The Nature of the Farm

Contracts, Risk, and Organization in Agriculture

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4 Choosing between Cropshare and Cash Rent Contracts

4.1 Introduction

In chapter 3, we showed how rather simple contracts persist in modern agriculture becau of the absence of specific assets and because the common law and reputations substitute explicit contractual details. In this way, even simple (and short-term) contracts can avo gross breaches of contract that are relatively easy to observe. Other issues in contract stru ture, however, remain in need of explanation even when contract simplicity is account for. Prominent among these issues is the age-old question of the choice between cash re contracts and cropshare contracts, which we examine in this chapter.[1]

Over the years economists have devoted an enormous effort examining the rationale sharecropping. While considerable theoretical efforts have been made, it has only be in the last decade that numerous empirical studies have been undertaken, especially modern Western agriculture.[2] Theoretical models often consider contracts that bear lit resemblance to those found in the United States and Canada today and thus generally do n yield predictions relevant for the available data. The model of landowner-farmer contracti that we develop is consistent with modern farm contracts, and we test its implications agai our data on individual contracts. This model serves as the basic framework for most of t subsequent chapters.

4.2 A Model of Contract Choice

Cheung (1969) demonstrated that when transaction costs are zero, contract choice will n influence the outcome of the contract; cash rent and cropshare contracts are equally effici methods of coordinating landowners and farmers. This application of the Coase Theore raises the obvious question: Why then, would farmers and landowners choose one type contract over another? As we noted in chapter 1, the economist's response to this que tion was the development of transaction cost and risk-sharing theories of sharecroppin Historically most models within the theoretical literature on cropshare contracts contain ements of risk sharing, but in recent years theoretical work has shifted away somewhat fro risk-sharing into double moral hazard, multitasking, and strategy.[3] Recent work includ for example, Dubois (2002) on intertemporal incentives, Laffont and Matoussi (1995) a Sengupta (1997) on moral hazard and financial constraints, Ray (1999) on strategic de gation, and Arruñada, Garicano, and Vazquez (2001) on automobile franchising. This ne theoretical literature mimics the recent change in emphasis in modern contract theory (example, Gibbons 1998; Holmström and Roberts 1998), but like the old theory it is aga rapidly outpacing empirical work (Chiappori and Salanié 2000). There also has been wo in economic history on the choice of contracts which also has a transaction cost foundatio

In this chapter we develop a model in the transaction cost tradition and ignore risk sharing by assuming both contracting parties to be risk neutral.[5] In our model we assume that a given tract of land is to be leased—owner cultivation is not an option—and the important choice is between a cash rent and cropshare contract. In developing a transaction cost model of contract choice, it is important to understand the incentives of each contract. In a cash rent contract, the farmer pays a fixed annual amount per acre of land and owns the entire crop. As a result, he supplies the optimal amount of his own inputs but overuses any inputs supplied by the landowner.[6] Farmers can increase their wealth by not planting crops in a proper rotation, overusing chemicals and fertilizers that damage the soil, and tilling in ways that increase current crop output but reduce the future productivity of the soil. By manipulating the timing of seeding, fertilizing, and harvest, the farmer can enhance his own return at the expense of the landowner's.[7] For example, if a hail- or rainstorm is expected, a farmer may harvest his own crop before a shared crop. In a cropshare contract the farmer shares the harvested crop with the landowner. Because the farmer receives less than the full amount of the crop, he uses fewer inputs and thus reduces the overall distortion from suboptimal input choices.[8] Hence, the benefit of the share contract is that it curbs the farmer's incentive to exploit the inputs supplied by the landowner, such as soil moisture and nutrients.

In principle, the landowner could also undersupply attributes of the land used by the farmer, but for the types of farming we consider, both farmers and landowners indicate that this is not likely. A landowner might be delinquent in road maintenance and fence upkeep, but we find little or no evidence that these are the duties of landowners for the cases we study. The large fraction of absentee landowners supports the view that landowners supply just land and no other services. Thus, we assume only the farmer chooses the inputs in these contracts, and our model features moral hazard only on the farmer's side.[9] Even though share contracts reduce total input distortions, they entail costs that are not present for cash rent contracts—the output has to be measured and divided.[10] For agriculture this requires physical measurement and division of the harvested crop. As a result, the farmer has an incentive to underreport the harvest to the landowner. Underreporting may take the form of crop quality as well as quantity. For example, a farmer may keep the best hay for himself, or he may keep the wheat with the fewest weeds, while not under-reporting quantity at all. Alternatively, land leased for pasture is most often cash rented because the costs of detecting quality and weight gain underreporting for live cattle is so high.[11] A cropshare contract also implies that both the farmer and the landowner must sell their share of the crop and incur the associated costs because cropshare contracts do not specify shares of the dollar value of the crop, but shares of the crop. The trade-off between input distortion costs and output division costs determines the contract choice, the joint wealth maximizing choice being the contract that yields the highest value of output net of all costs.

We use a two-stage contract choice model. First, we determine the input choices made by farmers in cash rent and cropshare contracts. Second, given the farmer's choices, we

determine the contract that maximizes joint (farmer-landowner) wealth by comparing net values of the two contracts as important parameters change. We assume there are j two inputs—farmland owned by landowners and farm capital (both human and physic owned by farmers—and that both parties are risk neutral. As we stressed in the introducti we also assume a random input to account for factors as weather and pests. Because of t uncertainty and because all of the attributes of the farmer and land inputs cannot be perfec specified in a contract, there are opportunities for farmer moral hazard.

In all cases, we consider the use of a tract of farmland of fixed acreage that is contrac for use by a single farmer for a single growing season.[12] Following our general product discussion in chapter 1, let $Q = h(e, l) + \theta$, where Q is the harvested output (with u price) per tract; e is a composite input of farmer inputs, including labor time and eff equipment, and other farming materials; l is a composite input of land attributes, su as fertility and moisture content that are not specified in the contract; and $\theta \sim (0,$ is a randomly distributed composite input that includes weather and pests. We assu that $h_e > 0$, $h_l > 0$, $h_{ee} < 0$, $h_{ll} < 0$, and $h_{el} = 0$, where the subscripts denote par derivatives.[13] The opportunity cost of the farmer's input is the competitive wage rate per unit of farmer's effort, and the opportunity cost of the unpriced land input (l) is r unit. In a farmland contract the priced land attribute is acres, which for our purposes ignored. Therefore it is worth stressing that r is not the price of land per acre, but the c of the composite unpriced land input.

If contracts could be enforced without cost, there would be no input distortion and output measurement. With risk-neutral landowners and farmers, the expected profit from farming operation is maximized, resulting in the employment of e^* and l^* units of farm and landowner inputs. These first-best, full-information input levels are identical for cropshare and cash rent contracts and satisfy the standard conditions that marginal produ equal marginal costs for both inputs.[14]

When contract enforcement is costly, however, the input choices will be second-best either contract, farmers have an incentive to exploit the land's unpriced attribute (l) beca they do not face the full costs, r. In addition, farmers have an incentive to underreport output in the cropshare contract. We examine the differential outcomes of the cash rent a cropshare contracts by modeling these incentives. For both contracts, the farmer choo the inputs, which depend on the type of contract. Once the input levels are determined, net value of each contract can be evaluated.

Cash Rent Contracts

For the cash rent contract, the farmer hires a tract of farmland for a lump-sum fee paid j prior to the growing season.[15] He owns the entire crop and chooses his inputs to maxim expected profit. Because the farmer does not have indefinite tenure of the land, he does face the true opportunity cost of using the attributes of the land. We denote the reduced costs he faces as $r' < r$, so the farmer's objective is

$$\max_{e,l} \Pi^r = h(e,l) - we - r'l. \quad (4.1)$$

The second-best solutions e^r and l^r satisfy: $h_e(e^r) \equiv w$ and $h_l(l^r) \equiv r'$. Given that $h_{el} = 0$, we note that the farmer's input level is identical to the first-best optimum; that is, $e^r = e^*$ It is also clear, however, that since $r' < r$, $l^r > l^*$, implying that the land is overworked because the farmer does not face the full cost of using the land's attributes.[16]

Cropshare Contracts

In a cropshare contract, the farmer has exclusive use of the plot of land without paying the landowner prior to production. At harvest time, the crop is divided between the farmer and landowner, with the farmer receiving sQ and the landowner receiving $(1-s)Q$, where $0 < s < 1$.[17] The farmer bears all costs of the variable inputs except the differential cost of the land's unpriced attributes. The farmer's objective is

$$\max_{e,l} \Pi^s = s[h(e,l)] - we - r'l. \quad (4.2)$$

Now the second-best solutions e^s and l^s satisfy: $sh_e(e^s) \equiv w$ and $sh_l(l^s) \equiv r'$ These solutions indicate that the farmer supplies too few of his inputs because he must share the output with the landowner; that is, $e^s < e^*$. As with cash rent, the farmer overuses the land attributes, or $l^s > l^*$; however, since $l^r > l^s > l^*$, the use of the land is less excessive than it is with cash rent. This means that although a share contract still provides the farmer with an incentive to overuse the land, this incentive is not as powerful as it is with the cash rent contract.

Figure 4.1 demonstrates the equilibrium of the model. For simplicity of presentation, the graphs use identical and linear marginal product curves for each input. When contracts are enforced without cost, the first-best input levels e^* and l^* are chosen. In a cash rent contract the farmer faces reduced costs of using land attributes and chooses l^r, resulting in a deadweight cost of DFG. In a share contract the perceived marginal products to the farmer are lower, and therefore, he reduces the amount of both inputs used to e^s and l^s, resulting in two deadweight costs, ABC and DEH. In order to understand the differential effects of the contract, consider a switch from cash rent to cropshare. In a cropshare contract the farmer chooses less of both inputs, which has two offsetting effects: the reduction in the use of land attributes (l) increases the value of the contract, while the decrease in effort (e) lowers it. The optimal share will be the one that just equates the marginal loss (AB) due to reducing effort to the marginal gain (EH) due to reducing the level of the land attributes. One obvious implication of the model is that l^s is always greater than l^* since $r' < r$.[18] If

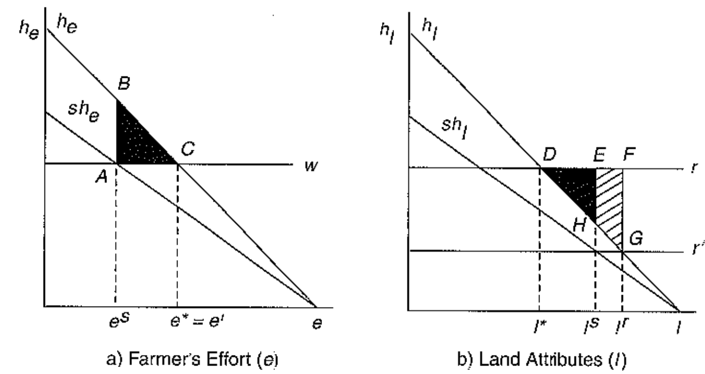

Figure 4.1
How share contracts minimize total input distortion.

there were no output division costs, the cropshare contract would always be superior t
rent because of the reduction in total input distortion. Cropshare contracts, however,
always dominate cash rent contracts, since they do create an incentive to underrep
quality and quantity of crop.[19]

Comparative Statics of Contract Choice

Farmers and landowners choose the contract that maximizes the joint expected return
tract of land.[20] Analytically, this requires comparing the expected net return to the l
both contracts, where the net return is given by the appropriate indirect objective fu
For the cash rent contract,

$$V^r(w,r,r') = h(e^r,l^r) - we^r - rl^r$$

With the cropshare contract, there are additional costs of measuring and dividi
harvested crop. These costs are given by μ so that the net value function is

$$V^s(w,r,r',\mu) = h(e^s,l^s) - we^s - rl^s - \mu.$$

The joint maximization problem is to choose the larger of V^r and V^s.

The trade-off between the two contracts is straightforward, as shown in table 4.
benefit of cash rent is the avoidance of the costs of dividing output μ. The ben
cropsharing is the reduction in the total distortion of input levels. Hence cropsharing s
be observed when output measurement costs are low and when soil attributes are e
exploit. Cash rent contracts should be observed under the opposite conditions. The ef

Table 4.1
Summary of incentives for contract choice

	Effort moral hazard	Land moral hazard	Output underreporting
Cropshare contract	Less	Yes	Yes
Cash rent contract	More	No	No

parameter changes on the net value of each contract can illuminate this trade-off and lead to hypotheses about contract choice. We consider changes in output division costs, μ, and the opportunity cost of land attributes, r.

Consider first how changes in μ affect V^r and V^s. The net value of the cash rent contract, V^r, does not depend on output division costs. The net value of the cropshare contract, V^s, however, declines as these costs increase. By the Envelope Theorem, $\partial V^s/\partial\mu < 0$. For low costs, the cropshare contract maximizes net value; for high costs, the cash rent contract maximizes net value. This implies that

PREDICTION 4.1 As the costs of output division increase, it is less likely that the cropshare contract will be chosen.

The comparative statics for r are similar. By the Envelope Theorem, $\partial V^s/\partial r = -l^s$ and $\partial V^r/\partial r = -l^r$, where $l^r > l^s$. Because neither l^s nor l^r depend on r, the second derivatives of V^s and V^r with respect to r are zero. Therefore, V^s and V^r are linear functions of r. Thus, an increase in the cost of land attributes will lower the value of either contract (holding r' constant), but it will lower the value of the cash rent contract more because land inputs are used more intensively in a cash rent contract than in a cropshare contract ($l^r > l^s$). This implies that

PREDICTION 4.2a As the unpriced attribute of the land becomes more easily damaged, it is more likely a cropshare contract will be chosen.

PREDICTION 4.2b As land value increases, it is more likely a cropshare contract will be chosen.

These predictions—regarding the choice of contract for different levels of crop division costs μ, and a farmer's incentive to exploit the soil $(r - r')$—can be tested by using data on contracts and the characteristics of crops, farmers, and landowners that allow us to measure output division costs and soil exploitation.

Our model also has implications about the level of input use under both types of contracts. However, the data available in our surveys of contracts from British Columbia, Louisiana, Nebraska, and South Dakota only allow a test of the contract choice implications. These

data have no information on the use of any farm inputs. A study by Shaban (1987), hc offers support for our implications for input choices. Using data from Indian vi Shaban found that input use was significantly lower (from 19 to 55%) on share compared to owned land. He concludes that the data refute the idea that land own able to stipulate and perfectly monitor input uses in a share contract. More recently, ((1996) finds heavier input use (for example, fertilizer, pesticides) in cash rent co compared to cropshare contracts using data from the United States in the late 1980s

4.3 Empirical Analysis: The Choice of Contract

To test the above predictions we use data from the same leasing surveys used in cha Again, each observation is a single contract between a farmer and a landowner, a variables used in this chapter are listed in table 4.2. Though the appendix describes tl in more detail, it is again useful to examine some features of the data used in this cl CONTRACT is a dummy variable that identifies cropshare contracts, and ADJUSTI is a dummy variable that identifies the presence of an adjustment clause in a cash co These are used as dependent variables in the analysis that follows. For the Nebraska– Dakota data we have over 3,400 contracts, and for the British Columbia–Louisian we have over 1,000 contracts. Information on ADJUSTMENT is only available f Great Plains data. For some estimates we divide the Nebraska–South Dakota dat two subsamples: one for which farmers provided data (1,261 contracts) and one for landowners provided data (2,171 contracts). Some information is only available for fa or for landowners.[21] These anomalies are discussed as they arise.

Independent variables can be grouped into those that measure output division cos soil exploitation. HAY and INSTITUTION are dummy variables that indicate the pre of hay and institutional landowners, respectively, are used as output division vari IRRIGATED, RICE, ROW CROP, and TREES are dummy variables that indica presence of irrigation systems, rice, row crops, and tree crops, respectively, and ar used as soil exploitation variables. DENSITY is the population density for the cou which the plot lies and is also a soil exploitation variable.[22] A number of variables ar as controls, and depending on the data set these include the age of the farmer (AGE), tl of the leased plot (ACRES), a dummy for leases between family members (FAMILY total farm sales (FARM SALES), and the fraction of income derived from the farm (F INCOME). ROW*HAY is an interaction variable also used as a control.[23] ABSEN dummy identifying absentee landowners and ACRES OWNED measures percent o acres owned by the farmer. These last two variables are used to test hypotheses from sources than our model.

Table 4.2
Definition of variables

Dependent variables	
CONTRACT	= 1 if contract was a cropshare contract; = 0 if a cash rent contract.
Independent variables	
ABSENT	= 1 if landowner lived in county different than contracted land; = 0 otherwise.
ACRES	= number of acres covered by contract.
ACRES OWNED	= percentage of farmed acres that are owned by the farmer.
AGE	= farmer's age in years (for British Columbia and Louisiana).
AGE	= 1 if farmer is younger than 25,
	= 2 if 25–34 years old,
	= 3 if 35–44 years old,
	= 4 if 45–54 years old,
	= 5 if 55–64 years old,
	= 6 if older than 65 (for Nebraska and South Dakota).
DENSITY	= population per square mile in the county of farm operation.
FAMILY	= 1 if landowner and farmer were related; = 0 otherwise.
FARM INCOME	= 1 if less than 30% of total income comes from farming.
	= 2 if between 30% and 49%.
	= 3 if between 50% and 80%.
	= 4 if more than 80%.
FARM SALES	= total farm sales for 1992.
HAY	= 1 if hay and other grass crops were the major income-producing crops;
	= 0 otherwise.
INSTITUTION	= 1 if the landowner is an institution (available for Nebraska and South Dakota farmer sample);
	= 0 if the owner is an individual.
IRRIGATED	= 1 if land is irrigated; = 0 if dryland.
RICE	= 1 if the crop was rice; = 0 otherwise.
ROW CROP	= 1 if a row crop (corn, sugar beets, sugarcane soybeans, sorghum);
	= 0 if not a row crop (wheat, oats, barley).
TREES	= 1 if fruit was grown (e.g., apples, pears, etc.);
	= 0 if no fruit was grown.

Prediction 4.1 says that a cropshare contract is most likely to occur when the costs of dividing the crop are relatively low. Crops can be divided into two categories to identify changes in output division costs: crops sold through public markets and crops sold through private sales. Most cash crops (grains typically) grown in our jurisdictions are sold at local elevators, probably within a thirty-mile drive, where the crop is independently weighed, graded, and, if there is a cropshare contract, divided. Most farm towns, especially on the Great Plains, have very few elevators, and it is usually well known where farmers take their crops.[24] Crops that must go to an elevator are relatively easy to measure. Alfalfa, brome, and native hay are crops in our sample that are not weighed and sold at an elevator or other third-party location. Because these hay crops are more difficult to measure at the time of

harvest, we expect cash rent contracts are more likely to be chosen.[25] Similarly, a cash contract is more likely to be chosen when the costs of on-farm storage is high, rende crop storage in a public elevator more likely.

Although we have no data on the extent of on-farm storage, we have other informa on landowners that can be used. Not all farmland owners are private individuals. In s cases, farmers lease land from city or state governments, Indian tribes, banks, or other stitutional" landowners. For these landowners, crop division costs are likely to be relati large. Agents of the institution would have little a priori knowledge or interest in the y or possibilities for underreporting. Thus, we expect institutional landowners to be n likely than private landowners to cash rent their land. To summarize, we expect nega coefficients for HAY and INSTITUTION.

Predictions 4.2a and 4.2b state that cropshare contracts are more likely when soil ploitation costs are high. Our data can be used to identify situations in which this is likel be true. For example, if farmland is soon to be used for purposes other than agriculture, soil quality becomes less important. In the extreme case, where the land is to be conve at the end of the current contract, the incentives of the landowner and the farmer toward extraction would be identical ($r' = r$). In this case, a cash rent contract would approxir the first-best solution and would be chosen over cropshare. Thus, we expect cash rent fa ing to be more common for farmland near urban populations, because the value of the for nonfarm uses is relatively high. The variable DENSITY approximates the urbaniza of an area and indicates the extent to which farmland may have alternative uses.

Other situations can also be used to identify cases where soil exploitation is relati unimportant. Irrigated land is less likely to suffer from soil exploitation because irrig land does not require fallowing, which is a method of conserving soil moisture.[26] T cropshare contracts are expected to be less likely for irrigated land than for land tha not irrigated. Tilling, cultivating, and other physical manipulations of the soil present same incentive conflict between the landowner and the farmer as fallowing does. The far does not have the incentive to take the long view regarding tilling. In certain cases, exces tilling can lead to wind and water erosion, nutrient depletion, and loss of moisture, wl may not be problematic in the immediate period but will lead to reduced crops in the fut For example, in the relatively dry climate on the Great Plains, the evaporation of sur moisture draws subsurface moisture upward and reduces the total amount available current and future crops. Cropsharing is more likely to be chosen when tillage becomes n important because the potential for land exploitation is greater. When one is considering incentives for different tillage practices, it is useful to distinguish between row crops (s as corn, potatoes, soybeans, and sugar beets), where the land is tilled more intensi and other crops (such as barley, hay, and wheat) where the land is tilled less intensiv

Thus, cropshare contracts are more likely to be chosen for row crops where tillage is important.[27] To summarize, we expect negative coefficients for DENSITY and IRRIGATED and a positive coefficient for ROW CROP.

Cash Rent versus Cropshare Estimates

We use our contract data to estimate the determinants of cropshare contracts (versus cash rent contracts) and test the predictions from our model. We use the same general empirical specification from chapter 3, so that for any farmland contract i the complete model is

$$C_i^* = X_i \beta_i + \epsilon_i \quad i = 1, \dots, n; \quad \text{and} \tag{4.5}$$

$$C_i = \begin{cases} 1, & \text{if } C_i^* > 0 \\ 0, & \text{if } C_i^* \leq 0, \end{cases} \tag{4.6}$$

where C_i^* is an unobserved farmland contract response variable; C_i is the observed dichotomous choice of land contract for plot i, which is equal to 1 for cropshare contracts and equal to 0 for cash rent contracts; X_i is a row vector of exogenous variables including the constant; β_i is a column vector of unknown coefficients; and ϵ_i is a plot-specific error term. We use a logit model to generate maximum likelihood estimates of the model given by equations (4.5) and (4.6) for various contract samples.

Table 4.3 shows the logit coefficients estimates of the influence of selected variables on the choice of contract for the Nebraska–South Dakota sample. The first equation includes all contracts (3,432). The coefficient estimates for the output division variables—HAY and INSTITUTION—are both negative and statistically significant as predicted. The coefficient estimates for the soil exploitation variables—DENSITY, IRRIGATED, and ROW CROP—also have the expected signs and are statistically significant. This implies that when soil exploitation is of less concern, a cropshare contract is less likely.[28] In the second and third equations in table 4.3, all of the coefficient estimates for these variables still fulfill the predictions, although in a few cases the t-statistics fall. These estimates offer support for our theory of contract choice and are also consistent with the observation of Gray et al. (1924, 589) that "especially in the Corn Belt it is frequently customary to cash rent the hay land while sharing the grain crop." Dubois (2002) finds that in the Philippines, corn—a crop that is hard on the land—is more likely to be cropshared than are the main alternatives of rice and sugar.

While we do not have data on soil quality directly, two recent empirical studies support our model. Using data from a special U.S. Census survey, Canjels (1996) finds that erodible land is more often cropshared. Similarly, Sotomayer, Ellinger, and Barry (2000) use a set

Table 4.3
Logit regression estimates: Cropshare vs. cash rent, Nebraska and South Dakota (1986)
(dependent variable = 1 if cropshare contract; = 0 if cash rent)

Independent variables	Full sample	Farmer sample	Landowner sample	Predicted
CONSTANT	−0.94	−0.30	0.28	
	(−0.61)	(−1.07)	(1.48)	
Output division				
HAY	−0.38	−0.18	−0.55	−
	(−2.71)*	(−0.79)	(−2.99)*	
INSTITUTION		−0.73		−
		(−3.26)*		
Soil exploitation				
DENSITY	−0.001	−0.001	−0.052	−
	(−2.00)*	(−1.31)	(−1.93)*	
IRRIGATED	−0.97	−0.73	−1.12	−
	(−8.37)*	(−4.24)*	(−6.86)*	
ROW CROP	2.76	2.10	3.44	+
	(23.97)*	(11.78)*	(20.36)*	
Other models				
ABSENT			−0.23	−
			(−1.71)*	
AGE		0.07		−
		(1.29)		
ACRES OWNED		−0.003		−
		(−0.93)		
FAMILY	−0.07	−0.046	0.30	+
	(−0.77)	(−0.32)	(2.16)*	
Controls				
ACRES	0.00002	0.0004	−0.00005	
	(0.28)	(2.92)*	(−1.11)	
FARM INCOME		−0.09	−0.18	
		(−1.77)	(−2.76)*	
ROW*HAY	0.039	0.16	−0.03	
	(0.19)	(0.56)	(−0.10)	
Observations	3,432	1,261	2,171	
χ^2 (df)	1,141.37(7)	300.83(11)	941.03(9)	
Log likelihood	−1,507.17	663.29	780.38	

Note: t-statistics in parentheses.
* significant at the 5 percent level (one-tailed test for coefficient with predicted signs).

of contracts from Illinois and find that land with higher quality soil is less likely to be cash rented. Both of these findings are consistent with predictions 4.2a and 4.2b.

Two control variables—ACRES and ROW*HAY—are included in all equations. ROW*HAY was included because of the data overlap we mentioned earlier. In all cases the coefficient for this variable was insignificantly different from zero. ACRES was included to control for the possibility that the size of the farm influences contract choice. The estimated coefficients for ACRES vary across the sample but show no statistically significantly effect in the full sample. FARM INCOME is also included as a control in the smaller samples.[29] The negative and statistically significant coefficients indicate that contracting parties (farmer or landowner) with larger fractions of income from farming are less likely to choose a cropshare contract.

Table 4.4 shows the estimated coefficients from a logit regression using the British Columbia–Louisiana data. The table shows estimates for the full sample and for British Columbia (155 contracts) and Louisiana (414 contracts) separately. The British Columbia–Louisiana data sample sizes are sensitive to the inclusion of variables because those variables relating to farm capital and wealth contain a number of missing observations. We estimated the equations in table 4.4 without these variables and obtained results for the remaining ones that were similar to those presented.

The estimates are similar to those found in table 4.3. For instance, as expected the estimated coefficients for HAY are negative and (usually) statistically significant. The coefficients for INSTITUTION are always negative and statistically significant. The estimated coefficients for IRRIGATED, however, are less supportive than in the Nebraska–South Dakota data. Only in the full and British Columbia samples are the estimates negative and they are not statistically significant. For the Louisiana sample, the estimates are actually positive. A plausible explanation is that for these data the IRRIGATED variable is dominated by flood irrigated rice that does not capture the soil exploitation phenomenon the same way it does for the Great Plains. The estimates for ROW CROP are, as expected, positive and statistically significant, except for the British Columbia sample.[30] Two additional variables, RICE and TREES, are used to measure the potential for soil exploitation. Rice, though not a row crop, is a crop for which soil degradation can be severe because of weed and disease problems; hence, it is expected to be shared.

Fruit trees, however, provide a novel test of our hypothesis, because the source of exploitation are the trees themselves, and farmers can extract more fruit in a given year at the expense of crops two or three years down the road by improper pruning. The share contract dampens this incentive and encourages proper tree maintenance.[31] Thus, we predict, and find, that the coefficients are positive (and statistically significant) for RICE and TREES. Orchards are found in British Columbia, but not in our Louisiana data. Hence the variable TREES is left out of the Louisiana regression.

Table 4.4
Logit regression estimates: Cropshare vs. cash rent, British Columbia and Louisiana (1992)
(dependent variable = 1 if cropshare contract; = 0 if cash rent)

Independent variables	Full sample	British Columbia sample	Louisiana sample	Predicted
CONSTANT	−0.86 (−1.57)	−2.59 (−2.16)*	0.08 (0.13)	
Output division				
HAY	−0.31 (−0.77)	−0.78 (−1.41)	−1.40 (−1.05)	−
INSTITUTION	−1.25 (−3.24)*	−2.11 (−1.91)*	−0.94 (−1.99)*	−
Soil exploitation				
DENSITY			−0.005 (−0.94)	−
IRRIGATED	−0.31 (−0.87)	−0.89 (−1.07)	0.002 (0.00)	−
RICE	2.27 (5.05)*		1.59 (3.21)*	+
ROW CROP	1.60 (5.75)*	1.49 (1.39)	1.21 (3.66)*	+
TREES	2.44 (3.77)*	3.51 (3.58)*		+
Other models				
ABSENT	9.01 (0.88)	10.30 (0.53)	8.41 (0.75)	−
AGE	0.008 (0.86)	0.031 (1.47)	−0.004 (−0.37)	−
ACRES OWNED	−1.29 (−3.23)*	−.51) (−0.62)	−1.17 (−2.36)*	−
FAMILY	0.49 (1.70)	−0.105 (−1.39)	0.47 (1.41)	+
Controls				
ACRES	0.0001 (0.28)	0.0001 (0.00)	0.0002 (0.00)	
FARM SALES	0.02 (0.47)	−0.12 (−0.81)	0.015 (0.29)	
Observations	569	155	414	
χ^2 (df)	222.31(12)	57.15(11)	90.51(13)	
Log likelihood	−433.37	−114.59	−297.72	

Note: t-statistics in parentheses.
* significant at the 5 percent level (one-tailed test for coefficients with predicted signs).

ACRES is again used as a control variable in all equations. In each case the estimated coefficient in not statistically significant, indicating that the size of the land plot does not affect contract terms.

Absentee Owners, Agricultural Ladders, Capital Constraints, and Families

We use additional variables to test our model against predictions—about absentee landowners, the agricultural ladder, capital constraints, and families—made elsewhere in the literature.[32] The Nebraska–South Dakota data are most amenable because we have extra information depending on whether or not farmers or landowners were surveyed. The British Columbia–Louisiana data do not have a detailed landowner component, so some of these tests can be conducted only against the Great Plains contract data.

In the landowner sample, ABSENT is included to test a common prediction of landowner behavior. In many models, landowners are assumed to provide valuable farming information and policing along with the land; therefore, the "absentee landowner" faces higher costs of participating in farming activities. This implies that absentee landowners will be less likely to cropshare, so the estimated coefficient for ABSENT should be negative.[33] The negative coefficient in the landowner sample supports this prediction. The prediction is, however, not consistent with the estimates in table 4.4 using the British Columbia–Louisiana data. Our model has no explicit prediction because the landowner does not monitor the farmer.

In the traditional theory of the agricultural ladder, a farmer "climbs" from wage farmer sharecropper to cash renter to, ultimately, landowning farmer. In Spillman's (1919) words: "The first rung of the agricultural ladder is represented by the period during which the embryo farmer is learning the rudiments of his trade. In a majority of cases this period is spent as an unpaid laborer on the family farm. The hired man stands on the second rung, the tenant on the third, while the farm owners has attained the fourth or final rung of this ladder" (171).

Although the ladder hypothesis is not derived from a well-defined economic model, it has had a strong following among agriculturalists and it does have a clear prediction regarding the choice between cash rent and cropshare. This implication is simply that older farmers, or those with more farming experience, are more likely to cash rent. Thus, the variable AGE is predicted to be negative. The evidence in the second equation in table 4.3, however, rejects this hypothesis, because the coefficient is small, positive, and statistically insignificant. The data in table 4.4 also reject this hypothesis using the British Columbia–Louisiana data.

In a cash rent contract, a farmer must pay the landowner prior to harvest; in a cropshare contract, the payment comes after harvest. Thus, there is a long history in economics, from Gray et al. (1924) to Laffont and Matoussi (1995), who argue that farmers facing capital constraints will be more likely to choose a cropshare contract. We use the variable ACRES OWNED—which measures the amount of land owned by a farmer—to measure such a

financial constraint. The farmer who owns more of his land base should have more collate and be able to secure loans more cheaply. Thus, the capital constraint theory implie negative coefficient for ACRES OWNED.[34] We find some support for this predicti especially in the British Columbia–Louisiana data (table 4.4) where all coefficient estima are negative and two are statistically significant. There is weaker support in the Nebrask South Dakota data (table 4.3).[35]

The variable FAMILY is included—in all specifications and for both data sets—to exa ine how family relationships influence the choice of contract. Otsuka and Hayami (19 argue that contracts between family members will generally be easier to enforce, so that m contracts will be between related individuals rather than "strangers." The aggregate e dence, however, refutes their hypothesis: Most contracts are not between family members. our Nebraska–South Dakota data, 66 percent of the contracts are between nonfamily me bers. Furthermore, Otsuka and Hayami claim that sharecropping should be more comm among family members, implying a positive coefficient on FAMILY in all specificatio The Nebraska–South Dakota data (table 4.3) reveals that only one of the three coefficie in positive and statistically significant. The British Columbia–Louisiana data (table 4. however, shows that all coefficients are positive and two are statistically significant. Ov all, then we find modest support for the prediction that cropshare contracts will be m likely among family members.[36]

Adjustment Clauses in Cash Rent Contracts

In the typical cash rent contract, the farmer is the complete residual claimant of the cr In our Nebraska–South Dakota data, however, roughly 10 percent of the cash rent contra (100 out of 1,008) have provisions to vary the amount of cash rent due to changes in act yields. We examine these cash rent adjustment clauses in order to further test our mod which implies that farmer-landowner contracts are organized to reduce the losses from in distortions and output division costs.

Because these adjustments are always upward—when crop yield meets a prespecifi level, the cash rent is increased—these clauses convert the cash rent contract into a part cropshare contract. A higher-than-expected yield may indicate that the farmer has overus the soil contrary to the landowner's long-term desires. An adjustment clause may, in pa serve as a deterrent to a farmer's excessive use of the land, because his marginal share reduced at the point at which the clause takes affect. Because an adjustment clause is partial share contract, predictions 4.1, 4.2a, and 4.2b are applicable. This implies that t adjustments will be more common for land where the farmer's ability to exploit the soil high. In addition, since the adjustment clause requires a measurement of the crop, cro where the division costs are high should be less likely to have adjustment clauses. Thus, expect that adjustment clauses will be less likely for hay land or irrigated land, because t ability of the farmer to overuse the land is limited in these cases, and hay crops are easier to underreport at harvest. With row crops, where the ability to exploit the soil is greater and where the relative cost of division is lower, adjustment clauses are more likely.

We test our predictions by using the sample of cash rent contracts from the Nebraska–South Dakota data using the empirical specification in equations (4.5) and (4.6). Table 4.5 presents the results of a logit regression equation that estimates the effects of several variables on the decision to include an adjustment clause in the cash rent contract. Our model predicts that all variables should have the same sign as in the previous test since the presence of an adjustment clause with a cash rent contract approximates a cropshare contract. Except for DENSITY, all estimated coefficients support our predictions. For the variables HAY and IRRIGATED we expect—and find—a negative relationship, although the coefficient for IRRIGATED is not statistically significant. The variable ROW CROP is positive and significant, as predicted, since the adjustment clause will discourage exploiting the soil to increase the current crop. DENSITY is predicted negative because alternative uses for the land reduce the cost of soil exploitation; however, this prediction is refuted by the data.

Like the estimates in table 4.3, we include ACRES, FAMILY, and ROW*HAY as control variables. ACRES and ROW*HAY have no statistically significant effect on the presence of an adjustment clause. FAMILY, however, has a positive and statistically significant effect on the probability that an adjustment clause will be chosen. This indicates that family members are more likely to exploit the soil under a pure cash rent contract than are nonfamily members. This finding is consistent with the majority of our estimates in tables 4.3 and 4.4 and supports the prediction that family members are more likely to use share contracts.

We also estimated this equation with the farmer sample to test our prediction about institutional landlords. The estimates for this equation are also shown in table 4.5. The coefficient for INSTITUTION was negative as predicted, and significant at the 10 percent level. The other coefficients were similar in size and statistical significance levels to the full sample coefficients.

4.4 Farmland Contracts in Historical Europe

Adam Smith was not a fan of cropsharing. His major discussion of the topic appears in chapter II of book III of *The Wealth of Nations*, under the general heading of "Discouragement of Agriculture." There Smith provides a brief history of agricultural contractual arrangements, beginning with the Roman Empire and continuing to his day. A major theme for Smith was that historical agriculture often involved slavery, and given the disincentives of slaves to work, innovate, and look after farm capital, these types of farms were eventually

Table 4.5
Logit regression estimates: Cash rent adjustment clauses, Nebraska and South Dakota (1986)
(dependent variable = 1 if adjustment clause is present)

Independent variables	Full sample	Farmer sample	Predicted s
CONSTANT	−2.44 (−9.19)*	−1.96 (−4.83)*	
Output division			
HAY	−0.75 (−1.95)*	−1.18 (−1.92)*	–
INSTITUTION		−1.15 (−1.85)*	–
Soil exploitation			
DENSITY	0.001 (2.37)*	0.002 (1.59)	–
IRRIGATED	−0.06 (−0.22)	−0.16 (−0.46)	–
ROW CROP	0.90 (3.67)*	0.72 (2.10)*	+
Controls			
ACRES	−0.0001 (−1.04)	0.0001 (0.46)	
FAMILY	0.46 (2.07)*	−0.066 (−0.20)	
ROW*HAY	−1.08 (-1.52)	−0.22 (0.25)	
Observations	1,008	437	
Chi-square (df)	45.76(7)	22.21(8)	
Log likelihood	−300.88	−144.31	

Note: t-statistics in parentheses.
* significant at the 5 percent level (one-tailed t-test for coefficient with predicted signs).

replaced by owned farms that often rented out land. Smith takes pains to point out that l viewed cropsharing as little better than slavery. For example, Smith stated (1992 [1776])

> To the slave cultivators of ancient times, gradually succeeded a species of farmers known at prese in France by the name of metayers. They have been so long in disuse in England that at present know no English name for them. The proprietor furnished them with the seed, cattle, and instrumen of husbandry, the whole stock, in short necessary for cultivating the farm. The produce was divid equally between the proprietor and the farmer. (P. 366)

Adam Smith was not particularly interested in explaining why a cropsharing syste survived in most of France while it failed to exist in England. Possibly influenced by the ne: continuous wars with France during the time, Smith made certain to argue the inferioriti of the French system. One of Smith's (1992 [1776]) important contributions to the analysis of cropsharing is his introduction of the notion of the share acting as a tax on behavior: "The tithe, which is but a tenth of the produce, is found to be a very great hindrance to improvement. A tax, therefore, which amounted to one-half, must have been an effectual bar to it" (376).

Interestingly, Smith (1992 [1776]) also was keen to point out the issue of the problem of measurement with cropsharing and noted that "in France, where five parts out of six of the whole kingdom are said to be still occupied by this species of cultivators, the proprietors complain that their metayers take every opportunity of employing the master's cattle rather in carriage than in cultivation; because in the one case they get the whole profits to themselves, in the other they share them with their landlord" (367).

In contrast to Smith, John Stuart Mill in his *Principles of Political Economy* (book II, chapter VIII) offered a much more balanced, and surprisingly modern, approach to cropsharing and cash renting. Writing roughly a century later than Smith, Mill agreed with Smith that France and Italy had a great deal of cropsharing and that this share acts as a tax on effort. Mill, however, surveyed several contemporary writers at the time, noting that these contracts had been in existence a long time, that the level of cultivation was not suffering, and that there was a great deal of variation in the contracts across the region. Mill (1965 [1871]), in great contrast to Smith, thus concluded: "I do not offer these quotations as evidence of the intrinsic excellence of the metayer system; but they surely suffice to prove that neither 'land miserably cultivated' nor a people in 'the most abject poverty' have any necessary connexion (*sic*) with it, and that the unmeasured vituperation lavished upon the system by English writers is grounded on an extremely narrow view of the subject" (315).

While the difference between Smith and Mill is of interest for those who follow the history of economics, our point here is more narrowly related to our own predictions about the determinants of farmland contracts. Both Smith and Mill acknowledged that cash rent and cropsharing existed in Europe, and that France, Italy, and Spain tended to be dominated by cropsharing while the northern European countries tended to be dominated by cash rent contracts. Many other writers since Smith and Mill, including modern economic historians, would agree with this general characterization of the distribution of farmland contracts across historical Europe. For instance, Kohn (2001) states: "Both fixed rent and share leases were to be found wherever the limited term lease appeared, but in most regions one or the other eventually came to predominate. The fixed-rent lease was the more common form in Northern France, the Low Countries, Western Germany, and the Po Valley. The share lease predominated in Western and Southern France and in Tuscany" (3). Similarly, when discussing France, Hoffman (1984) notes: "Sharecropping flourished both during the inflation of the sixteenth century and during the declining prices of the 1600s . . . despite overall similarities in European population trends, sharecropping took root only in particular

areas, such as parts of Italy and France" (310–311). Many other recent studies also confi this generalization, including Carmona and Simpson (1999) and Galassi (1992).

Although there are no detailed historical statistics on the precise distribution of th lease arrangements, the general facts appear consistent with our model. In northern Eur the most common type of farming would have been for small grains and grass crops. southern France, Italy, and Spain grapes, olives, and fruit were much more important.[37] we mentioned earlier in the context of fruit trees in British Columbia, the share contr mitigates the farmer exploiting the tree or vine asset. With grapes and fruit, pruning c be done in certain ways that increase the short-run volume of fruit, but that over time l the tree or drastically reduce the long-term productivity of the tree. Sharing lowers t incentive of the farmer to do this in the same manner it lowers the incentive to exploit s attributes.[38] The observations about European land leasing, first made by Adam Smith a John Stuart Mill, thus suggest that land contracts were chosen in response to the costs enforcing contracts over assets with many attributes. The dominance of cash rent contra in England and northern Europe was the result of the relative dominance of small grain a grass farming. Similarly, the dominance of cropsharing in France, Italy and Spain was t result of the relative dominance of orchard crops.

4.5 Summary

In this chapter we have shown the transaction cost approach to be a useful tool for u derstanding the choice of contracts for farmers and landowners in modern and histori agriculture. It is an unfortunate reality that transaction cost models often hinge on unc servable parameters. If economists could directly and cheaply measure the ability of farm to exploit soil moisture and nutrients or the number and quality of hay bales taken, then could landowners and farmers and there would be no contract incentive issues. Despite t problems with identifying output division costs and the cost of exploiting soil attribu faced by the farmer, we feel that our variables are reasonable and accurate. The ability obtain detailed knowledge of farming practices helps exploit the theoretical model, and o evidence indicates that the choice of cash rent and cropshare contracts lies primarily in th ability to create proper incentives.

As we note in chapter 1, government programs might influence contract choice. F example, farm commodity programs are another factor that could potentially influen farmland contracts. For some crops (for example, barley and wheat) farmers get dire payments; for some crops (for example, soybeans and sugar beets) farmers do not recei direct payments but receive indirect subsidies through tariffs; and for other crops (f example, cattle, hay) there are no programs. It is not clear what a model based on governme programs would imply, since the payments do not depend on the allocation of input costs. Furthermore, in the context of our model, it is not at all clear how government programs would influence measurement costs or soil exploitability. These programs reduce income variability, so—assuming risk aversion—one might argue that nonprogram crops be treated differently from program crops. But, for the Nebraska–South Dakota data, virtually all crops are program crops, so there is no way to test for effects even if implications were available. Interestingly, the only nonprogram crop is hay, and it is virtually never cropshared, contrary to the risk-sharing hypothesis.

Our data show that cropshare contracts are more likely when crop division costs are low and where the ability of farmers to adversely affect the soil is high, and that cash rent contracts often contain clauses that discourage exploitation of the soil. Our coefficient estimates support our general theory that the variation in contracts is largely determined by the costs of enforcing the contracts in various situations. Not only are the signs of our estimated coefficients consistent with our predictions, but the magnitude of the coefficients dwarf the coefficients for both the control variables and the variables testing other theories. The next chapter extends our model to the case of input sharing and provides more evidence in favor of the transaction cost framework.

5 Sharing Inputs and Outputs

5.1 Introduction

The model and evidence in chapter 4 showed that moral hazard and enforcement costs (o' land quality and output sharing) determined the choice between a cash rent and a cropsh: contract. In this chapter we extend the model developed in chapter 4 to focus solely cropshare contracts and, in particular, to determine the optimal sharing rule for both crop output and the variable input costs. Though cropshare contracts are common, th differ from one another in that some include the provision for some or all of the inputs to shared, while others contain no such provision. Heady (1947) was one of the first to po: out that sharing input costs in the same proportion as the output share offsets the taxi effect of the share on that input. His result almost exhausts what economists have had say regarding input sharing, save Braverman and Stiglitz (1982). In this chapter we deri explicit predictions about the relationship between input and output shares. In particular, o model makes the rather strong prediction that inputs are either shared in the same proporti as the output or they are not shared at all.[1]

5.2 Optimal Cropshare Contracts

The model is developed in three stages. First, we examine the incentives of the farm to choose inputs given exogenous input and output shares. Second, we derive the optim cropshare and input shares that maximize the expected net value of the contract, taking tl farmer's input choices as constraints in a joint wealth maximization problem. Third, v derive the comparative statics of various share contract forms by examining the effects parameter changes on the joint wealth of a contract. Testable implications are derived each stage.

Production and Input Use

We extend the previous analysis by assuming that there are three types of inputs rather th: just two: farmland owned by landowners; farm labor owned by farmers; and other variab inputs, such as fertilizer and seed, that may be owned by both farmers or landowners. A other model assumptions remain the same.[2] Hence, output is now $Q = h(e, l, k_i) + \theta$, whe all variables are as defined in chapter 4, and k_i is one of several (n) inputs such as fertilize pesticide, or seed. The opportunity cost of the i^{th} variable input is c_i per unit. In genera we ignore the subscripts on the k_i inputs and examine one such input at a time. Because th inputs are assumed to be independent, this causes no problem and clarifies the notation. I the empirical section, however, we consider many inputs.