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Security and Penalty in Debt Contracts

by

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Security and penalty are two institutions that induce debt contracts to be performed. *Security* is shorthand for any legal device guaranteeing some payment will be transferred from borrower to lender if the loan contract is not performed. *Penalty* is any device imposing adverse consequences on the borrower for default that does not provide a corresponding avantageous consequence for the lender. The most common source of security is collateral in the form of a marketable good placed at the easy disposal of the lender. Penalties may take many forms. The most prevalent is denial of future credit. In addition, a lender sometimes obtains a lien against property that has little or no value except to the borrower. Although the legal system does not condone such physical battery as arm-breaking for nonpayment of debt nor does it let a frustrated lender fire-bomb the borrower's car to inflict economic loss, "loan sharks" still may use these penalties. And activities such as obnoxious dunning letters and late-night telephone requests for payment are sometimes allowed and fit into the category of penalties.

The focus of this paper is on the need to motivate performance of contracts. There is a growing literature on the analysis of default in loan markets, some focusing on the use of collateral (BARRO [1976], BENJAMIN [1978], JACKSON and KRONMAN [1979], SMITH and WARNER [1979], SCHWARTZ [1981, 1984], LEVMORE [1982], DRUKARCZYK [1984], HESS [1984], and WHITE [1984]) and others addressing penalties (REA [1984] and EATON [1986]). While the discussion in this paper is in the context of loan contracts, the issue of motivating performance on contracts has a broader setting and has been studied by a large number of scholars (KLEIN, CRAWFORD and ALCHIAN [1978], SHAVELL [1980], TELSER [1980], KLEIN and LEFFLER [1981], KNOEBER [1983], KORNHAUSER [1983], POLINSKY [1983], and WILLIAMSON [1983]).

Two sorts of problems endemic to contract have received extensive treatment in the literature of the new institutional economics. The first is the incentive or effort problem of inducing a contracted party to try hard or not to shirk. In the principal/agent literature (see ALCHIAN and DEMSETZ [1972], ROSS [1973], JENSEN and MECKLING [1976], PRATT and ZECKHAUSER [1985]), this is the problem of providing agents an incentive to act in the interest of the principal. In the insurance literature (ARROW [1963], PAULY [1974]), this is the problem of moral hazard or inducing the insured not to avoid costly precaution (not to shirk) against the insured event. The second problem is the holdup problem whereby a contracted party attempts to appropriate (by seeking more favorable terms) the other party's contractual quasirents that flow from contract specific investments (KLEIN, CRAWFORD and ALCHIAN [1978]).

In this paper we develop models to analyze the two methods of mitigating default on loans. Within our debtor/creditor models, the first of the above problems does not arise since there is no moral hazard or scope for shirking. An extension that allows the probability of the "bad" state of debtor wealth to depend on debtor behavior would introduce this problem into the model. We comment on this possibility in the final section of the paper.

The second problem (holdup) does exist in our model and, indeed, is the focus. Once a loan is made, the services of that loan are specialized to the debtor. They cannot be stopped. The entire loan value is an asset of the lender that has become specialized to the debtor. Consequently, it is subject to appropriation by the debtor. The repayment services of the debtor may be stopped and so are not subject to appropriation by the lender. Only the lender has an appropriable quasirent and it is the entire loan value. Default or breach by the debtor is a holdup that appropriates the lender's entire quasirent.

An important and, we think, novel feature of our models is the division of borrower wealth into two categories corresponding to property exempt under bankruptcy law and that which is not. It is important in any study of default on debt to recognize that the law of bankruptcy provides protection for debtors. Virtually all personal bankruptcies in the United States are voluntary because of the attractive features of the 1978 Bankruptcy Reform Act. A resident of California, for example, can keep up to \$40,000 equity in a residence, \$500 interest in an automobile, \$2500 in professional tools and books, \$1000 deposited in savings and loans, \$1500 in a credit union, all necessary household items, life and health insurance, and all retirement and unemployment benefits. Anyone can go bankrupt. Approval by the creditors is not required. Once the bankruptcy petition is filed, efforts to collect debts must stop including wage garnishment and harassing dunning letters. As a result, over 2 million personal bankruptcies have occurred in the U.S. in the last decade. It is important to consider default on loans in the shadow of bankruptcy law.

The law provides a remedy to unsecured creditors, making available some (seizable) assets of the debtor upon default. The value of these assets reduces the appropriable quasi-rents of the lender. If these seizable assets equal or exceed the value of debt repayment, appropriable quasi-rents are eliminated and the debtor has no incentive to holdup the lender (default). This provides the basis for our analysis of the unsecured equilibrium. In addition to reliance on this legal remedy of bankruptcy law, other methods to avoid the holdup problem are available to the contracting parties. Vertical integration (KLEIN, CRAWFORD and ALCHIAN [1978]) and loss of repeat business (TELSER [1980], KLEIN and LEFFLER [1981]) are two. Adapting the form of the contract is a third (see, for example, KNOEBER [1983]). Since our concern is with debt contracts in a single period setting, the first two methods do not enter our model. The third does, in two ways. We first consider a bonding arrangement whereby the debtor posts collateral that is transferred to the lender (along with seizable assets) if default occurs. The model differs from others by considering collateral as an endogenous variable determined by the debtor as part of his maximization problem. We then consider a penalty whereby the lender destroys some of the debtor's exempt assets (and takes the seizable assets) if default occurs. The second approach is akin to the loss of repeat business in the multiperiod setting since in both cases a valuable asset is destroyed (rather than transferred) if a holdup occurs.

We begin the paper with a simple model of competitive loan markets. The model considers the possibility that unsecured loans may be breached when the borrower has the bad luck to experience a major loss in wealth. Since the equilibrium size of loans is reduced because of this potential for default, the creation of secured debt (collateral) is studied. The amount of collateral is an endogenous variable. Following this, we consider penalty as an alternative to secured debt. Here, the creditor penalizes the defaulting borrower by destroying some of the borrower's assets (including human capital, credit rating, or goodwill). We conclude with some remarks about the relative desirability and incidence of the two methods of inducing payment.

1. Unsecured Loan Contracts

Assume the debtor's portofolio of assets is divided into two components: exempt assets, E, and assets that may be seized upon default, S. For simplicity, E will be treated as though it has certain value; on the other hand, non-exempt assets have uncertain value. The random variable S takes on one of two values, 0 and s, with probabilities p and $1 - p$ respectively and it is assumed that the debtor and creditor hold identical beliefs about the stochastic elements of the debtor's wealth. The debtor takes out a loan with a debt D that requires a repayment of principal and interest in the amount DR, where $R = 1 + r$ is an interest rate factor.

Under what conditions will the debt be repaid? For now assume the debtor plans to repay when $S = s$ and to breach when $S = 0$. Let $V(D)$ be the dollar value of the benefits the debtor receives from the debt, where marginal value is positive but diminishing: $V'(D) = MV(D) > 0$ and $V''(D) < 0$. For the debtor, expected monetary value equals

$$EV = (1 - p)(V(D) - DR + E + s) + p(V(D) + E). \quad (1)$$

Now consider the creditor's problem. The debt will not be repaid if $S = 0$ and the seizable assets have no value. The creditor also knows that there is no way

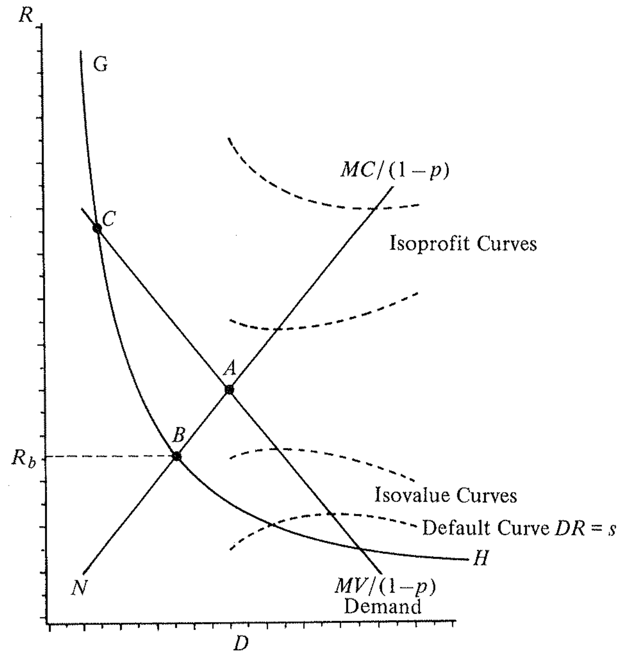

Figure 1

to attach exempt assets, so if DR exceeds the larger value of S, default may occur. We assume the creditor skeptically plans to prevent this default by limiting debt: $DR \leqq s$. Note that this assumption makes the debtor's strategy of paying off the debt except when bad luck occurs an optimal strategy. Let $CF(D)$ be the creditor's cost of funds to supply loan D to the debtor, where marginal costs are positive and increasing: $CF'(D) = MC > 0$ and $CF''(D) > 0$. For a given interest rate R the lender expects to earn a profit equal to

$$E\pi = (1 - p)(DR - CF(D)) + p(0 - CF(D)). \tag{2}$$

The creditor supplies loans, D, to maximize $E\pi$ subject to the restriction $DR \leqq s$.

Short-run competitive equilibrium is illustrated in Figure 1. The demand curve specifies the borrowing that maximizes the debtor's expected value for given interest rates. The $MC/(1 - p)$ curve shows the loans that maximize the unconstrained profit of the creditor for each interest rate. The default curve is the locus of contracts such that $DR = s$. The creditor expects that any contract (D, R) above this rectangular hyperbola will be breached even when $S = s$;

points below this curve will be performed. Given the need to motivate repayment of the loan, the supply curve of the competitive creditor is the two-segment curve *NBCG*. For interest rates above the level R_b, the default constraint $DR \leqq s$ is binding and the realistic choice that maximizes profit lies along the default curve.

What is the equilibrium in this loan market? The unconstrained equilibrium *A* in Figure 1 will not occur because the creditor knows that the required debt payment *DR* exceeds the value of seizable assets and default is possible. More realistically, the equilibrium contract will be at point *C* where the creditor expects to be repaid in the best situation $S = s$.[1] We can draw the following conclusions about the relationship between the realistic unsecured equilibirum *C* and the unconstrained equilibrium *A*.

Theorem 1: a. The realistic unsecured equilibrium has a higher interest rate and smaller debt than the unconstrained equilibrium.
b. The debtor is worse off in the realistic unsecured equilibrium than in the unconstrained equilibrium.
c. The lender may or may not be worse off in the realistic unsecured equilibrium than in the unconstrained equilibrium.
d. The realistic unsecured equilibrium is less efficient than the unconstrained equilibrium.

The first point follows from the downward sloping demand for loans. Point (b) is a simple application of the envelope theorem. Point (c) results because the rise in interest rate and fall in cost of funds might more than offset the reduced size of the loan. Finally, the mistrust implicit in the default condition reduces the volume of lending and wealth, $EV + E\pi$.[2]

The debtor's assets are divided between property exempt from attachment by the bankruptcy court and property that can be costlessly seized by creditors when default occurs. Suppose the bankruptcy law changes so that some exempt

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[1] If the amount of seizable assets is large, then the default curve of Figure 1 will be so far from the origin that the unconstrained equilibrium is realistic (points *A* and *C* coincide). We will consider only the case in which there is a difference.

[2] If the debtor also recognizes the default constraint, then he maximizes (1) subject to $DR \leqq S = s$ and the demand curve in Figure 1 coincides with the default curve below point *C*. As a consequence, the supply and demand curves overlap between *C* and *B* allowing many possible equilibria. In particular, should the debtor be able to pick a point on the lender's supply curve, point *B* would be chosen. This is the equilibrium analyzed by BENJAMIN [1978] and by EATON [1985]. We, too, have analyzed this equilibrium but do not include the results here. The implications for Theorem 1 are obvious. The implications for Theorem 2 below are less obvious. Result 2a is still true; 2b is reversed; 2c, d, e become -- the creditor is always better off and the debtor is better (worse) off, as $(1 - p)$ is greater (less) than $(MC/MV)(1 + 1/\varepsilon_R^D)$, where ε_R^D is the supply elasticity of loans.

assets become seizable. The adjusted portfolio is

(3) $$E - \Delta \quad \text{and} \quad S = \begin{cases} \Delta & \text{with probability } p \\ s + \Delta & \text{with probability } 1 - p . \end{cases}$$

The new (smaller) bankruptcy exemptions appear to favor the creditor and to provide less protection of the debtor's wealth when bad fortune strikes. Will this marginal change always increase the creditor's expected profit and diminish the debtor's expected value?

The equilibrium loan and interest rate will be characterized by the marginal condition for value maximization and the default constraint:

(4) $$MV(D) = (1 - p)R$$

and

(5) $$DR = s + \Delta .$$

The effect of this decrease in bankruptcy exemptions on the debtor and creditor can be expressed as

(6) $$EV = V(D) + E - \Delta - (1 - p)(DR - s - \Delta)$$

and

(7) $$E\pi = (1 - p)DR + p\Delta - \mathrm{CF}(D) .$$

These four equations (4)–(7) determine the four variables D, R, EV, $E\pi$, and permit an analysis of the effect of a change in Δ.

Standard comparative static analysis of demand leads to

(8) $$\frac{\partial D}{\partial \Delta} = \frac{1}{R} \frac{\eta_R^D}{1 + \eta_R^D} .$$

The demand elasticity η_R^D must exceed 1 in magnitude for the following reason. Since the default curve is a rectangular hyperbola, it has an elasticity of 1 in magnitude and the demand curve cuts through the default curve from above the equilibrium. If the equilibrium is stable, a decrease in the proportion of the assets that are exempt must increase the equilibrium size of loan. Since marginal value of the loan diminishes, the equilibrium interest rate will be smaller.

To see how reducing exempt assets and increasing seizable assets influences the expected value of the debtor, differentiate EV with respect to Δ to get

(9) $$\frac{\partial EV}{\partial \Delta} = MV(D) \frac{\partial D}{\partial \Delta} - 1 = (1 - p) \frac{\eta_R^D}{1 + \eta_R^D} - 1 .$$

There are two forces influencing the debtor when assets are moved out of the exempt category to the seizable category: the interest rate decreases and the value of assets lost upon default increases. Since these two factors affect expected value in opposite ways, the sign of the response $\partial EV/\partial \Delta$ is indeterminate and depends on the probability of default and the elasticity of demand for loans:

$$(10) \qquad \partial EV/\partial \Delta > 0 \quad \text{if and only if} \quad p \cdot |\eta_R^D| < 1 .$$

That is, if the probability of default or the elasticity of demand for loans is small, a reduction in bankruptcy exemptions increases the expected value of the debtor. This makes sense. If default is not likely, putting more wealth in a vulnerable position has little expected cost to the debtor. When the elasticity of demand for loans is small, an outward shift in the default curve will cause the equilibrium interest rate to fall dramatically.

To see how an increase in seizable assets influences the expected profit of the lender, differentiate $E\pi$ with respect to Δ to get

$$(11) \qquad \frac{\partial E\pi}{\partial \Delta} = 1 - MC\frac{\partial D}{\partial \Delta} = 1 - (1-p)\frac{MC}{MV}\frac{\eta_R^D}{1+\eta_R^D}.$$

Again, the sign of the response is indeterminate because two opposing forces are at work: a decrease in exempt assets drives the interest rate down but increases the payment upon default (since $S + \Delta$ is now always positive, we have introduced security).

To see the effect of exemptions on total welfare, add (9) and (11) to get

$$(12) \qquad \frac{\partial EV + E\pi}{\partial \Delta} = (1-p)\frac{\eta_R^D}{1+\eta_R^D}\left(1 - \frac{MC}{MV}\right).$$

Stability of the realistic equilibrium implies the second term on the right-hand side is positive and because the equilibrium occurs to the left of the $MC/(1-p)$ curve, the third term must be positive. Since the probability of repayment is positive, this implies that an increase in seizable assets will decrease the inefficiency of the realistic equilibrium.

Theorem 2: Suppose the bankruptcy law changes so that Δ exempt assets become seizable assets:

a. The economy is more efficient since larger loans are made.
b. The equilibrium interest rate on loans drops.
c. If probability of repayment is in the range where

$$1 - p > (MV/MC)(1 + 1/\eta_R^D),$$

the debtor is better off and the creditor is worse off.

d. If the probability of repayment is in the range where

$$(1 + 1/\eta_R^D) < 1 - p < (MV/MC)(1 + 1/\eta_R^D),$$

the debtor and creditor are better off.

e. If the probability of repayment is in the range where

$$1 - p < (1 + 1/\eta_R^D),$$

2. Security

The amount of seizable assets can be controlled directly by the debtor by pledging some of the exempt assets as collateral. How much collateral will the debtor use to secure debts? To address this question, suppose the debtor chooses not only the amount D to borrow at a given interest rate, but the amount of exempt assets C to pledge as collateral. Following the above notation, $S + C$ is the total security and $E - C$ is the remaining exempt assets. We will assume that the increase in collateral is achieved without cost. Also, assume the debtor knows that the lender worries about default and therefore always plans to match a demand D for loans with an increase in security C so that $s + C \geqq DR$.[3] The debtor maximizes expected value EV subject to this constraint and the constraint that C cannot exceed E:

$$\text{(13)} \qquad \underset{D,\, C}{\text{Maximize}} \quad EV = V(D) + E - C - (1 - p)(DR - s - C)$$

$$\text{(14)} \qquad \text{subject to} \quad DR \leqq s + C,$$

$$\text{(15)} \qquad \text{and} \quad 0 \leqq C \leqq E.$$

The constraint set is illustrated in Figure 2 along with isovalue curves that describe combinations of D and C that hold EV constant. As the interest rate

[3] As suggested in footnote 2, this assumption introduces the possibility of multiple equilibria. We continue to assume that where supply and demand curves for loans overlap, the lender's most preferred outcome (point C in Figure 1) occurs. For our analysis of an interior choice of collateral ($E > C > 0$), this is irrevelant, as a unique equilibrium occurs.

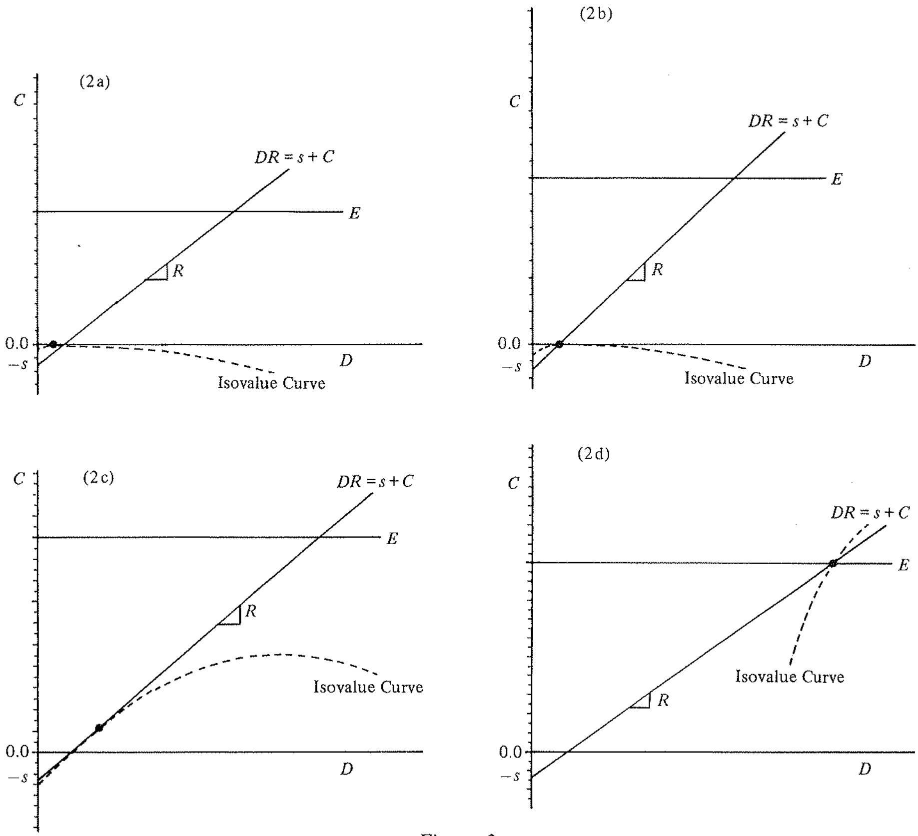

Figure 2

increases, the constraint line $DR = s + C$ becomes steeper and the peak of the isovalue curves (where $MV(D) = (1-p)R$) moves to the left.

Figure 2 shows the four different solutions that may occur. In Figure 2a, the interest rate is so large and the corresponding demand for loans so small that the default constraint is slack. In Figure 2b the default constraint is binding, but the debtor does not want to increase the collateral. In Figure 2c there is an interior solution in which some but not all of the exempt assets are pledged as collateral and the default constraint is binding. In this case by substitution from (14) into (13), the demand for debt D is determined to

$$\text{(16)} \qquad \underset{D}{\text{maximize}} \quad EV = V(D) - DR + E + s\,.$$

Since the default constraint is binding, the debtor receives the same value whether S takes its high value (payment equals the dollar value of all non-exempt assets $s + C$) or S takes a zero value (payment equals the dollar value of all non-exempt assets $0 + C$). In either case, only the remaining exempt assets $E - C$ belong to the debtor. As a consequence, p does not enter (16). First order conditions for the solution D^*, C^* of the debtor's problem corresponding to Figure 2c, are

$$MV(D^*) = R, \tag{17}$$

$$C^* = D^*R - s. \tag{18}$$

Finally, in Figure 2d the debtor has pledged all available assets as collateral and borrowed as much as the default constraint allows.

In Figure 3, the debtor's demand for loans is the curve labeled $ABCDE$. The segment AB, corresponding to Figure 2a, is the graph of $MV(D) = (1 - p)R$, while the segment BC (see Figure 2b) is the default constraint $DR = s$. In both of these segments the debtor chooses not to supplement the seizable assets by transforming exempt assets into collateral. The segment CD of the curve $MV(D) = R$ (see Figure 2c) corresponds to interest rates low enough that the debtor wants to expand borrowing and must pledge collateral C. Finally, along the segment DE the debtor has pledged all exempt assets as collateral on the loan D (see Figure 2d). Again, the creditor maximizes profit subject to the default constraint, so the supply of loans is the two-segment curve determined by $MC/(1 - p)$ and $DR = s + C$ (see Figure 1).

When the amount of collateral is determined by the debtor, the equilibrium depends on the relative location of the five curves, $MV/(1 - p)$, MV, $DR = s$, $DR = s + C$, and $MC/(1 - p)$. In Figure 3, the supply curve cuts through the demand curve in the segment CD where the debtor supplements seizable assets by transforming some exempt assets C into collateral. We will call the contract F the *secured equilibrium*. Had the marginal cost of funds been larger, the equilibrium might have been somewhere along the segment ABC, where the debtor chooses to stand pat with the original amount of seizable assets and no secured debt.

The secured equilibrium is characterized by the marginal conditions (17) and (18) and

$$MC(D) = (1 - p)R. \tag{19}$$

The welfare of the debtor and creditor is expressed as in (1) and (2). The notation D^*, C^*, R^*, EV^*, $E\pi^*$ refers to the secured equilibrium.

Compare the equilibrium with and without collateral. If the debtor had insisted on $C = 0$, the equilibrium would have been at the realistic unsecured equilibrium B, as discussed above. The secured equilibrium interest rate is lower

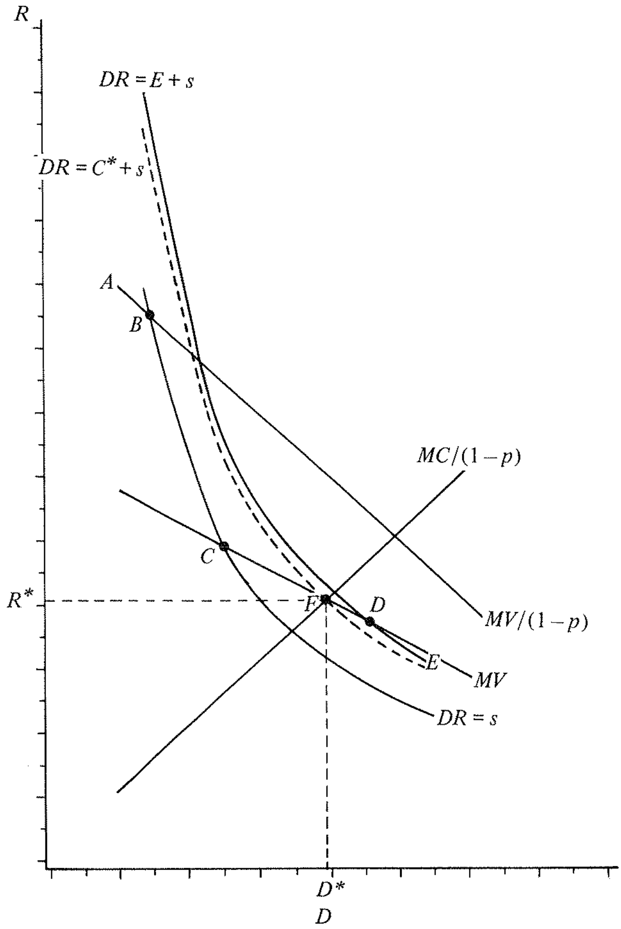

Figure 3

than that at the realistic unsecured equilibrium. Expected value for the debtor is larger in the secured equilibrium if

$$EV^* = V(D^*) + E - C^* - (1-p)(D^*R^* - s - C^*) > EV \qquad (20)$$
$$= V(D) + E - (1-p)(DR - s).$$

Using the equilibrium conditions, this can be expressed as

$$V(D^*) - C^* > V(D) - 0. \qquad (21)$$

Since D is the optimal choice in the problem (13) – (15) at the higher interest rate R, (D^*, C^*) must give the debtor higher expected utility than $(D, 0)$. The change in expected profit of the creditor is ambiguous. Although the expected revenue rises because $D^*R^* > DR$ and $C > 0$, the increased cost of supplying a larger loan may actually decrease profits.

Compare the total of expected value and expected profit to find

$$(22) \qquad EV^* + E\pi = V(D^*) - CF(D^*) + E + (1-p)s > EV + E\pi$$
$$= V(D) - CF(D) + E + (1-p)s,$$

since $D^* > D$ and $MV(D) - MC(D) > 0$ for all D in this range. We have established the following result.

Theorem 3: Suppose the debtor chooses not only the amount of borrowing but also the amount of collateral to maximize expected value. Then the resulting secured equilibrium has the following characteristics:
(a) The interest rate is lower.
(b) The economy is more efficient.
(c) The debtor is better off.
(d) The creditor may or may not be better off.

SCHWARTZ [1981, 1984] has argued that the Modigliani-Miller irrelevance theorem of finance theory should be applied to the use of security, with the conclusion that since security is costly to set up, collateral is not an efficient institution. We argue, following WHITE [1984], that some assets are not available to repay unsecured creditors but can be made available as security. This might be because the assets are protected by bankruptcy exemptions or because the assets are easy to hide from creditors. Transforming these assets into security on a loan will lower the risk premium on the secured debt but will not correspondingly increase the premium on unsecured debt. As a result, the economy is more efficient with collateral.

Consider again a change in the bankruptcy law that decreases exempt assets. Since the debtor has control over the amount of assets that are vulnerable to collection through the creation of collateral, in the long run a *marginal* increase or decrease in the level of bankruptcy exemptions will have no effect on the size of the loan. If exemptions are diminished, then collateral will be diminished in a matching amount to re-optimize the debtor's loan contract at $C^* + \Delta - dC = C^*$. The marginal change in the bankruptcy law has no impact on the loan size or interest rate but does influence the amount of security pledged.

On the other hand, a *significant* reduction in bankruptcy exemptions may have an effect on the loan size, for the largest compensating reduction in collateral the debtor can make is $dC = -C^*$. This may not provide enough slack to re-establish the level of seizable assets at C^*. A sufficiently large reduction in exempt assets and increase in seizable assets will shift the default curve out so as to increase the demand for loans compatible with the incentive to default. The equilibrium size loan and interest rate will rise.

Theorem 4: Suppose the debtor chooses not only the amount of borrowing but also the amount of collateral to maximize expected value. A marginal decrease in bankruptcy exemptions will have no effect on the size of loans or the interest rate, but a significant decrease in exemptions will
(a) increase interest rates,
(b) increase the size of loans,
(c) increase the efficiency of the economy,
(d) decrease the expected value of the debtor,
(e) increase the expected profit of the lender.

3. *Penalty*

Consider now the use of penalties by lenders to induce performance of debt contracts. Penalties may be in the form of denial of future loans, harassment, publication of the fact that the debtor defaulted, or foreclosure on assets that have no value to the creditor. These penalties bring the lender no resources. In fact they may cost the lender considerable time and money to impose, but since we previously analyzed a model of costless collateral, it will be assumed that the penalty is also costless to impose. The sole objective of the penalty is to make default so distasteful that borrowers will want to repay loans rather than face the penalty.

To model penalties, we assume the penalty entails destruction of some of the borrower's exempt assets. If the debtor defaults on the loan, a fraction k of these assets is destroyed by the lender. Expected value for the debtor is

$$EV = (1-p)(V(D) - DR + s) + p(V(D) + E - kE). \tag{23}$$

Expected profit of the lender equals

$$E\pi = (1-p)(DR - CF(D)) + p(0 - CF(D)). \tag{24}$$

The creditor will again limit the loan, so the borrower repays when assets are large:

$$DR \leqq s + kE. \tag{25}$$

The debtor loses the assets s through seizure by creditors, as well as a fraction of the exempt assets through imposition of the penalty, and this is sufficient to induce performance of the contract when $S = s$. The magnitude of the penalty, k, is controlled by the creditor within legal limits. If the harshest penalty the creditor can impose is κ, then the creditor will choose D and k to maximize $E\pi$ subject to (25) and $0 \leqq k \leqq \kappa$. When the interest rate is very low, the profit-maximizing loan will be so small that default is prevented entirely by the threat of loss of seizable assets. For moderately higher values of the interest rate, the default constraint still does not influence the loan decision of the creditor: as long as the legal limitation on penalties is not binding, the creditor can assure repayment by increasing the size of the penalty. When the interest rate is significantly higher, the debt obligation is so large the creditor cannot increase the penalty to motivate repayment and the default constraint determines the supply of loans.

The penalty equilibrium in Figure 4 is at point C where the demand for loans cuts through the default curve. In this case the unconstrained equilibrium A is not compatible with the need to motivate payment of debt.[4]

The relationship between the penalty equilibrium and the unconstrained equilibrium is identical to the relationship between the realistic unsecured equilibrium and the unconstrained equilibrium. See Theorem 1.

What is the impact of increasing the severity of the maximum legal penalty, κ? The equilibrium levels of D, R, EV, and $E\pi$ are determined by the conditions:

$$MV(D) = (1-p)R, \tag{26}$$

$$DR = s + \kappa E, \tag{27}$$

$$EV = V(D) - (1-p)(DR - E - s) + p(1-\kappa)E, \tag{28}$$

$$E\pi = (1-p)DR - CF(D). \tag{29}$$

Using the same method of analysis as in the previous section, we can derive the following results.

Theorem 5: Suppose that the legal limit to the severity of the penalty κ increases:

(a) Larger loans are made at lower interest rates.

(b) The debtor is better off if

$$p < \frac{1}{|\eta_R^D|}.$$

(c) The creditor is better off if

$$\frac{MC}{MV}\frac{\eta_R^D}{1+\eta_R^D} < 1.$$

[4] Had κ been larger, the default curve would be irrelevant and the unconstrained equilibrium would occur.

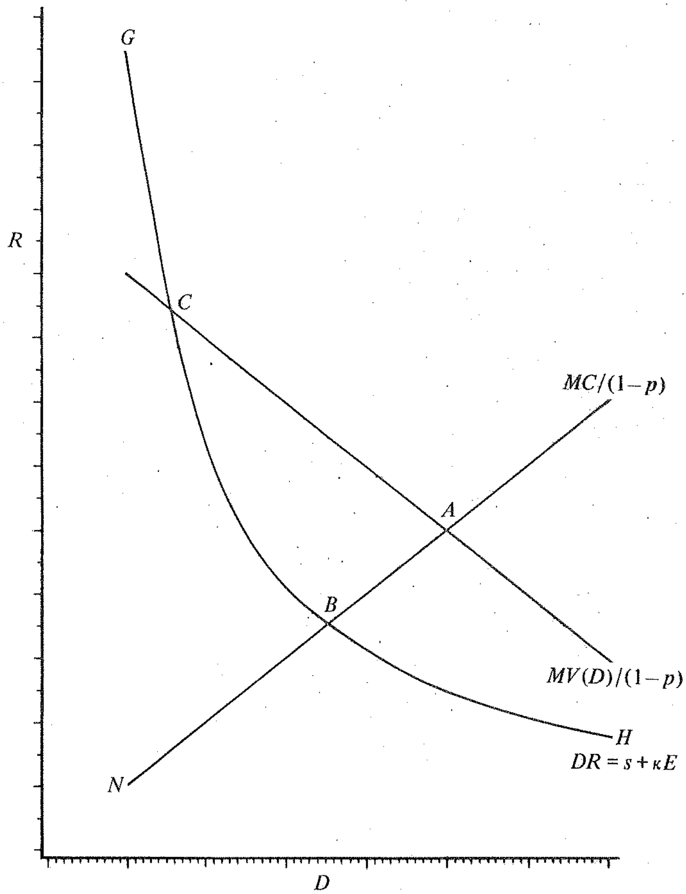

Figure 4

(d) The economy is more efficient if

$$1 - p > \left(1 + (1 - MC/MV)\,\frac{\eta_R^D}{1 + \eta_R^D}\right)^{-1}.$$

The efficiency result is ambiguous because the increased lending creates greater welfare, but the destruction of assets reduces welfare. It is impossible to conclude that the economy is better off with larger penalties.

4. Comparison of Security and Penalty

To conclude, we offer some exploratory thoughts on the relative advantage of security and penalty to enforce debt contracts and the empirical implications of these advantages. These thoughts are framed by the foregoing models but consider a richer setting in which some of the restrictive assumptions do not hold.

In our framework, loans are both loan and insurance. As long as the default constraint is binding, unsecured loans ($DR = s$), collateralized loans ($DR = s + C$) and loans enforced by penalty ($DR = s + kE$), all leave the debtor indifferent as to the realization of S. In each case, the risk initially borne by the debtor is completely shifted to the lender. As an example, recall equation (1), characterizing expected value for an unsecured debtor. If the default constraint is binding, this is reduced to $EV = V(D) + E$. Since the probability of a bad outcome, p, no longer appears, expected value is a certain value. If the default constraint is not binding, a loan still entails insurance but does not completely eliminate risk bearing by the debtor.

In our model, this insurance is of no import, as risk aversion is not considered. Still, since each form of loan provides such insurance, risk aversion considerations would not seem to change the relative attractiveness of unsecured, collateralized, and enforced-by-penalty loans. But they do. Because penalty involves the destruction of assets in the bad luck state (since this is the only state in which default occurs), its use makes a bad state worse or leads to greater risk. With risk averse debtors and creditors, then, loans enforced by penalty will increase in cost relative to those enforced by collateral. For more risk averse debtors, collateral should be more prevalent. An implication is that personal loans will more likely be collateralized than business loans.

Even beyond this, recognizing the insurance aspect is important. Endemic to insurance contracts is the moral hazard problem in which behavior by the insured adjusts (upward) the odds of the insured event occurring. In our model, these odds are exogenous (p is fixed); therefore, moral hazard is not a problem. What if p were subject to control by the lender? By analogy to the insurance literature, this would reduce the amount of insurance provided with loan contracts. Indeed, in the extreme case, no insurance would be provided. For collateralized loans, the size of the debt would be constrained by $DR \leqq C$; and for loans enforced by penalty, the size of the debt would be constrained by $DR \leqq kE$. The loan would not relieve the borrower of any risk-bearing costs and loans would always be repaid, so the lender would not assume any risk-bearing costs. Although this consideration suggests no clear advantage to collateral or to penalty, it does suggest that the less influence debtors have over p, the more insurance will be provided with loans. Evidence may come in the form of greater incidence of default (insurance claims) and large loan values relative to the value of collateral or penalty where p is less subject to control by the debtor.

Eaton [1986] has pointed out another attractive feature of security relative to penalty. Since there may be costs involved in carrying out the plan of taking resources away from a defaulting debtor, the creditor needs to have a reputation for executing the contract. Otherwise the debtor may default on the loan contract with the hope that the debt can be breached without loss. The foreclosure on secured loans transfers wealth into the pocket of the creditor and there is an obvious incentive to attach the collateral upon default. Not so with penalties. Since the creditor gains nothing by imposing the penalty, why should he carry out the threat? The creditor must maintain a reputation for enforcing penalties or be exploited. If the creditor were making a one-shot loan, with no plans for similar loans in the future, the debtor might call the penalty bluff yet believe the threat of foreclosure on collateral. As a result it is likely that individual lenders would require collateral, whereas, infinite-lived financial institutions might resort to penalty. Similarly, when discount rates are high and so the present value of reputation is low, collateral is more likely.

Penalties require destruction of resources rather than transfer of property. If the creditor could independently verify the state of wealth, then a contract could be struck that would eliminate the wasteful imposition of the penalty in the bad state $S = 0$. The contract would specify forgiveness of the debt in this situation, yet the debtor would not be able to fool the creditor by claiming the state was $S = 0$ when it was $S = s$. The lender could still maintain a desired reputation by imposing the penalty whenever the debt was defaulted because of bad faith rather than bad luck. This makes the use of penalties more efficient and attractive when the state is observable. An implication is that imposition of penalties will be more likely when bad luck is easily distinguished from bad performance and that these penalties will not always be imposed upon default. Consider as an example, debts incurred by farmers and debts incurred by individuals to purchase homes. Both types of debt typically are collateralized but farm debt also entails a sizeable enforcement penalty. Much human capital is specific to a farm, little is specific to a house. Foreclosing on a house simply transfers the collateral from borrower to lender. Foreclosing on a farm transfers collateral from borrower to lender but also destroys specific human capital (a penalty). Why is a penalty used in farm loans but not house loans? One reason may be that bad luck is easier to recognize than bad performance in the former case than in the latter. If this is true, it should also follow that farm loans are more likely to be forgiven (or extended) in hard times (bad luck) than house loans. Casual observation suggests this is the case.

Finally, collateral is useful because it supplements the seizable assets used to guarantee good faith on unsecured debts. If the debtor has few exempt assets, then there is little reason for secured debt. Greater reliance on penalty is expected for debtors who have few assets that fall in the exempt category. Greater use of penalties ought to be observed on loans to businesses, which are not protected by the personal exemptions of bankruptcy laws and greater use of collateral should be observed for loans to individuals.

References

ALCHIAN, A. A. and DEMSETZ, H. [1972], "Production, Information Costs and Economic Organization", *American Economic Review,* 62, 777–95.

ARROW, K. J. [1963], "Uncertainty and the Welfare Economics of Medical Care", *American Economic Review,* 53, 941–989.

BARRO, R. J. [1976], "The Loan Market, Collateral, and Rates of Interest", *Journal of Money, Credit and Banking,* 8, 439–56.

BENJAMIN, D. K. [1978], "The Use of Collateral to Enforce Debt Contracts", *Economic Inquiry,* 16, 333–359.

DRUKARCZYK, J. [1984], "Credit Contracts, Collateral-Based Security Agreements and Bankruptcy", pp. 139–159, in: G. Bamberg und K. Spremann (eds.), *Risk and Capital,* Berlin.

EATON, J. [1985], "Lending with Costly Enforcement of Repayment and Potential Fraud", *Journal of Banking and Finance,* 10, 281–293.

HESS, J. D. [1984], "The Use of Collateral to Enforce Debt: Profit Maximization", *Economic Inquiry,* 24, 349–356.

JACKSON, T. H. and KRONMAN, A. T. [1979], "Secured Financing and Priorities among Creditors", *Yale Law Review,* 88, 1143–1158.

JENSEN, M. C. and MECKLING, W. [1976], "Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure", *Journal of Financial Economics,* 3, 304–360.

KLEIN, B. and LEFFLER, K. [1981], "The Role of Market Forces in Assuring Contractual Performance", *Journal of Political Economy,* 89, 615–641.

KLEIN, B., CRAWFORD, R. G., and ALCHIAN, A. A. [1978], "Vertical Integration, Appropriable Rents, and the Competitive Contracting Process", *Journal of Law and Economics,* 21, 297–326.

KNOEBER, C. R. [1983], "An Alternative Mechanism to Assure Contractual Reliability", *Journal of Legal Studies,* 12, 333–343.

KORNHAUSER, L. A. [1983], "Reliance, Reputation, and Breach of Contract", *Journal of Law and Economics,* 26, 691–706.

LEVMORE, S. [1982], "Monitors and Freeriders in Commercial and Corporate Settings", *Yale Law Review,* 92, 49–82.

PAULY, M. V. [1974], "Overinsurance and Public Provision of Insurance: The Roles of Moral Hazard and Adverse Selection", *Quarterly Journal of Economics,* 88, 44–54.

POLINSKY, M. [1983], "Risk Sharing through Breach of Contract Remedies", *Journal of Legal Studies,* 12, 427–444.

PRATT, J. and ZECKHAUSER, R. (Eds.) [1985], *Principals and Agents: The Structure of Business,* Boston.

REA, S. A. [1984], "Arm-Breaking, Consumer Credit and Personal Bankruptcy", *Economic Inquiry,* 22, 188–208.

ROSS, S. A. [1973], "The Economic Theory of Agency: The Principal's Problem", *American Economic Review,* 63, 134–139.

SCHWARTZ, A. [1981], "Security Interests and Bankruptcy Priorities: A Review of Current Theories", *Journal of Legal Studies,* 10, 1–37.

-- [1984], "The Continuing Puzzle of Secured Debt", *Vanderbilt Law Review,* 37, 1051–1069.

SHAVELL, S. [1980], "Damage Measures for Breach of Contract", *Bell Journal of Economics,* 11, 466–490.

SMITH, C. W. and WARNER, J. B. [1979], "Bankruptcy, Secured Debt, and Optimal Capital Structure: Comment", *Journal of Finance,* 34, 247–251.

TELSER, L. G. [1980], "A Theory of Self-Enforcing Agreements", *Journal of Business,* 53, 27–44.

White, J. [1984], "Efficiency Justification for Personal Property Security", *Vanderbilt Law Review,* 37, 473–508.
Williamson, O. [1983], "Credible Commitments: Using Hostages to Support Exchange", *American Economic Review,* 73, 519–540.

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Security and Penalty in Debt Contracts

Comment

by

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Most prior research on efficient financial transactions has focused on systematic and unsystematic financial risk and the required return to equity capital. James Hess and Charles Knoeber present a model synthesizing the new efficient contracts literature on *default* risk and the required return to *debt* capital. Their particular focus is the role of collateralized "security assets" and private market penalties in discouraging the breach of loan contracts. Insights from the literature on self-enforcing implicit contracts (e.g., KLEIN, CRAWFORD, and ALCHIAN [1978], TESLER [1980], KLEIN and LEFFLER [1981])[1] motivate this contribution on *explicit* debt contracts.

In my mind, the Hess and Knoeber paper raises three questions. First, do security assets and/or penalties motivate the performance of debt contracts making such contracts self-enforcing? Second, can security assets and penalties mitigate a loan default sufficiently to raise the equilibrium size of loans, ceteris paribus? And third, would legislated limitations on the security requirements a lender may impose simply increase the penalties without altering the equilibrium size of loans? Hess and Knoeber's analysis of these questions is distinctive from the previous literature in that (a) it accounts explicitly for the bankruptcy law rendering certain "exempt assets" invulnerable to seizure by creditors, and (b) it makes the size of loans (and thus, the unit cost of debt) endogenous.

Taking the last question first, Hess and Knoeber find penalties and security assets are not perfect substitutes. Damaging credit reports and even credit terminations are not "credible threats" because once loan default has occurred, the creditor has nothing to gain monetarily by imposing the penalty. And furthermore the imposition entails expense. Consequently, penalties cannot entirely replace the credible threat of seizure in discouraging loan defaults. This is especially true when repeated transactions are unlikely, discount rates are high, and when debtors have relatively many assets that are rendered exempt from seizure by the bankruptcy law (e.g., personal debtors versus business debtors).

[1] Cited in HESS and KNOEBER [1987].