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How Cropland Contract Type and Term Decisions are Made: Evidence from an Arkansas Tenant Survey

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Abstract: This study examines land contract decision-making with the use of an eastern Arkansas data set. Estimated probit models used to test contract choice hypotheses support a credit constraint hypothesis, indicating that contract choice is based on: 1) the tenant's financial position and operating expense levels, 2) the size of the operation; 3) alternative uses of agricultural land; and 4) the supply of contracted land. Results indicate limited support for the agency problem hypothesis and reject the risk aversion and farmer managerial ability hypotheses. Regression equations used to select lease term hypotheses indicate that cash rent levels are sensitive to land quality, supply of contract acres, irrigation, and crops produced. Tenant shares of the crop and variable costs are less sensitive to land quality than cash rents. Other variables that influence tenant shares of the crop and variable costs include tenant/landlord social capital, the supply of contracted acres, and crop selection.

Contracted agricultural land has been shown to have several advantages over agricultural land purchased on credit. First, contracted land allows operators to farm with less debt, thus decreasing the likelihood of bankruptcy. Second,

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contracted land gives operators greater flexibility to increase or decrease acreage. Third, contracted land is typically associated with higher cash flow (Hotell and Harrington, 1979; Baker and Thomassin, 1991). Similarly, there are sufficient monetary and non-monetary incentives to make owning and contracting out agricultural land attractive to investors. In the United States 43% of agricultural land was contracted in 1992. Moreover, in five states (Arkansas, California, Illinois, Iowa, and Louisiana) which exhibit crop-intensive agriculture and a high proportion of commercial farms, 50% or more of agricultural land was contracted (1992 Census of Agriculture).

Contract decision-making, here defined as *contract choice* (cash rent versus shares) and the selection of *contract terms* (levels of cash rent and shares), has important implications for tenant/landlord sharing of total net revenue, risk, and managerial responsibilities. Because of this, a substantial literature has developed which tests land contract choice hypotheses. Hypotheses tested include the agency problem, tenant/landlord sharing of risk, tenant/landlord social capital, tenant managerial ability, the agricultural ladder, and tenant credit constraints. The empirical evidence from this literature, however, does not universally support any one hypothesis or subset of hypotheses, and in many instances, the conclusions drawn are conflicting. It is difficult to draw conclusions from the empirical land contract choice literature because: 1) study data are gathered over different time periods and locations; 2) the set of explanatory variables are not consistent across studies; and, 3) results are often consistent with alternative competing hypotheses which authors often fail to acknowledge. Surprisingly, there is no literature on the selection of contract terms which is a serious shortcoming since contract terms are equally as important as contract choice in determining tenant/landlord sharing of total net revenue, risk, and managerial responsibilities. Given the inability to draw conclusions from the contract choice literature and the lack of contract term studies, further empirical research is needed in the land contract decision-making area.

The primary purpose of this study is to test cropland contract decision-making hypotheses with data from eastern Arkansas. Unlike earlier studies, both contract choice and selection of contract terms hypotheses are tested. And, unlike the dichotomous choice between cash rent and share contracts found in earlier studies, we allow for trichotomous contract choice by distinguishing between share contracts in which both output and variable costs are shared (costshare) and those contracts in which only output is shared (cropshare). Furthermore, emphasis is placed on tenant credit constraints as the underlying rationale for lease choice. Even though Heady recognized the importance of credit constraints in cropland contract choice over 50 years ago, this hypothesis has attracted little attention in the empirical literature.

The following section reviews the relevant contract choice literature. The second section discusses the Arkansas data set. The third section provides a

discussion of the credit constraint hypothesis and testable implications. Results from ordered probit models to test alternative contract choice hypothesis with emphasis placed on a credit constraint hypothesis are presented in section four. The contract term results are discussed in section five followed by the conclusions.

Relevant Contract Choice Literature

Empirical tests of cropland contract choice hypotheses have focused on small-scale agriculture in developing countries (especially India), southern U.S. agriculture in the post-Civil War period, and modern agriculture in the north central region of the United States. See Dasgupta, Knight, and Love (1999) for a review of the cropland contract choice literature. Because of the relevance of modern U.S. studies, they are briefly reviewed here. Brown and Atkinson (1981) hypothesize that a major function of contract choice is to distinguish between tenants with varying degrees of managerial ability so that, ceteris paribus, those tenants with better managerial skills will prefer cash rent contracts in which tenants typically have higher levels of managerial discretion over share contracts in which tenants and landlords tend to work more closely together. Brown and Atkinson use contingency valuation to test the tenant managerial ability hypothesis. Tenant managerial ability variables are found to be related to contract choice in a manner which is consistent with the tenant managerial ability hypothesis.

Gwilliam (1993) indicates that tenant/landlord social capital levels are a key determinant of contract choice. Specifically, Gwilliam hypothesizes that with share contracts there is a synergism that occurs when tenants and landlords combine their managerial skills which results in higher total net returns than in cash rent contracts in which landlords are less involved in decision-making. Gwilliam further hypothesizes that tenant/landlord synergism increases with tenant/landlord social capital and thus the probability of choosing a share contract. A Michigan data set weakly supports the social capital theory.

Allen and Lueck (1992, 1993) test the agency problem hypothesis. Under the agency problem, each contracting situation presents unique opportunities for the tenant to take undetected advantage of the landlord. This assumes that landlords cannot use output as a proxy for tenant effort due to the uncertainties of weather and other natural forces. Examples of the agency problem include: 1) cropshare contracts give incentives to supply inputs at levels which maximize tenant net returns and not joint tenant/landlord net returns, 2) share contracts give incentives to underreport crop yields, 3) costshare contracts give incentives to divert landlord supplied inputs to other uses, and 4) cash rent contracts give incentives to overutilize landlord supplied inputs, i.e., soil characteristics. Empirical evidence

from binomial limited dependent variable models fitted with Nebraska-South Dakota data is consistent with the agency problem hypothesis.

Data Set

The data for this study are taken from 447 respondents to the 1991 *Cropland Rental Arrangement Survey* which was mailed to a random sample of 1,513 tenants in crop reporting districts three, six, and nine of eastern Arkansas. The sample was selected by the Arkansas state office of the National Agricultural Statistical Service (NASS). Because contract choice and the selection of contract terms are crop sensitive, tenants were asked to treat each crop in a contract separately. When multiple contracts and multiple crops in a contract are taken into account, there are 880 usable responses which are composed of 191 cash rent, 478 cropshare, and 211 costshare contracts.

Eastern Arkansas is an intensively cropped area where contracting is the dominant land tenure form. The region contains 83% of Arkansas' cropland and produces over 92% of the state's cash crops. Livestock production is relatively unimportant. The data set is attractive for testing cropland contract decision-making hypotheses because farm operators in the region are highly dependent on land contracting; there is a good mix of cash rent, cropshare, and costshare contracts; and high input crops such as cotton and rice as well as low input crops are produced.

Model variable definitions are reported in Table 1 and summary statistics are reported in Table 2. Tenant farm sizes tend to be large with 44.5% of contracts on farms over 1000 operating acres, 32.2% on farms between 500 and 1000 operating acres, and only 23.3% of contracts on farms under 500 operating acres. Most tenants are full-time farm operators. Only in 13.5% of contracts do tenants derive less than 50% of their total family income from farming while in 69.2% of the contracts farm income accounts for more than 75% of total family income. Interestingly, about 36% of contracts are between relatives. About 60% of leases are irrigated. Rice is grown on 25% of contracts, irrigated soybeans 23%, dryland wheat 22%, dryland soybeans 10%, irrigated cotton 7%, irrigated sorghum 5%, and dryland cotton 3%.

The Credit Constraint Hypothesis and Testable Implications

The credit constraint hypothesis assumes that a tenant chooses a cropland contract in order to maximize net returns subject to a credit constraint. While all cropland contracts relieve the tenant of the long-term debt payments associated with owned land, they have differential impacts on operating expenses. In a cash rent contract the tenant pays the landowner a fixed annual cash payment, pays all operating

Table 1. Model Variable Definitions

Variable	*Definition*
Dependent Variables	
CONTRACT	0 if contract a cash rent; 1 if contract a cropshare; 2 if contract a costshare.
RENT	Cash rent ($/acre) if CONTRACT = 0.
CROPCROP	Tenant's share (%) of CONTRACT = 1
CROPCOST	Tenant's share (%) of crop if CONTRACT = 2
COSTCOST	Tenant's share (%) of operating expenses if CONTRACT = 2
Explanatory Variables	
OPERATED	Number of acres operated by tenant.
EQUITY	Ratio of owned to operated acres.
LABOR	1 if family provides less than 25% of labor; 2 if family provides 25–49%; 3 if family provides 50–75%; 4 if family provides > 75%.
START	1 if inherit land from relatives; 2 if purchase from relatives; 3 if purchase from non-relatives; 4 if contract from relatives; 5 if contract from non-relatives.
YEARS	Number of years parcel has been contracted from landlord.
INCOME	1 if < 25% of income from farming; 2 if 25–49%; 3 if 50–75%; 4 if > 75%.
IRRIGATION	1 if contracted parcel is irrigated; 0 otherwise.
QUALITY	1980–1990 county average soybean yield (bu/acre).
SUPPLY	Ratio of 1987 contracted acres in county to number of operators in county.
VARIANCE	1980–1990 county yield coefficient of variation for pertinent crop.
ROW	1 if planted crop is cotton, soybeans, corn, or sorghum; 0 otherwise.
DENSITY	1990 county population per square mile.
ACRES	Number of acres in contracted parcel.
RELATIVE	1 if landlord is a relative; 0 otherwise.
EDUCATION	1 if less than 8 years; 2 if some high school; 3 if high school diploma; 4 if vo-tech school; 5 if some college; 6 if bachelor's degree or higher.
AGE	Age of tenant in years.
RICE	1 if contracted parcel is planted in rice; 0 otherwise.
ISOY	1 if contracted parcel is planted in irrigated soybeans; 0 otherwise.
DSOY	1 if contracted parcel is planted in dryland soybeans; 0 otherwise.
ICOTTON	1 if contracted parcel is planted in irrigated cotton; 0 otherwise.
DCOTTON	1 if contracted parcel is planted in dryland cotton; 0 otherwise.
ISORGHUM	1 if contracted parcel is planted in irrigated sorghum; 0 otherwise.
DSORGHUM	1 if contracted parcel is planted in dryland sorghum; 0 otherwise.

expenses, and receives all of the income. A cash rent contract increases operating expenses by the amount of the fixed cash payment, however, this is thought to be less than the annual debt payment associated with land ownership (Hottel and Harrington, 1979). In a cropshare contract the tenant shares the crop with the landlord and is responsible for all operating expenses. There is no difference in operating expense levels between a cropshare contract and ownership (assuming no inefficiences with a cropshare). With a costshare contract, the tenant gives the landlord a share of the output—typically higher than a cropshare contract—but unlike the cropshare contract, the landlord pays a share of the operating expenses. The costshare contract reduces the tenant's operating expenses by the amount of the landlord's share of operating expenses. Under the credit constraint hypothesis, tenants are able to overcome credit constraints (increase leverage) and expand by moving from a cash rent to a cropshare to a costshare contract. Since landlords expect additional financial and managerial compensation to induce them to take

Table 2. Summary Statistics of Model Variables

Variable	*Full Sample Mean*	*Cash Rent Mean*	*Cropshare Mean*	*Costshare Mean*	*Minimum*	*Maximum*
Dependent Variables						
CONTRACT	1.02	0	1	2	0	2
RENT	—	49.3	—	—	10.0	121.0
CROPCROP	—	—	73.2	—	10.0	90.0
CROPCOST	—	—	—	66.5	50.0	80.0
COSTCOST	—	—	—	76.0	50.5	94.1
Explanatory Variables						
OPERATED	1085	951	1099	1178	37	5000
EQUITY	0.18	0.26	0.15	0.16	0	0.95
LABOR	2.55	2.61	2.55	2.49	1	4
START	1.76	1.79	1.75	1.76	1	5
YEARS	12.84	11.76	12.86	13.80	1	52
INCOME	3.50	3.41	3.51	3.55	1	4
IRRIGATION	0.60	0.47	0.61	0.70	0	1
QUALITY	23.3	23.7	22.9	23.8	18.6	28.6
SUPPLY	430.7	481.7	406.9	439.9	72.1	729.5
VARIANCE	0.16	0.17	0.16	0.15	0.08	0.46
ROW	0.53	0.58	0.53	0.47	0	1
DENSITY	38.7	43.4	38.7	34.6	14.7	97.0
ACRES	244	196	266	265	4	1850
RELATIVE	0.36	0.30	0.38	0.37	0	1
EDUCATION	4.16	4.15	4.16	4.17	1	6
AGE	46	48	45	46	21	82
RICE	0.25	0.18	0.24	0.33	0	1
ISOY	0.23	0.18	0.24	0.24	0	1
DSOY	0.10	0.05	0.10	0.05	0	1
ICOTTON	0.07	0.05	0.08	0.07	0	1
DCOTTON	0.03	0.06	0.02	0.03	0	1
ISORGHUM	0.05	0.04	0.04	0.07	0	1
DORGHUM	0.04	0.04	0.04	0.03	0	1

on share contracts, per acre tenant profits are typically highest with a cash rent contract, followed by cropshare and costshare contracts, ceteris paribus (Parsch and Danforth, 1994; Parsch, Danforth, and Watkins, 1994; Dunaway and Morrow, 1980; Hottel and Harrington, 1979).

Following the credit constraint hypothesis, the probability of choosing a costshare (cash rent) contract should increase (decrease) with operating expenses, cash rent, and landlord financial strength. Thus, variables that indicate the levels of operating expenses, cash rent, and tenant and landlord financial strength are useful for testing the credit constraint hypothesis. Because the survey queried tenants only, there are no landlord financial variables available. However, this may not be as problematic as it appears. Landlords typically have higher equity levels and more diverse asset portfolios than tenants and thus their credit constraints are less binding. In 1988 the average U.S. landlord held 327 acres valued at $197,772 of which 85.3% of landlords had a 100% equity interest. Only 4% of landlords had less than a 60% equity interest in their land. Furthermore, for

67.9% of landlords their land contract income represented 25% or less of total income and for only 19.8% did it represent more than 50% (1987 Agriculture Census, Vol. 2, Part 3). Thus, for the purposes of testing the credit constraint hypothesis, operating expenses, cash rent, and tenant financial indicators should be the most relevant explanatory variables. Ted L. Glaub, a professional farm manager from Jonesboro, Arkansas and the president elect of the American Society of Farm Managers and Rural Appraisers, Inc., indicates that tenants have significant input in lease decision-making because 1) the majority of tenants and landlords are relatives or close friends at the time contracts are entered into, 2) good farm managers are high in demand by landlords, and 3) tenants typically have better information than landlords (personal communication). Empirical proxies for tenant financial indicators, operating expenses, and cash rents are described below.

An important tenant financial indicator is the level of collateral or equity held in the operation. Because bankers are usually more willing to lend to tenants with higher equity levels, the probability of choosing a cropshare contract should decrease as equity increases. Akin to equity are the conditions under which the tenant began operating. For example, did the tenant get a "good start" by inheriting a sizable tract of land or did he experience a "poor start" in which all land was initially contracted from non-relatives? Because tenant financial indicators are slow to change and the conditions under which the tenant began operating should be reflected in current financial indicators, we hypothesize that a poor start in farming increases the probability of choosing a costshare contract. A potential means of overcoming credit constraints is to borrow from off-farm income. Tenants may utilize off-farm income to purchase assets, secure loans, and smooth out cash flows. As off-farm income increases, the probability of choosing a costshare contract would decrease. A final tenant financial indicator with which to test the credit constraint hypothesis is the total number of operating acres. Larger farms tend to be more highly leveraged which increases the likelihood that they will be denied credit. The testable implication is that the probability of choosing a costshare contract increases with total operating acres.

There are several characteristics which indicate operating expense and cash rent levels for contracted parcels. First, the number of acres in the contract is positively related to total operating expenses and total cash rent. Thus, larger tracts of land are expected to be cost shared. Second, higher quality land (higher soil fertility) renders higher yields and thus commands higher per acre cash rents. Because of this, land quality should be positively related to the probability of choosing a costshare contract. Third, the presence of irrigation is an important determinant of operating expenses and cash rent levels. Irrigation encourages tenants to use higher per acre variable input levels because the primary yield risk factor, insufficient moisture, is no longer a concern and water is complementary with other inputs. Because irrigation increases operating expenses and commands

higher annual cash rent payments, the presence of irrigation should increase the probability of choosing a costshare contract. Fourth, per acre cash rent is influenced by the supply and demand for contracted land. High per acre cash rent, associated with a small supply of available contract acres, will increase operating expenses—making costshare contracts more attractive. Fifth, some tenants are able to furnish inputs which reduce their cash operating expenses. One of the most common examples of this is family labor. Thus, we hypothesize that as tenants are able to supply a higher percentage of labor needs, the probability of choosing a costshare contract will decrease. Finally, we expect that tenants with poor financial indicators seek to lock in contracts with favorable financial terms for extended periods of time. Johnson and Lins (1974) note that while most cropland contracts are legally of a short-term nature, they are quite stable and evolve into long-term commitments. Tenants in this survey held their leases for an average of nearly 13 years. Johnson, (1974) and Allen and Lueck (1992) found similarly lengthy tenant/landlord relations. Thus, we expect that the number of years the parcel has been contracted will be positively related to the probability of selecting a costshare contract.

Ordered Probit Analysis of Contract Choice Hypotheses

Ordered Probit

Under the credit constraint hypothesis there are three contract choices which have an inherent, ordinal ordering according to their financial incentives. This indicates that a method that is capable of assigning a probability to choosing each of the three contracts is needed. Ordered multinomial probit that is estimated with a maximum likelihood procedure is such a method. In the trinomial ordered problem the cumulative density function is split into three ordered sections, each of which represents the probability of choosing one of the three contract types. In order to split the cumulative density function into three ordered categories, another parameter, μ, must be estimated along with the coefficients of the independent variables, β. The Prob[Y=0] (cash rent) = $1 - F(\beta' X)$, where $F(\beta' X)$ is the cumulative density function of the standard normal density function evaluated at $\beta' X$. The Prob[Y=1] (cropshare) = $F(\mu - \beta' X) - F(-\beta' X)$ and the Prob[Y=2] (costshare) = $1 - F(\mu - \beta' X)$ with $\mu > 0$.

The kth component of the ordered multinomial probit coefficient vector estimate, β, does not have the usual interpretation of the marginal change in Y as x_k increases. In itself β only indicates the qualitative change in Y as x_k increases, according to the sign of β. The marginal change in the probability of selecting Y as x_k increases is estimated by the standard normal density function of the underlying cumulative density function. The marginal probability of choosing $Y = 0$ as x_k increases is $-f(\beta' X)\beta_k$, the marginal probability of choosing Y =

1 as x_k increases is $f(-\beta' X)\beta_k - f(\mu - \beta' X)\beta_k$, and the marginal probability of choosing $Y = 2$ as x_k increases is $f(\mu - \beta' X)\beta_k$. Note that unlike the classical regression model, the marginal change in probabilities is a function of $\beta' X$ as well as β_k. Since $f(\cdot)$ is strictly greater than zero, positive coefficient estimates indicate that the probability that a costshare contract is chosen increases as x_k increases and the probability that a cash rent contract is chosen decreases. The opposite holds for negative coefficient estimates. The sign on the marginal probability function for a cropshare contract as x_k increases, however cannot be determined unless the function is evaluated at a given X. It is likely that the marginal probability function for the cropshare contract changes signs as X varies.

Credit Constraint Model Results and Interpretation

The coefficient estimates for the 'credit constraint' ordered probit model are reported in the first column of Table 3. Asymptotic *t*-ratios are reported in parentheses. Several of the model variables are significant at the $\alpha = 0.10$ level and higher, and μ is positive and significant, supporting the hypothesis that the three contracts are ordered according to their financial incentives as *a priori* hypothesized.

All of the tenant financial indicators—OPERATED, EQUITY, LABOR, START, YEARS, and INCOME—have the correct, anticipated sign, and OPERATED, EQUITY, and YEARS are significant at the 0.05 level. This result is consistent with the credit constraint hypothesis and it supports the notion that tenants play a significant role in contract choice. EQUITY, the ratio of owned to operated acres, is used as a proxy for tenant equity. Tenants with higher ratios of owned to operated acres should have relatively higher equity levels because with time equity positions in owned cropland increase as land debt is paid down, ceteris paribus. Since tenants hold no equity position in contracted cropland, it follows that the equity position for owned land will be greater than or equal to the equity position of contracted land. Since cropland constitutes the bulk of total tenant owned and contracted assets, this difference should be substantive. Ellinger and Barry (1987) find that increasing EQUITY is associated with higher levels of equity and lower debt-to-asset ratios. The authors find similar relationships with a Kansas Farm Management Association (KFMA) data set of 409 farms for the 1977 to 1992 period (see Langemeier (1990) for documentation of KFMA data set).

Following the earlier discussion, factors which affect the cash rent levels of contracted cropland should also play a role in contract choice. We hypothesize that IRRIGATION and QUALITY will increase cash rent and the probability of choosing a costshare lease while SUPPLY will decrease cash rent and the probability of choosing a costshare lease. The estimated coefficients on IRRIGATION, QUALITY, and SUPPLY have the anticipated signs, and the IRRIGA-

Table 3. Estimated Ordered Probit Coefficients for Contracted Choice Models

Explanatory Variable	*1: Credit Constratint Model*	*2: Alternative Hypothesis Model*	*3: Risk Aversion Model*
OPERATED	0.0001**	—	0.0001**
	(1.979)[1]		(1.995)
EQUITY	−0.8119***	—	−0.6893***
	(−4.884)		(−4.980)
LABOR	−0.0068	—	−0.0045
	(0.196)		(0.132)
START	0.0798	—	0.0781
	(1.341)		(1.306)
YEARS	0.0086**	—	0.0105**
	(2.065)		(2.493)
INCOME	0.0251	0.0182	0.0004
	(0.508)	(0.388)	(0.008)
IRRIGATION	0.3179***	0.3265***	—
	(3.948)	(4.051)	
QUALITY	0.0080	—	0.0102
	(0.525)		(0.672)
SUPPLY	−0.0009***	—	−0.0009***
	(−3.045)		(−2.948)
VARIANCE	−1.3594*	—	—
	(−1.768)		
ROW	—	−0.2223***	—
		(−2.870)	
DENSITY	—	−0.0057***	—
		(−3.541)	
ACRES	—	0.0004**	—
		(2.251)	
RELATIVE	—	0.1000	—
		(1.193)	
EDUCATION	—	−0.0139	—
		(−0.501)	
AGE	—	−0.0010	—
		(−0.285)	
RICE	—	—	0.3222***
			(2.943)
ISOY	—	—	0.1973*
			(1.718)
DSOY	—	—	−0.3428**
			(−2.196)
ICOTTON	—	—	0.2086
			(1.152)
DCOTTON	—	—	−0.1965
			(−0.992)
ISORGHUM	—	—	0.3012*
			(1.670)
DSORGHUM	—	—	−0.1015
			(−0.461)
μ	1.5507***	1.5418***	1.5696***
	(26.583)	(26.005)	(26.199)

(continued)

Table 3. Continued

Explanatory Variable	*1: Credit Constratint Model*	*2: Alternative Hypothesis Model*	*3: Risk Aversion Model*
Davidson-McKinnon Tests of Non-nested Hypotheses Tests			
H_0: 1 true model H_1: 2 true model	$\chi^2 = 16.81$**		
H_0: 1 true model H_1: 3 true model	$\chi^2 = 6.55$		
H_0: 2 true model H_1: 1 true model		$\chi^2 = 31.63$**	
H_0: 2 true model H_1: 3 true model		$\chi^2 = 36.81$**	
H_0: 3 true model H_1: 1 true model			$\chi^2 = 0.61$
H_0: 3 true model H_1: 2 true model			$\chi^2 = 18.44$**

***Significant at the 0.01 level
**Significant at the 0.05 level
*Significant at the 0.10 level
[1]Asymptotic *t*-ratios

TION and SUPPLY coefficient estimates are highly significant. This result is consistent with the credit constraint hypothesis and, specifically, that factors which affect cash rent levels play a role in contract choice.

In addition to the credit constraint hypothesis, we test the risk aversion hypothesis which is based on the idea that share contracts are chosen in order to share yield risk between the tenant and the landlord. Under the risk aversion hypothesis yield variance should be positively related to the probability of choosing a costshare contract. Following the literature, VARIANCE is used as a proxy for risk aversion. Contrary to the risk aversion hypothesis and consistent with the Allen and Lueck (1993) findings, VARIANCE is found to be negatively related to the probability of choosing a costshare contract and weakly significant (two-sided test).

Alternative Model: Agency Problem

Explanatory variables are chosen for the 'Alternative Hypothesis Model' (the second model in Table 3) in order to render results comparable to the Allen and Lueck (1992) binomial 'Farmer' model which explains the choice between cash rent and share contracts. Under the risk aversion theory INCOME is expected to be positively related to the probability of choosing a costshare contract because tenants are thought to want to reduce the variability of their farm income as the importance of their non-farm income declines. Thus, under both the credit constraint and risk aversion theories INCOME's expected sign is positive. The

estimated coefficent is positive and like Allen and Lueck, insignificant. Under the agency problem, Allen and Lueck hypothesize that IRRIGATION is negatively correlated to the probability of choosing a share contract because tenants cannot deplete soil moisture on irrigated land and thus landlords should be inclined to grant a cash rent contract. They find support for their hypothesis, but here, the significant positive sign on IRRIGATION supports the credit constraint, not the agency problem hypothesis. In a similar vein, Allen and Lueck expect ROW to be positively related to the probability of choosing a costshare contract due to the intensive cultivation practices of row crops. Allen and Lueck find support for this hypothesis, but here, the significant negative sign on ROW is contrary to the agency problem hypothesis. In Allen and Lueck DENSITY—which serves as a proxy for alternative uses of agricultural land—is hypothesized to be inversely related to the probability of choosing a share contract since landowners should be more willing to cash rent because they are less concerned about soil degradation when alternative uses for farm land are strong. Here, like Allen and Lueck, the sign on DENSITY is negative and significant—supporting the agency problem hypothesis. Allen and Lueck use ACRES as a control variable which they find to be insignificant. Under the credit constraint hypothesis, the variable ACRES is expected to be positively related to the likelihood of choosing a costshare contract because tenants who lease larger acreages have higher operating expenses and thus should be more likely to need landlord financing. The coefficient estimate is positive and significant—consistent with the credit constraint hypothesis.

Otsaka and Hayami (1988) note that contracts between family members should be easier to enforce, so that the variable RELATIVE is expected to be positively related to the probability of choosing a costshare contract. The insignificant RELATIVE coefficient corroborates Allen and Lueck's findings that family relations do not appear to play an important role in contract choice.

Following Brown and Atkinson (1981), EDUCATION and AGE—proxies for managerial ability—are expected to be inversely related to the probability of choosing a costshare contract. Allen and Lueck, based on the agricultural ladder theory, hypothesize that AGE is negatively related to the probability of choosing a share contract. In the agricultural ladder theory, farmers move from share contracts to cash rent to owner-operators over their life-time. Although both EDUCATION and AGE carry the expected negative sign, neither is significant—thus neither the agricultural ladder nor the agency problem theory is supported.

Alternative Model: Risk Aversion

The "Risk Aversion Model" is estimated to further explore the risk aversion hypothesis. In place of VARIANCE, dummy variables are used for rice, irrigated and dryland soybeans, irrigated and dryland cotton, and irrigated and dryland sorghum. IRRIGATION is dropped in order to avoid multicollinearity with the

dummy variables. The means of VARIANCE for cotton and sorghum are at least 30% higher than the means of VARIANCE for rice and soybeans. According to the risk aversion hypothesis, this would indicate that DCOTTON and DSORGHUM would be the strongest candidates for share contracts. RICE and ISOY would be the strongest candidates for cash rent contracts. Contrary to the risk aversion hypothesis, the results indicate that irrigated crops tend to be positively related to the likelihood of selecting costshare contracts and dryland crops to be inversely related to the probability of selecting costshare contracts. The coefficients on ICOTTON, DCOTTON, and DSORGHUM are not statistically significant, however. These results are consistent with the credit constraint hypothesis in which irrigated crops need greater landlord financing since operating expenses and cash rents are higher.

Davidson and MacKinnon's non-nested testing procedure (Greene, 1997, p. 365) is used to determine whether one of the ordered probit models is preferred over the other two. The hypothesis H_o: $y = f(X\beta)$ versus H_1: $y = f(Z\beta)$ is tested, where X and Z are alternative matrices of explanatory variables. Following Davidson and MacKinnon, the model $y = f(X\beta)$ and the augmented model $y = f(X\beta + Z_1\Gamma_1)$ are fitted, where Z_1 contains the variables in Z that are not in X. The likelihood ratio test is then used to test the hypothesis that $\Gamma_1 = 0$. Test results reported in Table 3 do not favor any model over the other two.

Analysis of Contract Term Regressions

In this section, regression models are estimated which explain: 1) the tenant's cash rent level in a cash rent contract; 2) the tenant's percentage share of the crop in a cropshare contract; and 3) the tenant's percentage share of the crop and costs in a costshare contract. OLS estimates are likely to be inconsistent because cash rents are observed only when CONTRACT = 0, the tenant's share of the crop only when CONTRACT = 1, etc. Thus, in effect, CONTRACT and the contract terms are correlated. This problem is referred to as incidental truncation and is akin to the omitted variable specification problem. By adding the inverse Mills ratio (IMR) from the ordered probit model to the regressions, the inconsistency problem can be rectified.

Following Greene (1992), the IMR is estimated for each observation from the ordered probit model evaluated at $\text{Prob}[\text{Contract}_i = j]$. In the regression equations, the appropriate dependent variable is regressed on X and the IMR using OLS, which is the Heckman (1979) approach. The coefficients' standard errors are computed as recommended in Greene (1992).

We hypothesize that cash rent and tenant share levels are based on land and tenant characteristics, tenant/landlord social capital, crop selection, and the supply of contract acres. Land characteristics include QUALITY, VARIANCE, IRRI-

GATION and ACRES. We hypothesize that cash rents will have to be lower or tenant crop shares higher (tenant cost shares lower) in order to induce tenants to take on land with higher yield variances. Similarly, we hypothesize that higher quality land as proxied for by QUALITY and IRRIGATION are associated with higher cash rents and lower tenant crop shares because these tracts are higher valued and higher yielding. Because of operating convenience and economies of scale, we hypothesize that tracts of land with larger acreages (ACRES) are associated with higher cash rents and lower tenant crop shares.

We hypothesize that tenants with superior managerial skills as proxied for with EDUCATION are associated with lower cash rents and higher tenant crop shares because of superior bargaining and search skills, and they are in greater demand as tenants. We hypothesize that landlords give better terms to the tenant when social capital is high, i.e., tenant and landlord are related (RELATIVE) or have worked together for numerous years (YEARS). Following the law of supply and demand, we hypothesize that a larger supply of contracted land (SUPPLY) results in lower cash rents and higher tenant crop shares. Tenants who are less dependent on leasing should be in a stronger bargaining position and thus cash rents should decrease and tenant crop shares increase with EQUITY. Finally, cash rent and shares may vary by crop. We hypothesize that higher valued crops such as cotton and rice demand higher cash rents and lower tenant crop shares. Ameliorating the higher values of cotton and rice is the specialized harvesting equipment, high operating costs (especially for cotton), and superior managerial skills needed to produce these crops. These factors suggest that tenants may need to receive larger crop shares to induce them to take on cotton and rice production.

Regression model coefficient estimates are reported in Table 4. Asymptotic *t*-ratios are reported in parentheses. Variable definitions are reported in Table 1 with the exception that SOY, COTTON, and SORGHUM are aggregated over dryland and irrigated soybeans, cotton, and sorghum, respectively. The RENT model determines the tenant's cash rent level if a cash rent contract is selected. The CROPCROP model determines the tenant's crop share if a cropshare contract is chosen. If a costshare contract is chosen, separate models are estimated for the crop share and the cost share. These two models are denoted as CROPCOST and COSTCOST, respectively. The dependent variable COSTCOST is measured as a weighted average of the tenant's cost share of seven variable inputs. The variable inputs queried in the survey are seed, fertilizer/lime, pesticide, aerial application, machinery fuel/oil, custom machinery hire, and other. The weights sum to one and are the percentage of total variable costs that each of the seven variable inputs represent. The weights are taken from Windham et al. The coefficients of determination are around 0.3 or higher except for CROPCROP, which is reasonable for cross-sectional data. The asymptotic *t*-ratios on the Inverse Mill's ratio indicate that the bias created by incidental truncation is not significant for any of the four regressions.

Table 4. Estimated Coefficients for Regression Equations (Contract Terms)

Independent Variable	*RENT*	*CROPCROP*	*CROPCOST*	*COSTCOST*
CONSTANT	4.4700	80.9940***	99.9286***	109.5257***
	(0.244)[1]	(10.935)	(11.469)	(8.989)
QUALITY	1.7996***	−0.3315*	−1.3699***	−1.5645***
	(3.738)	(−1.851)	(−5.906)	(−5.287)
VARIANCE	−110.8387***	−8.1137	−28.7265	−15.4037
	(−3.450)	(−0.635)	(−1.556)	(−0.525)
IRRIGATION	10.3372***	1.0524	−7.9762***	−8.9426***
	(3.947)	(1.190)	(5.587)	(4.380)
ACRES	0.0060	0.0005	0.0028	0.0009
	(0.917)	(0.326)	(1.039)	(0.243)
EDUCATION	0.1354	−0.3682	0.4101	−0.0296
	(0.150)	(−1.366)	(0.977)	(0.054)
RELATIVE	2.9552	−1.7701**	2.8651**	3.4578*
	(1.159)	(−2.108)	(2.128)	(1.940)
YEARS	−0.0162	0.0746*	0.0256	−0.0168
	(−0.117)	(1.865)	(0.409)	(−0.192)
SUPPLY	0.0153*	0.0093***	−0.0072	−0.0130**
	(1.800)	(3.680)	(−1.512)	(−2.106)
EQUITY	−4.5720	3.9113**	−0.9853	−0.8289
	(−1.026)	(2.169)	(−0.346)	(−0.226)
SOY	−4.8569*	0.3154	9.1274***	12.2896***
	(−1.654)	(0.285)	(5.345)	(4.888)
COTTON	5.4107	3.0993	11.9372***	14.0835***
	(1.036)	(1.500)	(4.007)	(3.192)
SORGHUM	−0.7891	0.3092	10.7063***	8.0246**
	(−0.150)	(0.180)	(4.105)	(2.139)
INVERSE MILL'S	6.4473	−4.4948	3.1125	9.0336
RATIO	(0.750)	(0.576)	(0.765)	(1.473)
F-statistic	7.64	2.45	9.68	11.79
ADJ. R^2	0.3136	0.0381	0.3485	0.3784

***Significant at 0.01 level
**Significant at 0.05 level
*Significant at the 0.10 level
[1]Asymptotic *t*-ratios

In the RENT model, coefficient estimates for QUALITY, VARIANCE, IRRIGATION, and ACRES have the expected signs and only ACRES is insignificant. These results are consistent with the notion that land characteristics are important determinants of cash rent levels. The negative sign on the VARIANCE coefficient estimate explains why land with higher yield variances is cash rented and not shared, and is consistent with the credit constraint hypothesis. Irrigated land carries a $10.34 premium over dryland. EDUCATION RELATIVE, and YEARS are neither significant nor of the anticipated sign, indicating that neither tenant managerial skills nor tenant/landlord social capital play a role in determining cash rent levels. Contrary to expectations, SUPPLY is positive and significant. We have no explanation for this result. EQUITY has the anticipated sign, but is not significant.

The crop dummy coefficient estimates indicate that cash rent premiums are

associated with cotton ($5.41) and discounts with soybeans (−$4.86) and sorghum (−$4.57) which is consistent with the notion that higher-valued crops command higher cash rents. However, only the soybean coefficient estimate is significant.

It is anticipated that the hypotheses for each of the variables in the RENT equation will also hold in the three share equations, with the anticipated sign for each of the share equation coefficients being the opposite of their counterpart in the RENT equation. In the CROPCROP equation the coefficient estimate on QUALITY has the anticipated sign and is significant. VARIANCE, IRRIGATION, and ACRES do not have the anticipated sign and are not significant—indicating that land characteristics are less important in determining crop share than cash rent levels. EDUCATION does not have the anticipated sign and is not significant. Interestingly, RELATIVE indicates that if tenants and landlords are related, the tenant receives a smaller share. YEARS has the anticipated positive sign and is significant. The coefficient estimates of SUPPLY and EQUITY which are significant, support the hypotheses that tenants receive higher crop shares as supplies of leased acres and equity levels increase. All of the crop dummy coefficients are positive, but none are significant.

The coefficient estimates on the CROPCOST and COSTCOST models indicate that there is a tradeoff between crop and cost shares in costshare contracts. That is, if the tenant receives a higher share of the crop, he will typically bear a higher share of the costs. Note that as the tenant's share of the crop and cost increase in a similar proportion, the tenant's net income would be expected to increase.

This tradeoff is demonstrated by similar signs on all of the significant coefficient estimates in the two costshare regressions. QUALITY carries the anticipated negative sign and is highly significant. The coefficient estimates on VARIANCE and ACRES are contrary to expectations and insignificant. As expected, the IRRIGATION coefficient estimates carry the expected negative signs and are highly significant. The signs on EDUCATION are not consistent across the two regressions and the two coefficient estimates are not significant. Unlike the CROPCROP model, RELATIVE is positive as expected and significant. Contrary to expectations, SUPPLY is negative, but significant only for the COSTCOST regression. The sign on EQUITY is contrary to expectations and is not significant. Soybeans, cotton, and sorghum receive share premiums in relation to rice. The smaller share on rice is consistent with the landlord attempting to collect a higher percentage of the government payments, which for rice are traditionally the highest of grains in the deficiency payment program.

Conclusions

This study examines land contract decision-making with the use of an eastern Arkansas data set. Ordered probit models are used to test a credit constraint and other alternative contract choice hypotheses. Four regressions which account for

sample selection bias are also fitted in order to identify variables which affect cash rent and share levels (lease terms). The ordered probit results support the credit constraint hypothesis, indicating that contract choice is based on: 1) the tenant's financial position and operating expense levels, 2) the size of the operation; 3) alternative uses of agricultural land; and 4) the supply of contracted land. Results indicate limited support for the agency problem hypothesis and reject the risk aversion and farmer managerial ability hypotheses.

The regression equations indicate that cash rent levels are sensitive to land quality, supply of contract acres, irrigation, and crops produced. Tenant shares of the crop and variable costs are less sensitive to land quality than cash rents. Other variables which influence tenant shares of the crop and variable costs include tenant/landlord social capital, the supply of contracted acres, and crop selection. For costshare contracts, the tenant's crop and cost shares vary proportionately.

Our results indicate that the credit constraint hypothesis has merit and should be given equal consideration with the agency problem and risk aversion when considering contract choice theories. U.S. contract choice studies indicate that results may be sensitive to such factors as location, crop types, and costs. A goal of future studies may be to disentangle these effects on contract choice using a data set composed of heterogeneous farms from diverse geographic areas.

Notes

1. Typically, in a costshare contract, operating expenses are shared at the same level as the crop since this is widely considered to maximize total net returns. In effect, however, crop shares and total operating expense shares are unlikely to be the same since not all operating expenses are typically shared.
2. Landowners typically play a greater managerial role in cropshare and costshare contracts because they have a direct stake in the growing crop.
3. A 1997 survey of eastern Arkansas tenants by the same authors indicates that about 92% of tenants and landlords were relatives, close friends or acquaintances at the time the initial contract was entered into.
4. Based on 1994 Arkansas Cooperative Extension Services published enterprise budgets (Windham et al., 1994), per acre irrigated production costs are estimated to be 76% higher than per acre non-irrigated production costs for the same crop.
5. The variables LABOR, EDUCATION, INCOME, START, and SALES are modeled as continuous variables even though they could also be modeled as qualitative variables using binary variables. It is assumed that the numerical values assigned are reasonable for measuring the factors of interest. This quantitative approach is used to provide a parsimonious parameterization for the probit model where an excessive numbers of parameters could lead to computational problems in obtaining parameter estimates and for ease of interpretation. Also, these variables were collected in the survey as categorical data.
6. Because contract type and terms are likely chosen simultaneously, an argument could be made that the contract choice and contract terms models should contain the same set of independent variables. Empirically this is not practical because the IMR is highly correlated with the set of independent variables in the first-step probit equation, which causes collinearity problems in the

second-step regressions. To correct this problem, a set of independent variables are used in the probit model which explain contract selection, but which are not highly collinear with the set of independent variables in the regression equation.

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