

ADVERSE SELECTION PROBLEMS IN LOAN MARKETS:
SOME EVIDENCE FROM THE FARM CREDIT SYSTEM

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1. Introduction

This paper takes up three questions. First, there is a substantial theoretical literature on how private information impacts on credit market arrangements.¹ However, to our knowledge, there is little evidence documenting the importance of these problems for observed behavior in credit markets. Here we argue that recent behavior in agricultural loan markets, and in particular in the Farm Credit System (FCS), provides convincing evidence of the importance of adverse selection problems in these markets.²

Second, there are a number of different specifications of the behavior of firms in the adverse selection literature. For instance, Rothschild and Stiglitz [1976] employed a Nash specification of firm behavior, while Wilson [1977], Miyazaki [1977], Spence [1978], and others have employed specifications in which firms conjecture certain kinds of reactive behavior on the parts of other firms to their own actions. We will argue that recent developments in agricultural loan markets suggest the appropriateness of the Nash specification.

Third, Smith and Stutzer [1986] showed that modifying a standard adverse selection model to incorporate aggregate uncertainty (in an apparently innocuous way) had important implications for the structure of an industry facing adverse selection problems. In particular, it was demonstrated that the presence of aggregate uncertainty in loan markets implied that cooperative lenders should coexist with investor-owned intermediaries. This is what is observed in agricultural loan markets. Moreover, in Smith and Stutzer, the disbursement of dividend payments by a

cooperative lender to its owner-borrowers took a very specific form. This pattern of disbursements is closely approximated in the FCS.

The paper proceeds as follows. Section 2 describes the Farm Credit System. Section 3 indicates the apparent importance of adverse selection problems in agricultural lending. Section 4 describes how the FCS makes payments to its owner-borrowers that have similar aspects to the disbursements of dividends predicted by Smith and Stutzer [1986].

2. The Farm Credit System: A Recent History

The cooperatively organized Farm Credit System is the largest farm lender in the United States, holding close to one-third of U.S. farm debt. During the 1970s, the FCS had good years, and established certain advantages over its competitors in agricultural lending. First, the FCS experienced very low default rates on long-term loans secured by farm real estate, the largest single category of FCS loans. Losses on these loans, issued through the FCS borrower-owned Federal Land Bank Associations (FLBAs), were only 0.0003 percent of the average level of outstanding loans for the years 1971-76. Even after a temporary fall in farm income in 1976, the loss rate never rose above 0.025 percent during the next two years. And between 1979-80, the loss rate was negative, as previously written off loans started to accrue again. During the 1970s, its commercial bank competitors had substantially higher loss rates [Todd 1985, p. 17].

Second, the FCS benefited from the ability to obtain loanable funds at lower costs than its competitors in the 1970s.

Unlike its commercial bank and insurance company competitors, the FCS's cost of funds closely rivaled the U.S. Treasury's over this period. This comparative advantage was made possible by its size and success, access to national capital markets, and some investor's perceptions that the federal government was at least morally obligated to stand behind the FCS's long-term, noncallable bonds.

But both the FCS's lower default rate and cost of funds advantages disappeared during the 1980s. Farm prices, net income, and land values fell dramatically during the 1980s, resulting in higher default rates, both within and outside the FCS. Comparing the bad years of 1980-84 with the period of 1972-79, real income attributable to farm assets fell 36 percent. As a result, the real value of farm real estate fell 32 percent between 1980-85 [Todd 1985, p. 8]. Not surprisingly, the level of nonperforming and/or delinquent farm loans rose sharply over the same period, rising by 1985 to 15.6 percent of the farm real estate portfolio held by the FCS's FLBAs, and to 16.0 percent held by its Production Credit Associations (PCAs). It has been estimated that only 10.5 percent of commercial banks' aggregate farm loan portfolio was nonperforming and/or delinquent in 1985 [GAO, 9/3/86, p. 59].

The FCS's cost of funds advantage also disappeared during the 1980s. It continued to issue long-term, noncallable debt between 1980 and 1982, a period when long-term interest rates soared. As interest rates fell thereafter, the noncallable debt left the FCS with a relatively high average cost of funds [GAO, 9/18/86, p. 18]. The problem was exacerbated by a risk premium investors attached to FCS securities late in 1985. The risk

premium was due to reported and projected future losses, caused by its high cost of funds and default rate [GAO, 12/23/85, p. 36].

The FCS responded in a number of ways to these alarming developments. It increased its provisions for loan losses from only 0.42 percent of average gross loans in 1984 to well over 4 percent in 1986. It has also relied less heavily on raising funds through long-term, fixed rate, noncallable debt. Finally, during 1986 the FCS commenced the widespread adoption of charging differential, risk-based interest rates for its mortgage borrowers [GAO, 9/18/86]. Prior to 1986, real estate loans issued by FLBAs had always been at equal rates to all owner-borrowers.

The stated reason for the latter change was that competition for low-risk borrowers and earnings pressure forced the system to try to retain its low-risk borrowers via lower rates. The differential rate policy is not liked by some of the FCS owner-borrowers (see Karr [1986]), many of whom believe that the "one farmer, one vote" principle of cooperatives precludes its adoption.

3. Adverse Selection Problems and Lender Behavior

To one familiar with adverse selection models like Rothschild and Stiglitz [1976], these developments in the FCS are exactly what would be expected if adverse selection was a problem in agricultural loan markets, and if agricultural lenders behaved according to standard Nash specifications. To illustrate, we sketch a simple (linear) model of a loan market characterized by an adverse selection problem.³

In particular, consider an economy in which there are two dates ($t = 1, 2$), and in which at $t = 1$, there are three kinds of economic agents. The first type is a set of risk neutral lenders, who have a positive endowment of some (single) good at $t = 1$, and wish to lend it to generate income at $t = 2$. The second and third types of agents are risk-neutral borrowers. A borrower can be of either type H or L, to be described briefly. The fraction of borrowers of type H is denoted θ ; $\theta \in (0,1)$. We assume the number of borrowers is "large" (and is large relative to the number of lenders), and for simplicity we assume that borrowers have no endowment of the good when young.

Let c_t denote consumption at date t . Then lenders have the objective function $c_1 + c_2$, while borrowers of type i ($i = H, L$) have utility functions defined on R_+^2 of the form

$$u_i(c_1, c_2) = \beta_i c_1 + c_2; \beta_i > 1; i = L, H.$$

Further, a borrower of type i receives an endowment of the good of y units when old with probability p_i , and an endowment of zero with probability $1 - p_i$. Then borrowers repay loans if they receive a positive endowment, and default otherwise. Finally, $p_L > p_H$, so type H borrowers are high-risk borrowers. Also, we assume that $(\beta_H/\beta_L) > (p_H/p_L)$.

We let the quantity borrowed by a type i borrower be denoted x_i , and we let R_i denote the (gross) rate of interest that lenders charge type i borrowers. Lenders do not observe a borrower's type directly, but can induce borrowers to self-select by contract accepted. That is, lenders can offer distinct interest

rate-loan pairs (R_H, x_H) and (R_L, x_L) satisfying the self-selection conditions

$$(1) \quad \beta_L x_L + p_L(y - R_L x_L) \geq \beta_L x_H + p_L(y - R_H x_H)$$

$$(2) \quad \beta_H x_H + p_H(y - R_H x_H) \geq \beta_H x_L + p_H(y - R_L x_L).$$

If loan contracts satisfy these conditions, then high-risk borrowers voluntarily take the loan contract (R_H, x_H) , and low-risk borrowers take the contract (R_L, x_L) .

We assume that lenders are not monopolists, and that their behavior is noncooperative (Nash). We also require each contract to earn nonnegative profits. Then it is easy to show the following:

- (i) Any Nash equilibrium has $(R_H, x_H) \neq (R_L, x_L)$. Such a situation is referred to as a separating equilibrium, since borrowers of different types adopt separate contracts. Pooling refers to the situation in which all borrowers receive the same loan terms. In particular, then, there is no pooling equilibrium.
- (ii) If an equilibrium exists, $R_H = p_H^{-1}$, $R_L = p_L^{-1}$, $x_H = R_H^{-1}y$, and $x_L = (\beta_H - 1)x_H / [\beta_H - (R_L/R_H)]$.
- (iii) An equilibrium exists if $\beta_2 \leq \bar{R}/R_L$, where $\bar{R} = [\theta p_H + (1-\theta)p_L]^{-1}$.

It is instructive to review why no pooling equilibrium exists here. Suppose that all borrowers were to receive identical loan contracts specifying a loan quantity x and an interest rate R . Then some lender could earn a positive (expected) profit by offering a different contract (\hat{R}, \hat{x}) satisfying

$$(3) \quad \beta_L \hat{x} + p_L(y - \hat{R}\hat{x}) > \beta_L x + p_L(y - Rx)$$

$$(4) \quad \beta_H \hat{x} + p_H(y - \hat{R}\hat{x}) < \beta_H x + p_H(y - Rx).$$

Under the assumption that $(\beta_H/\beta_L) > (p_H/p_L)$, such a contract exists with $\hat{R} < R$. Then all low-risk borrowers would take the contract (\hat{R}, \hat{x}) , and no high-risk borrowers would take this contract. \hat{R} can be chosen arbitrarily close to R , and the contract (R, x) earned nonnegative profits when it attracted all borrowers. Thus (\hat{R}, \hat{x}) must earn positive profits if \hat{R} is sufficiently close to R .

In summary, then, there is no pooling equilibrium because, if borrowers were pooled, some lender would have an incentive to offer a loan contract with a lower interest rate, and attract all the low-risk borrowers.

We now apply this analysis to agricultural loan markets. If all agricultural lenders were identical, competition among lenders for low-risk borrowers would have prevented agricultural borrowers from being pooled. However, as seen in Section 2, all agricultural lenders were not identical during the 1970s and early 1980s. In particular, the FCS enjoyed a substantial cost advantage over other such lenders, effectively insulating it from the kind of competition that prevents a pooling equilibrium. This enabled it to offer identical interest rates to all borrowers. Once this cost advantage disappeared in the early 1980s, however, standard adverse selection models (and Nash behavioral assumptions) would predict that the FCS should have eventually lost its low-risk borrowers. In fact, as seen above, the FCS was eventu-

ally forced to adopt the practice of charging differential rates to prevent the loss of these borrowers. Thus, recent developments in the FCS strongly suggest that adverse selection problems are present in agricultural loan markets. These developments are consistent with the assumption of Nash behavior on the part of firms. If firm behavior was not Nash, then presumably the previously existing FCS arrangements could have been disrupted only if the incentives of the FCS to pool borrowers had changed.⁴ (See, e.g., Wilson [1977].)

4. Aggregate Uncertainty

In Smith and Stutzer [1986] we analyzed how a loan market characterized by the presence of adverse selection problems and aggregate uncertainty would operate. In particular, the model of Section 3 can be augmented by letting the probability of a nonnegative period 2 endowment for borrowers depend on the realization (at $t = 2$) of some aggregate shock. Specifically, define

$$p_i(s) \equiv \text{prob}[w = y|s]; \quad i = H, L,$$

where w is the second period endowment; $w \in \{0, y\}$. We let s take one of two values; $s \in \{1, 2\}$, and we let the probability of state s be denoted $\pi(s)$. We let $s = 2$ be a "good state," so that $p_i(2) \geq p_i(1)$; $i = H, L$, with strict inequality for some i , while $p_L(s) > p_H(s)$; $s = 1, 2$. In the agricultural lending context, the state $s = 1$ is simply the state of declining average farm income. Also, to reiterate, s is realized after loan contracts are entered into. Finally, we assume that $p_L(1)/p_L(2) \neq p_H(1)/p_H(2)$.⁵

Under this assumption, Smith and Stutzer demonstrate the following:

- (i) Loan markets should display the coexistence of cooperative lenders with investor-owned intermediaries. As the existence of the FCS demonstrates, this is what is observed in agricultural loan markets.
- (ii) Cooperative lenders should pass along would-be returns on capital only to low-risk borrowers.

The remainder of this section argues that observed FCS arrangements closely approximate (ii). In the FCS, both the FLBAs and PCAs could pay dividends on their owner-borrowers' stock [Farm Credit Administration 1984] but have not typically done so [Ruen 1987]. However, there is another way in which payments can be made to FCS stockholders.

To see how this can be done, we must consider the unusual nature of FCS stock. A borrower must buy stock in her/his lending association, usually with par value equal to 5 percent of the amount borrowed. At the borrower's option, the association must redeem the stock at par when the loan is repaid. Capital losses are not allowed to be passed through to the borrower stockholder, unless the association is declared insolvent and liquidated.

The farm bust of the 1980s helped push some poorly managed associations into insolvency. The General Accounting Office has examined the 1983 liquidation of four PCAs [GAO 10/18/85]. Their report noted that in all cases FCS units offered

interest-free loans to stockholder-borrowers of the insolvent associations, for the purpose of purchasing stock in other associations willing to assume their loans. In this way, the FCS made an additional "payment" (i.e., the forgone interest) to borrowers good enough to be accepted by another FCS lending association. This helped keep good, i.e. lower-risk, borrowers in the FCS and away from its competitors.

Furthermore, the report noted the FCS's Federal Intermediate Credit Bank of Spokane paid par value on all stock held by the stockholder-borrowers of its insolvent PCAs. This was done despite the likelihood that its value after liquidation would be less. While special legal circumstances may have motivated that action, the Congress subsequently permitted the FCS to utilize extraordinary loss accounting procedures.⁶ These procedures were intended to permit its associations to continue operating and redeeming stock at par during times when GAAP accounting would have them declared insolvent. The FCS hopes the new policy will help prevent a flight of low-risk borrowers away from financially ailing associations, which otherwise might have to be declared insolvent, impairing their stock. Utilizing the new policy, the Federal Land Bank of St. Paul informed stockholder-borrowers of its FLBAs that GAAP accounting would value their stock at only 55 cents on the dollar, but that the new accounting procedures would permit continuing redemption of their stock at par value [Minneapolis Star & Tribune 1/29/87]. It is mainly the low-risk borrowers who are able to pay off their loans in order to redeem their stock. So, the new accounting procedures assure low-risk borrow-

ers in the St. Paul district that their stock will be valued in excess of its market value upon redemption, encouraging them to continue their relationship with the FCS, rather than refinancing with a competitor. The excess valuation constitutes a de facto payment to low-risk borrowers, corroborating our model's predictions.⁷

5. Conclusion

In summary, there are a number of aspects of FCS history that indicate the importance of adverse selection problems in (agricultural) loan markets. First, historically, the FCS generally pooled borrowers of apparently differing types, offering all borrowers the same interest rate. There would seem to be little reason to expect this in the absence of signaling/informational considerations. Second, when the FCS lost its cost advantages vis-a-vis other lenders, the predictions of standard adverse selection analyses (with Nash behavioral specifications) were exactly borne out. In particular, other lenders tried to attract low-risk borrowers away from the FCS, forcing the FCS to price discriminate. Third, in the absence of problems of private information, there would be no reason to expect lending cooperatives to coexist with investor-owned intermediaries. However, private information models with aggregate uncertainty predict this outcome. Fourth, such models predict that cooperatives should find methods of rebating funds to low-risk borrowers. Despite the absence of dividend payments in the FCS, it appears that methods have been found for doing exactly that.

Footnotes

¹This literature is far too large to provide exhaustive references. Examples are Jaffee and Russell [1976], Stiglitz and Weiss [1981,1983], and Smith [1983]. Smith and Stutzer [1986] analyze a loan market with adverse selection that provides the basis for the results cited below.

²Evidence to this effect is also of interest because it has been argued (by Calomiris et al. [1986]) that farm debt problems have been particularly severe because of the importance of private information in agricultural credit markets. However, Calomiris et al. did not document the importance of these problems for agricultural lending. In fact, a good deal of the discussion subsequent to that paper questioned the importance of informational asymmetries in these markets. This paper suggests that there is evidence that such problems are quite important in agricultural loan markets.

³The model laid out here and in Section 4 is analyzed in detail in Smith and Stutzer [1986].

⁴Some readers have suggested an alternative explanation of FCS behavior. They have suggested that the FCS' early cost advantage may have permitted it to exercise a continuing degree of monopoly power over its borrowers, and that a monopolist possessing perfect information about its borrowers might have behaved the way the FCS did. (Incidentally, a monopolist facing an adverse selection problem would never have pooled borrowers. See Stiglitz [1977].)

We argue against this view, for three reasons. First, agricultural lending markets have never been sufficiently highly concentrated to enable the FCS to exercise such monopoly power. The FCS' market share of non-real estate farm debt rose from 4 percent in 1940 to only 23 percent in 1980, before falling back to 14 percent by 1985. Its share of real estate farm debt fell from 42 percent in 1940 to around 20 percent in 1960, before rising to 38 percent in 1980 and finally back to 42 percent by 1985 [USDA, 1986, pp. 69-72]. The majority of agricultural lending is thus done by the FCS' competitors, including insurance companies, the Farmers Home Administration, and most importantly, thousands of independent banks and other creditors. Second, suppose for the sake of argument that the market structure did permit the FCS to exercise monopoly power. Then, as a price discriminating monopolist, the FCS might indeed have tried to charge borrowers' interest rates which were inversely related to their respective loan demand elasticities. But then why didn't the FCS implement its differential rate policy on real estate loans back in 1940, when its market share was just as high? Third, why is the cooperatively organized FCS best thought of as a monopolist? In summary, a monopoly explanation is not convincing.

⁵Existence of a Nash equilibrium is guaranteed by the assumptions that

$$p_L(s) \geq \beta_L [\theta p_H(s) + (1-\theta)p_L(s)]; s = 1, 2.$$

and that

$$\frac{\beta_H}{\beta_L} > \frac{\sum \pi(s)p_H(s)}{\sum \pi(s)p_L(s)}.$$

⁶See the Omnibus Reconciliation Act of 1986, subtitle D.

⁷It is interesting to notice that, if $p_H(1)/p_H(2) < p_L(1)/p_L(2)$, then the analysis of Smith and Stutzer [1986] predicts dividend payments to low-risk borrowers in the "bad state" ($s = 1$). This condition is likely to hold in farm credit markets, where high-risk borrowers have a relatively much harder time repaying loans in bad times than they do in good times. The implicit payments to FCS borrowers discussed above have been made in a period of declining farm income, as suggested by the analysis.

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