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Both debt financing and government intervention in agricultural credit markets are extensive in the United States and elsewhere. In the United States, 74 percent of farm operators with sales over $20,000 had debt in 1979, and the government continues to subsidize farm credit, directly via the Farmers Home Administration and indirectly via its support of the Farm Credit System. These interventions have often been criticized as leading to an overallocation of credit (and overinvestment) in agriculture (e.g., Barry (1981), Duncan (1983)). However, these criticisms have not been preceded by explanations of debt contract forms. The objectives in the research presented here are: (i) to construct a theory of contracts which is consistent with the use of debt (rather than equity) financial instruments, and (ii) to investigate the effects of government interventions in a setting consistent with such a theory. Surprising conclusions emerge from this approach to the study of agricultural credit markets.

In this paper, I attempt to motivate the investigation of models with asymmetric information in agricultural finance, lay out some of the implications of these models, and provide a little intuition for the results they give. The interested reader is referred to the manuscripts cited at the end of the paper for a complete treatment of these issues.[1]

Why Asymmetric Information?

To motivate an asymmetric information specification, consider a world with perfect information and ask the following question: Would debt contracts emerge in such a world? In general, the answer is "no." Two types of considerations give rise to this conclusion: (1) risk-sharing, and (2) taxes.

With respect to the first, note that, on the one hand, farmers tend to be less well-diversified than investors, and, on the other, systematic risk in agriculture is low (e.g., Barry (1980)). These two observations indicate that a specification with risk neutral investors and risk averse farmers is plausible,

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[1]These manuscripts are available from the author upon request.

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with the former property based on finance theory formalized in Rubinstein (1974). Given these risk preferences and a competitive credit market, it can be shown that farmers will raise external investment funds exclusively with equity-type instruments.

For an intuitive derivation of this result, consider a single period setting in which the farmer must choose between all-debt and all-equity financing of a given external investment. With debt, the farmer obtains the maximum of the residual value of the farm after his debt payment (including profits), and zero. Formally, his payoff is max $(\pi - z, 0)$, where π is farm value (plus profit) and z is the promised debt payment. With equity, the farmer's payoff is $(1-\alpha)\pi$, where α is the share of the farm given to the external investor. These payoff functions are graphed in Figure 1, which shows that debt gives a higher farmer payoff in high profit states of nature and equity gives a higher payoff in low profit states. Now note that the investor will obtain the same expected payoff in either case due to the assumptions of competitive behavior and risk neutral preferences; he will just get an expected return on his investment which is equal to the risk-free rate of return. This observation implies that the probability weighted "gain with debt" area in Figure 1 is equal to the probability-weighted "gain with equity" area. Therefore, from the farmer's point of view, a move from equity to debt is equivalent to an exchange of high profit state income for low profit state income on a (probability-weighted) dollar-for-dollar basis. Due to the inverse relation between marginal utility and profits, this trade makes the risk averse farmer better off, implying all-equity financing.

Now add taxes and, to avoid risk sharing considerations, suppose that farmers are also risk neutral. With taxes, investor competition implies that the outside financier gets a post-tax expected return equal to that which he can get on a tax-free (risk-free) government bond. The farmer's expected payoff is therefore:

$$(1)\quad \begin{array}{l}\text{Expected}\\ \text{Profit on}\\ \text{the Farm}\end{array} - \begin{array}{l}\text{Expected}\\ \text{Farmer}\\ \text{Taxes}\end{array} - \left[\begin{array}{l}\text{Expected}\\ \text{Post-Tax}\\ \text{Investor}\\ \text{Payoff}\end{array} + \begin{array}{l}\text{Expected}\\ \text{Investor}\\ \text{Taxes on}\\ \text{the Contract}\end{array}\right]$$

The bracketed terms represent the expected farmer payment to the investor. By construction, the first and third terms in (1) are fixed. Hence, the financial contract will be chosen to minimize the total taxes paid by the two parties. Now note that with partnerships and S Corporations, there are no firm-level taxes; rather, all income is taxed at a personal level. Hence, the only difference between debt and equity is that tax shields (such as pre-productive expenses, depreciation, and tax credits) can be allocated to equity-holders and not lenders. To the extent that these tax shields have greater value to investors than farmers (because of different tax rates or different abilities to offset tax deductions against other income), the farmer will want to transfer them to investors with equity financing.

Of course, there is a big "if" here, the validity of which depends on various institutional features of the tax code, as well as individual farmer tax characteristics. A careful treatment of some of these features reveals that tax loss limits can sometimes favor debt financing, though in most cases, the tax structure favors equity (see Innes (1987d)).

In sum, perfect information generally implies all equity financing. Therefore, to understand agricultural credit markets more fully, I believe that it is important to explore informational explanations for capital structure choices and the attendant implications for government policy.

Two Types of Imperfect Information

There are two types of imperfect information that merit investigation:

(1) There may be a "moral hazard" or "principal-agent" problem in which the farmer chooses effort or consumption or risk levels which are unobservable to the investor.

(2) There may be an "adverse selection" problem in which the farmer's quality level cannot be observed by others.

In the following discussion, I will focus most attention on the latter type of asymmetry. But before launching into this discussion, let me comment briefly on the former (see Innes (1987b) for details). In an agency cost model, financial contract terms will affect the incentives for farmer choices, which in turn affect the return to investors. Investors know this relationship and, considering the indirect effects on farmer choices, they will set contract parameters so as to earn them their required expected return. In this way, investors are "left whole" by the agency problem, but farmers must bear the costs of not being able to commit to their "first best" decisions. These costs, it turns out, will depend on the capital structure decision. In fact, with effort-type choices, agency costs are higher with equity than with debt. This outcome is not too surprising since the farmer bears more of the cost of lower effort with debt (which is similar to a fixed payment) than with equity; hence, by lowering effort less with debt, he will deviate less from his "first best" effort level. When farmers are risk averse, these incentive considerations (favoring debt) are traded off with risk-sharing considerations (favoring equity) to yield internal capital structures (i.e., a mix of debt and equity financing). The latter implication is particularly interesting in that mixed capital structures are actually prevalent in many farm firms, with equity taking the form of a share land rental arrangement.[2]

While agency costs lead to deviations from a "first best," they do not in and of themselves lead to "constrained inefficiencies," where "constrained inefficiency" implies that there are Pareto-improving interventions. Rather, government is constrained in the same way as private agents in its choice of contract regime (which may include taxes); hence, if the government could achieve a Pareto improvement, so could private agents--and the private agents would themselves alter contracts to achieve this improvement. This conclusion contrasts sharply with other analyses (e.g., Stiglitz and Weiss (1983), Leathers and Chavas (1986)); the reason for the contrast is that the latter papers implicitly allow government a wider range of financial instruments than private agents.

Despite this "efficiency" conclusion, there are potential sources of inefficiency in more complicated models. For example, if equilibria in other markets affect effort choices, an externality is present and Pareto-improving interventions may be possible (see Arnott and Stiglitz (1986)). In addition, the presence of profit taxes makes government an external agent which is affected by private contracts, but not a party to them; again, the resulting externality can sometimes permit Pareto-improving interventions.[3]

Adverse Selection

The second type of informational asymmetry can also explain debt financing. But, unlike the first, the unfettered competitive equilibrium is often constrained inefficient--that is, Pareto improvements are possible. Interestingly, the optimal form of intervention in this setting is not unlike that which we observe in agriculture, namely, credit subsidies to low-quality farmers.

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[2]From the 1979 Farm Finance Survey, 44 percent of U.S. farm acreage was rented in 1979 and 68 percent of land rents were share payments.

[3]For investigation of tax externalities in an adverse selection model, see Innes (1987c).

The debt financing result can be derived informally as follows. Suppose farmers are risk-neutral and of two quality types, high (H) and low (L). Further, consider for the moment a fixed investment level common to both quality types which can be financed by mixes of debt and equity. A financial contract will then be characterized by two parameters:

$z \equiv$ promised loan payment
$\alpha \equiv$ external equity share

Two types of curves in (z,α)-space will give us an equilibrium (see Figure 2):

(1) Indifference Curves (IC_H, IC_L), which are sets of (z,α) combinations that give a given quality farmer a given expected profit.

(2) Offer Curves, which are sets of contracts which investors are willing to offer (i.e., contracts which earn investors their required expected return). These curves come in two types:

(i) Separating (OC_H, OC_L), for when the investor observes the farmer's quality.

(ii) Pooling (OC_P), for when the investor cannot observe quality and, therefore, attaches a probability distribution to it.

Several properties of these curves are useful:

(1) Higher indifference curves are associated with lower farmer utility; farmers prefer to pay less to investors.

(2) From before, risk neutral farmers are indifferent between debt and equity financing in a world of perfect information. Therefore, the separating offer curves (OC_L and OC_H) are also indifference curves (IC_L and IC_H, respectively).

(3) High quality indifference curves are steeper than low quality indifference curves. Why? Consider a set of debt-equity combinations on IC_L, giving L the same expected payoff. Going back to Figure 1, a movement down IC_L represents a trade of high profit state income for low profit state income which is dollar-for-dollar with L's probability weights. But H has a higher probability weighting in high profit states and a lower

probability weighting in low profit states. Therefore, the move down IC_L makes H worse off, implying that H must be on a higher indifference curve and, thus, that IC_H is steeper than IC_L.

(4) Just as farmers are indifferent between contracts on the appropriate separating offer curves, an indifference curve gives a set of contracts yielding a given expected investor payoff on the relevant quality type. Therefore, OC_P must lie between IC_H^* and IC_L^*.

So what is the equilibrium? The answer is e, the all-debt point on OC_P. This is the point on OC_P most preferred by the high quality farmer. The low quality type prefers this contract to any point on OC_L and, hence, must take it in order to conceal his quality. Somewhat more rigorously, consider trying to break e as an equilibrium by offers in any of the following regions:

(1) On or below IC_H^*. Such an offer will attract both quality types. Hence, since it is below OC_P, the investor will lose money.

(2) Between IC_H^* and IC_L^*. This offer will attract only low quality types. Thus, since it will be below OC_L, the renegrade contract will be unprofitable for the investor.

(3) Above IC_L^*. No farmer will take such a contract.

Thus, there is no way to break e as an equilibrium and debt contracts prevail.

But what about investment choices? Perhaps these choices can signal a farmer's quality, implying that the foregoing analysis, with a single common investment level, is inappropriate. In fact, this is so; by investing a sufficiently large amount, implying a correspondingly high loan payment, the high quality farmer can prevent the low quality farmer from wanting (and choosing) to masquerade; in other words, the low quality farmer will prefer his "first best" investment level to the high quality contract, even though he reveals his quality by his choice. Thus, with variable investment, a separating equilibrium can sometimes emerge (though not always) and the following question is raised: do debt contracts still prevail when separation occurs?

For a high quality farmer, it is easy to see that they do. First, recall that an indifference curve (in Figure 2) represents a set of (z,α) contracts which give both the farmer and the investor constant expected payoffs. Now consider the low quality farmer's preferences among contracts on a high quality indifference curve, IC_H. Because IC_H is steeper than IC_L, the low quality farmer least prefers the all-debt point on IC_H. Therefore, by choosing all-debt, the high quality farmer increases the cost to the low quality farmer of masquerading, and at no cost to himself. He will thereby relax the no-masquerading (self-selection) constraint and permit a lower cost of investment signaling.

As for the low quality farmer, he is effectively in a world of perfect information when separation occurs. Thus, one capital structure (such as all-debt) is as good as any other.

This discussion has already suggested the importance of asymmetric information for investment choices. In some cases, the high quality type's investment choice can "signal" his quality, in which case a separating equilibrium emerges. If he can signal his quality by simply taking his "first best" (perfect information) contract, then he will do so and the information problem will cease to be of particular economic interest. However, if the low quality farmer prefers the high quality farmer's "first best" contract to his own, the informational asymmetry will be important. In order to signal his type, the high quality farmer will have to invest more than at his "first best," just as a highly productive "worker" over-invests in education in Spence's (1974) original signaling model. Moreover, if the associated cost of investment signaling is large, the high quality type will prefer a pooling contract (i.e., a contract taken by both quality types) and a pooling equilibrium will emerge. In this case, not surprisingly, the investment level will be between the "first best" levels for high and low quality types, implying low quality over-investment and high quality under-investment.

In both pooling and separating cases, the inefficiency can be corrected by subsidizing the low quality credit contract. Intuitively, by subsidizing the low quality contract, government will reduce the incentive of low quality farmers to conceal their type and it will thereby permit the high quality type to choose his "first best" contract without risk of adverse selection.

Notably, with an appropriate set of taxes, the debt subsidy intervention can often be Pareto-improving, not just optimal in an ex-post sense. The reason for government's implicit advantage over private agents in this model (i.e., the reason for the constrained inefficiency) relates to the nature of competition; because of the competitive process, each and every contract must earn investors nonnegative expected profit. But government is not constrained by this requirement and, hence, can support a set of cross-subsidized contracts (i.e., separating contracts with negative expected profit on low quality types and positive expected profit on high quality types) which is preferred by everyone.

Curiously, the positive implications of debt subsidy intervention are also different than emerge from a perfect information analysis. When the original equilibrium is separating, the debt subsidy policy leads to lower investment by the high quality farmer. When the initial equilibrium is pooling, the debt subsidy leads to higher investment by the high quality type but lower investment by the low quality type.

In sum, by exploring an adverse-selection-based explanation for financial contract forms in agriculture, the positive and normative implications of policy interventions have been found to diverge in important ways from analyses formulated in a world of perfect information.[4] Of course, the analysis is not without its limitations; it would be nice, for example, to allow for dynamic (e.g., reputation-building) and political economic considerations, as well as more complex information structures. The implications of farmer risk aversion also deserve attention. Though, in my opinion, these extensions are unlikely to alter the motivation for present results in any fundamental way, they could address a host of other issues which are necessarily untouched here.

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[4]See Innes (1987a) for a complete treatment of the issues discussed above. Recent related work has been done by Mankiw (1986) and deMeza and Webb (1987).

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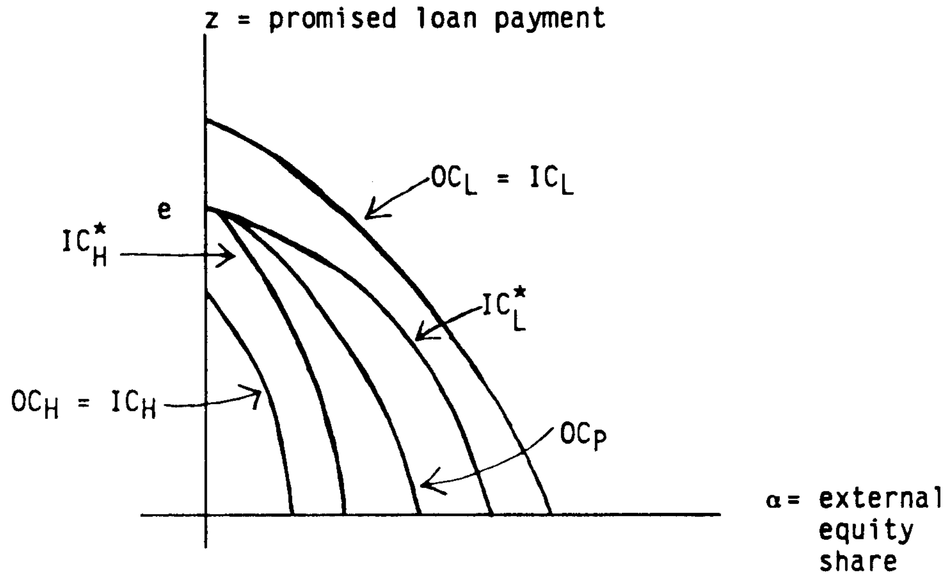
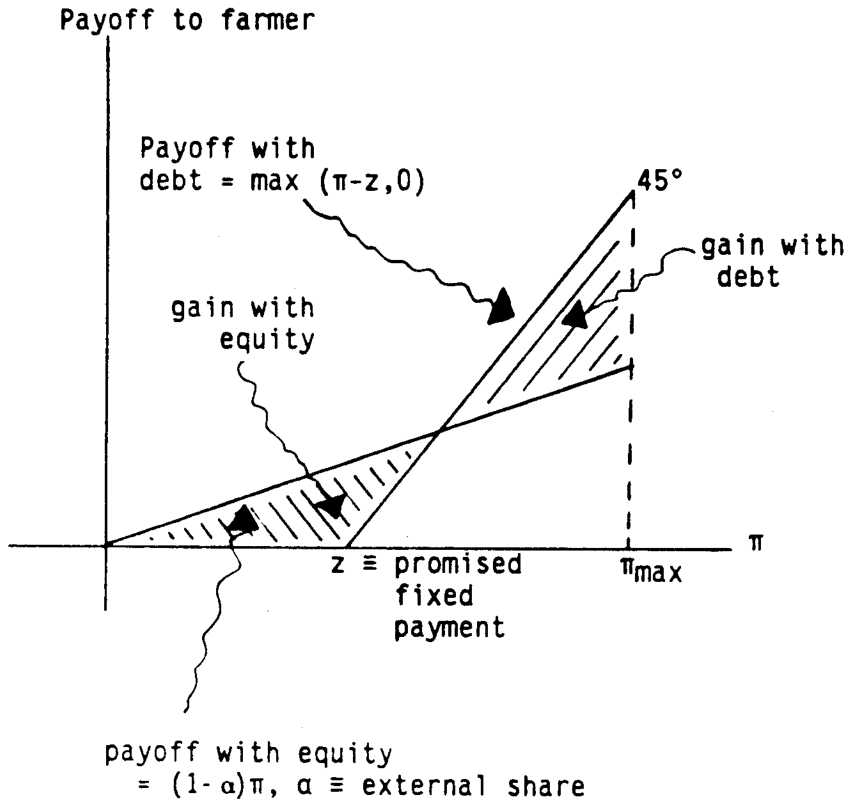
FIGURE 2



z = promised loan payment
$OC_L = IC_L$
e
IC_H^*
IC_L^*
$OC_H = IC_H$
OC_P
α = external equity share

FIGURE 1



Payoff to farmer
Payoff with
debt = max (π-z,0)
45°
gain with
debt
gain with
equity
π
z ≡ promised
fixed
payment
π_{max}
payoff with equity
= (1- α)π, α ≡ external share