, Bengt (1982), 'Moral Hazard in Teams', **13** *Bell Journal of Economics*, 324-340.
- Isé, Sabrina and Perloff, Jeffrey M. (1995), 'Legal Status and Earnings of Agricultural Workers', **77** *American Journal of Agricultural Economics*, 355-386.
- Jaynes, Gerald Davis (1984), 'Economic Theory and Land Tenure', in Binswanger, Hans P. and Rosenzweig, Mark R. (eds), *Contractual Arrangements, Employment, and Wages in Rural Labor Markets in Asia*, New Haven, Yale University Press, 43-62.
- Johnson, C. Scott and Foster, Kenneth A. (1994), 'Risk Preferences and Contracting in the U.S. Hog Industry', **26** *Journal of Agricultural and Applied Economics*, 393-405.
- Johnson, D. Gale (1950), 'Resource Allocation Under Share Contracts', **58** *Journal of Political Economy*, 111-123.
- Johnson, D. Gale (1958), 'Government and Agriculture: Is Agriculture a Special Case?', **1** *Journal of Law and Economics*, 122-135.
- Johnson, Nancy L. (1995), *The Diffusion of Livestock Breeding Technology in the U.S.: Observations on the Relationship between Technical Change and Industry Structure*, Minnesota, University of Minnesota, Department of Applied Economics.
- Khan, Shahrukh Rafi (1988), 'Henry George and an Alternative Islamic Land Tenure System', **36** *Economic Development and Cultural Change*, 721-739.
- Klein, Benjamin, Crawford, Robert G. and Alchian, Armen A. (1978), 'Vertical Integration, Appropriable Rents, and the Competitive Contracting Process', **21** *Journal of Law and Economics*, 297-326.
- Kliebenstein, James B. and Lawrence, John D. (1995), 'Contracting and Vertical Coordination in the United States Pork Industry', **77** *American Journal of Agricultural Economics*, 1213-1218.
- Knoeber, Charles R. (1983), 'An Alternative Mechanism to Assure Contractual Reliability', **12** *Journal of Legal Studies*, 333-343.
- Knoeber, Charles R. (1989), 'A Real Game of Chicken: Contracts, Tournaments, and the Production of Broilers', **5** *Journal of Law, Economics, and Organization*, 271-292.
- Knoeber, Charles R. (1997), 'Explaining State Bans on Corporate Farming', **35** *Economic Inquiry*, 151-166.
- Knoeber, Charles R. and Baumer, David L. (1986), 'Guaranteeing a Market and the Contracts of Bargaining Cooperatives', **1** *Journal of Agricultural Cooperation*, 1-10.
- Knoeber, Charles R. and Thurman, Walter N. (1994), 'Testing the Theory of Tournaments: An Empirical Analysis of Broiler Production', **12** *Journal of Labor Economics*, 155-179.
- Knoeber, Charles R. and Thurman, Walter N. (1995), 'Don't Count Your Chickens...: Risk and Risk Shifting in the Broiler Industry', **77** *American Journal of Agricultural Economics*, 486-496.
- Ladd, George W. (1974), 'A Model of a Bargaining Cooperative', **56** *American Journal of Agricultural Economics*, 509-519.
- Laffont, Jean-Jacques and Matoussi, Mohamed Salah (1995), 'Moral Hazard, Financial Constraints and Sharecropping in El Ouja', **62** *Review of Economic Studies*, 381-399.
- Lazear, Edward P. and Rosen, Sherwin (1981), 'Rank-Order Tournaments as Optimum Labor Contracts', **89** *Journal of Political Economy*, 841-864.

- Leffler, Keith B. and Rucker, Randal R. (1991), 'Transaction Costs and the Efficient Organization of Production: A Study of Timber Harvesting Contracts', *99 Journal of Political Economy*, 1060-1087.
- Lucas, Robert E.B. (1979), 'Sharing, Monitoring, and Incentives: Marshallian Misallocation Reassessed', *87 Journal of Political Economy*, 501-521.
- Martin, Laura L. (1994), *Pork ... The Other White Meat?, An Analysis of Vertical Coordination and Contracting in the North Carolina Pork Industry*, Ph.D. Dissertation, North Carolina State University.
- Menard, Claude (1996), 'On Clusters, Hybrids, and other Strange Forms: The Case of the French Poultry Industry', *152 Journal of Institutional and Theoretical Economics*, 154-183.
- Miller, Geoffrey P. (1987), 'The True Story of Carolene Products, 1987', *Supreme Court Review*, 397 ff.
- Miller, Geoffrey P. (1989), 'Public Choice at the Dawn of the Special Interest State: The Story of Butter and Margarine', *77 California Law Review*, 83-131.
- Mitra, Pradeep K. (1983), 'A Theory of Interlinked Rural Transactions', *20 Journal of Public Economics*, 167-191.
- Morooka, Yoshinori and Hayami, Yujiro (1989), 'Contract Choice and Enforcement in an Agrarian Community: Agricultural Tenancy in Upland Java', *26 Journal of Development Studies*, 28-42.
- Murrell, Peter (1983), 'The Economics of Sharing: A Transactions Costs Analysis of Contractual Choice in Farming', *14 Bell Journal of Economics*, 283-293.
- Nabi, Ijaz (1986), 'Contracts, Resource Use and Productivity in Sharecropping', *22 Journal of Development Studies*, 429-442.
- Netz, Janet (1995), 'The Effect of Futures Markets and Corners on Storage and Spot Price Variability', *77 American Journal of Agricultural Economics*, 182-193.
- Netz, Janet (1996), 'An Empirical Test of the Effect of Basis Risk on Cash Market Positions', *16 Journal of Futures Markets*, 289-312.
- Newberry, David M.G. (1975), 'Tenurial Obstacles to Innovation', *11 Journal of Development Studies*, 263-277.
- Newberry, David M.G. (1977), 'Risk Sharing, Sharecropping and Uncertain Labor Markets', *44 Review of Economic Studies*, 585-594.
- Newberry, David M.G. and Stiglitz, Joseph E. (1979), 'Sharecropping, Risk Sharing, and the Importance of Imperfect Information', in Roumasset, James A., Boussard, Jean-Marc and Singh, Inderjit (eds), *Risk, Uncertainty, and Agricultural Development*, Laguna, Philippines, Agricultural Development Council and Southeast Regional Center for Graduate Study and Research in Agriculture, 311-339.
- Newberry, D.M.G. (1974), 'Cropsharing Tenancy in Agriculture: Comment', *64 American Economic Review*, 1060-1066.
- Otsuka, Keijiro and Hayami, Yujiro (1988), 'Theories of Share Tenancy: A Critical Survey', *37 Economic Development and Cultural Change*, 31-68.
- Otsuka, Keijiro, Hiroyuki, Chuma and Hayami, Yujiro (1992), 'Land and Labor Contracts in Agrarian Economies: Theories and Facts', *30 Journal of Economic Literature*, 1965-2018.
- Otsuka, Keijiro, Kikuchi, Masao and Hayami, Yujiro (1986), 'Community and Market in Contract Choice: The Jeepney in the Philippines', *34 Economic Development and Cultural Change*, 279-298.

- Parthasarathy, G. and Prasad, D.S. (1974), 'Responses to, and Impact of, H.Y.V. Rice According to Land Size and Tenure in a Delta Village, Andhra Pradesh, India', **12** *Developing Economies*, 182-198.
- Petersson, Johan and Andersson, Hans (1996), 'The Benefits of Share Contracts: Some European Results', **47** *Journal of Agricultural Economics*, 158-171.
- Porter, Philip K. and Scully, Gerald W. (1987), 'Economic Efficiency in Cooperatives', **30** *Journal of Law and Economics*, 489-512.
- Rao, C.H. Hanumantha (1971), 'Uncertainty, Entrepreneurship, and Sharecropping in India', **79** *Journal of Political Economy*, 578-595.
- Reid, Joseph D., Jr (1973), 'Sharecropping as an Understandable Market Response', **33** *Journal of Economic History*, 106-130.
- Reid, Joseph D. Jr (1976), 'Sharecropping and Agricultural Uncertainty', **24** *Economic Development and Cultural Change*, 549-576.
- Reid, Joseph D., Jr (1977), 'The Theory of Share Tenancy Revisited-Again', **25** *Journal of Political Economy*, 403-407.
- Reimund, Donn A., Martin, J. Rod and Moore, Charles V. (1981), *Structural Change in Agriculture: The Experience for Broilers, Fed Cattle, and Processing Vegetables*, Washington, DC, US Department of Agriculture.
- Rucker, Randal R. (1995), 'Endogenous Policy Dynamics, the Visibility of Rents, and Changes in the Transferability of Production Rights: The Case of Flue-Cured Tobacco', Montana, Department of Economics and Applied Economics, Montana State University.
- Rucker, Randal R. and Thurman, Walter N. (1990), 'The Economic Effect of Supply Controls: The Simple Analytics of the U.S. Peanut Program', **33** *Journal of Law and Economics*, 483-515.
- Rucker, Randal R., Thurman, Walter N. and Sumner, Daniel A. (1995), 'Restricting the Market for Quota: An Analysis of Tobacco Production Rights with Corroboration from Congressional Testimony', **103** *Journal of Political Economy*, 142-175.
- Ruttan, Vernon W. (1977), 'The Green Revolution: Seven Generalizations', **19** *International Development Review*, 16-25.
- Seagraves, James A. (1969), 'Capitalized Values of Tobacco Allotments and the Return to Allotment Owners', **51** *American Journal of Agricultural Economics*, 320-334.
- Sexton, Richard J. (1986), 'Cooperatives and the Forces Shaping Agricultural Marketing', **68** *American Journal of Agricultural Economics*, 1167-1172.
- Sexton, Richard J., Wilson, Brooks M. and Wann, Joyce J. (1989), 'Some Tests of the Economic Theory of Cooperatives: Methodology and Applications to Cotton Ginning', **14** *Western Journal of Agricultural Economics*, 56-66.
- Shaban, Radwan Ali (1987), 'Testing Between Competing Models in Sharecropping', **95** *Journal of Political Economy*, 893-920.
- Shelden, Ian M. (1996), 'Contracting, Imperfect Information, and the Food System', **18** *Review of Agricultural Economics*, 7-19.
- Singh, Nirvikar (1989), 'Theories of Sharecropping', in Pranab K. Bardhan (ed.), *The Economic Theory of Agrarian Institutions*, Oxford, Clarendon, 33-72.
- Sporleder, Thomas L. (1992), 'Managerial Economics of Vertically Coordinated Agricultural Firms', **74** *American Journal of Agricultural Economics*, 1226-1231.

- Squires, Dale (1987), 'Public Regulation and the Structure of Production in Multiproduct Industries: An Application to the New England Otter Trawl Industry', **18** *Rand Journal of Economics*, 232-247.
- Stiglitz, Joseph E. (1974), 'Incentives and Risk Sharing in Sharecropping', **41** *Review of Economic Studies*, 397-426.
- Stiglitz, Joseph E. (1987), 'Sharecropping', in Eatwell, John, Milgate, Murray and Newman, Peter (eds), *The New Palgrave: A Dictionary of Economics*, London, Macmillan, 20-323.
- Stiglitz, Joseph E. (1988), 'Economic Organization, Information, and Development', in Chenery, Hollis and Srinivasan, T.N. (eds), *Handbook of Development Economics Volume 1*, Amsterdam, North Holland, 93-159.
- Subramanian, Shankar (1995), 'Wage Labor, Sharecropping and Credit Transactions', **47** *Oxford Economic Papers*, 329-356.
- Trojan, C. (1987), 'Landbouw (Agriculture)', in X (ed.), *18de Vlaams Wetenschappelijk Economisch Congres, Brussel 8 en 9 mei 1987, Sociaal-economische Deregulering*, Brussel, V.E.H.U.B., 475-504.
- Truran, James A. and Fox, Roger W. (1979), 'Resource Productivity of Landowners and Sharecroppers in the Cariri Region of Ceara, Brazil', **55** *Land Economics*, 93-107.
- Tsouhouhas, Theofanis and Vukina, Tomislav (1997), 'Processor Contracts with Many Agents and Bankruptcy', North Carolina, Department of Economics, North Carolina State University.
- Tunali, Insan (1993), 'Choice of Contracts in Turkish Agriculture', **42** *Economic Development and Cultural Change*, 67-87.
- Ulrich, Alvin, Furtan, William H. and Schmitz, Andrew (1987), 'The Cost of a Licensing System Regulation: An Example from Canadian Prairie Agriculture', **95** *Journal of Political Economy*, 160-178.
- Vantrese, Valerie L., Reed, Michael R. and Skees, Jerry R. (1989), 'Mandatory Production Controls and Asset Values: A Case Study of Burley Tobacco Quotas', **71** *American Journal of Agricultural Economics*, 319-325.
- Warr, Peter G. (1978), 'Share Contracts, Limited Information, and Production Uncertainty', **17** *Australian Economic Papers*, 110-123.
- Wilcox, Christopher J. (1989), 'Social Costs of Regulation of Primary Industry: An Application to Animal Welfare Regulation of the Victorian Pig Industry', **33** *Australian Journal of Agricultural Economics*, 187-202.
- Williamson, Oliver E. (1983), 'Credible Commitments: Using Hostages to Support Exchange', **73** *American Economic Review*, 519-540.