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Collateral versus project screening: a model of lazy banks

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Many economists argue that the primary economic function of banks is to provide cheap credit, and to facilitate this function, they advocate the strict protection of creditor rights. But banks can serve another important economic function: by screening projects they can reduce the number of project failures and thus mitigate their private and social costs. In this article we show that because of market imperfections in the banking industry, strong creditor protection may lead to market equilibria in which cheap credit is inappropriately emphasized over project screening. Restrictions on collateral requirements and the protection of debtors in bankruptcy may redress this imbalance and increase credit-market efficiency.

1. Introduction

■ What is the role of collateral in lending? A recent strand of economic literature argues that it is central to the relationship between lenders and borrowers, to the point that credit would not be extended in the absence of the right to repossess collateral:

[C]reditors are paid because they have the right to repossess collateral. Without these rights, investors would not be able to get paid, and therefore firms would not have the benefit of raising funds from these investors. (La Porta et al., 1998, p. 1114.)

This view of collateral derives from the idea that moral hazard is the main problem in financial relationships, especially with regard to the behavior of borrowers. Borrowers may have

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the incentive to use the money borrowed unproductively, say, to finance their own consumption, or simply to hide the proceeds of the project from their creditors and default on their promise to repay (strategic default). The right to repossess collateral gives lenders an essential threat to ensure that borrowers will not behave in this way. This disciplinary role of collateral is central to the whole theory of incomplete financial contracts developed by Aghion and Bolton (1992), Hart (1995), and others.

An immediate implication of this view is that the stronger the protection creditors obtain via collateral, the more abundant and cheaper credit will be for entrepreneurs and households. Some evidence points in this direction. La Porta et al. (1997) use empirical measures of the protection of creditor rights (among which is the right to repossess collateral) to explain the cross-country variation in the availability of external financing to the private sector. They find that countries with more tenuous protection of creditor rights (especially French civil law countries) have more narrow debt markets than do other countries.[1]

Even within the U.S. legal system, interstate differences in the laws governing the right to repossess collateral appear to affect the terms at which credit is available. Alston (1984) reports that the farm foreclosure moratorium legislation during the 1930s led to both fewer farm loans and higher interest rates in states that enacted this legislation. Gropp, Scholz, and White (1997) analyze how cross-state differences in U.S. personal bankruptcy rules affect the supply and demand for household credit, using data from the 1983 Survey of Consumer Finances. They find that generous state-level bankruptcy exemptions reduce the amount of credit available to low-asset households (controlling for their observable characteristics) and increase their interest rates on automobile loans. Berkowitz and White (2000) estimate that small firms are 25% more likely to be denied credit if they are located in states with unlimited rather than low homestead bankruptcy exemptions.

Based on this literature, one may be tempted to conclude that the best thing that legislators can do for the development and efficiency of the credit market is to grant a steely protection to the creditor right to repossess collateral and eliminate bankruptcy exemptions (or reduce them to a minimum). In this article we argue that this conclusion is unwarranted. This conventional view of creditor rights neglects a number of reasons why lenders' unrestricted reliance on collateral might have a negative impact on credit-market efficiency. We discuss several such reasons in this article, but specifically we focus on a very important one: a bank may be in a good position to evaluate the profitability of a planned investment project, and a high level of collateral will weaken the bank's incentive to do so.

Banks and other financial institutions[2] that fund large numbers of investment projects in a specific sector of the economy are well placed to appraise the potential performance of those projects. Unlike individual entrepreneurs, they may have considerable experience with similar projects undertaken by a range of businesses, and they may be more familiar with the economic features of their locality as well as general economic trends. As a result, banks are likely to be more knowledgeable about some aspects of project quality than are many of the entrepreneurs they lend to, a point that is not new to the literature (see Garmaise (2001) and the studies quoted there).[3] This view is consistent with the evidence that bank-financed firms have higher survival rates than firms funded by family investors (Reid, 1991), while entrepreneurs often overestimate

[1] Rajan and Zingales (1995) find, however, that among the G-7 countries, those with the toughest bankruptcy codes are also the ones where firms have the least debt.

[2] As we explain below, in the context of this article only the collateralized portion of a financial contract must be interpreted as debt. The remainder may be interpreted as either debt or equity. Consequently, the reader is free to think of the financial institution as something other than a traditional bank. Indeed, in many countries, including the United States, banks now have increased freedom to take equity positions in firms that they finance.

[3] Economists of a certain stripe seem to have difficulty accepting this obvious point. For example, an anonymous referee of a previous version of this article wrote: "The idea that a bank has a better idea of the success of a project than the entrepreneur who dreamed up the project seems so off that I find the rest of the paper uninteresting." An anonymous colleague of ours has a similar point of view. "The idea that a referee is more able to evaluate the quality of a paper than the economist who wrote it," he says, "seems so off that I find the contents of their reports completely uninteresting."

the profitability of their own projects (Cooper, Woo, and Dunkelberg, 1988), generally earning much less than they could obtain in paid employment (Hamilton, 2000). This is why banks are, and ought to be, in the project-evaluation business.

Of course, in markets with perfectly competitive banks and complete contracts, banks would offer to screen projects as a service to entrepreneurs, who would then bear the cost of screening. However, if the screening services of banks cannot be enforced by contract, banks that are highly protected by collateral may perform too little screening of the projects that they finance. Clearly, collateral and screening are substitutes from the point of view of banks.[4] Yet they are not equivalent from the social standpoint. Because of their superior expertise in project evaluation, the screening activity of banks is a value-enhancing activity for society, whereas the posting of collateral is not, since it merely allows a transfer of wealth from the borrower to the bank when things go badly.

This implies that there is an economic-efficiency case in favor of collateral limitations, including bankruptcy exemptions and the "fresh-start" provisions of some bankruptcy codes, which require the discharge of all debts remaining at the conclusion of bankruptcy proceedings. The empirical findings that large bankruptcy exemptions are correlated with denials of credit should not be taken to imply that such denials are inefficient. Indeed, the opposite may well be true: by denying credit, banks may be helping borrowers avoid unwise investments. This is not a novel insight—it was stressed years ago by one of the most authoritative experts on bankruptcy law:

> Discharge . . . heightens creditors incentives to monitor: by providing for a right of discharge, society enlists creditors in the effort to oversee the individual's credit decisions. (Jackson, 1986, p. 249.)

The complaint that banks do too little screening and tend to rely excessively on collateral may be particularly relevant for small business. In the United States, approximately 40% of the small business loans and almost 60% of their value are guaranteed and/or secured with personal assets: see Ang, Lyn, and Tyler (1995) and Avery, Bostic, and Samolyk (1998). Collateral requirements are even larger for small businesses in developing countries and in backward regions of developed economies. For instance, Harhoff and Korting (1998) report that small firms from the former East Germany tend to pledge collateral more often than their counterparts in the former West Germany.

In this article we develop a very simple model of competitive banking that highlights the point we wish to make. In our model, investment projects may differ in quality. Banks, and only banks, have the expertise to determine project quality, which they can accomplish by engaging in a costly screening process. In Section 2 we show that, given certain types of imperfect information, some entrepreneurs and banks might voluntarily choose loan contracts that specify a high level of posted collateral and leave banks without an incentive to screen projects, even though project screening would be efficient. Interestingly, in Section 3 we find that the inefficiency arising from the banks' lazy attitude toward screening disappears as we move from a competitive to a monopolistic banking model. Because the monopolistic bank can extract all surplus from entrepreneurs, it internalizes the problem of choosing the level of screening activity that maximizes total social surplus, and it screens efficiently. This suggests that in highly competitive credit markets, limiting creditor rights to repossess collateral may be of special importance.

Section 4 discusses the empirical implications of the model. Section 5 places the argument made in this article into the context of the literature on the role of collateral and in the wider debate on the role and limits of creditor protection in bankruptcy procedures. On the whole, the literature highlights both the need to use collateral to correct moral hazard problems in credit relationships and a number of reasons to avoid excessive reliance on collateral. We do not dispute the important role that collateral plays in preventing moral hazard by borrowers. In this article, though, we focus on countervailing efficiency considerations, and therefore we do not model borrowers' moral hazard.

In Section 6 we summarize the article and conclude.

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[4] This is consistent with the fact that banks require less collateral from firms with which they have a stable relationship, and therefore for which screening has been more accurate: see the evidence by Berger and Udell (1995) for the United States and by Harhoff and Korting (1998) for Germany.

2. The competitive model

■ In this section we illustrate how the unrestricted availability of collateral may lead to an inefficient outcome in a competitive credit market. Throughout the article our efficiency criterion will be utilitarian: the constrained maximization of social surplus.

□ **The benchmark case with efficiency.** To help the reader grasp the intuition of the model, we begin with a simpler example in which credit markets are efficient. Suppose projects come in two qualities, good (positive expected present value) or bad (negative expected present value). All entrepreneurs are identical, and each one selects a project at random. Entrepreneurs know the probability of choosing a good project, but they cannot observe actual project quality directly.[5]

Entrepreneurs cannot finance their own projects; they must obtain loans from banks. Banks can discover the quality of a project by screening it at a cost. The act of screening is assumed to be unobservable and noncontractible, so that banks are not able to sell screening to entrepreneurs as a service. Nor can banks require loan applicants to pay for screening when their applications are denied, because in that situation banks would have an incentive to deny loan applications without screening and thus accrue revenue costlessly. Therefore, banks will screen a project as part of a loan-approval procedure only when the direct benefit to the bank of the information obtained exceeds the screening cost. Entrepreneurs whose loan applications are approved will have to pay not only their own screening costs, but also a prorated share of the screening costs of those applicants whose loans are denied.

A bank would never have an incentive to screen a project when a borrower posts full collateral, because then the bank would be fully protected from the consequences of default. If a bank does screen, then it will be in the bank's interest to finance a project only when the project turns out to be a good one; otherwise the screening costs would have been wasted.

Suppose, now, that screening costs are sufficiently small that screening entrepreneurs' projects is socially efficient. This implies that among loan contracts that earn zero profits for the bank, an entrepreneur would choose a contract with collateral sufficiently small so as to induce the bank to screen. In equilibrium, banks would screen all projects, fund only the entrepreneurs with good projects, and charge an interest rate equal to the cost of funds plus the screening cost for the individual applicant plus the screening costs of all unapproved applicants prorated over all approved loans. The competitive equilibrium would be efficient despite the noncontractibility of screening by banks.

□ **The effect of adverse selection.** We now argue that with an additional dimension of imperfect information, a competitive credit market may turn out to be inefficient. Consider the above scenario but now with two types of loan applicants: a high-type applicant with a high probability of selecting a good project, and a low-type applicant with a lower probability of selecting a good project. Suppose that applicants can observe their own type, but banks cannot observe applicant types. In any competitive pooling equilibrium in which all projects are screened, only applicants with good projects will have their loan applications approved, so no entrepreneurs of either type will default. However, high-type entrepreneurs will have to pay a prorated share of the screening costs for unapproved loans not only of high-type applicants but of low-type applicants as well, and the latter costs will be higher, since low types are more likely to have bad projects. This means that high types would have something to gain by separating from low types. Thus, high-type entrepreneurs might choose contracts that require the posting of collateral so as to remove the incentive of banks to screen, with the knowledge that low types would be less attracted to such contracts because of their higher probability of default.

In the model that follows, we will show that for a region of the parameter space, the unique competitive equilibrium is a separating equilibrium in which high-type entrepreneurs post collateral and are not screened. In this equilibrium, the high types forgo the protection from bad projects

[5] In the real world, of course, entrepreneurs do have some information about the quality of their projects. In this model, we assume that only banks can uncover such information, because we want to focus on the social value of their screening function.

provided by the banks' screening, in order to avoid subsidizing the screening costs of low-type entrepreneurs. By doing so, they trade away a socially valuable service in return for a transfer that has no effect on the welfare of society as a whole. Thus, in this region, the competitive equilibrium leads to a loss of social surplus. In the context of our model, the imposition of collateral limitations on banks would restore this lost surplus and yield an efficient outcome.

Our model is structured as a screening model with incomplete information, rather than as a signalling model. In that regard, this model is similar to the Rothschild and Stiglitz (1976) model of insurance markets. But because we model project screening as a binary choice—projects are either screened entirely or not at all—we don't have the problems of equilibrium existence that were present in that article. Unlike Rothschild-Stiglitz, low types will not be indifferent between their own contract and the contract of the high types in a separating equilibrium of the present model.

□ **Model description.** Suppose there is a continuum of risk-neutral entrepreneurs. Each entrepreneur chooses a project of fixed size, which for simplicity is normalized to one. Each project has one of two possible quality levels: good (G) and bad (B). The good project pays $X > 0$, and the bad project pays zero. To finance his project, each entrepreneur borrows from at most one bank. Entrepreneurs have an outside option that pays zero, so they will participate only if their expected payoff is nonnegative.

Each entrepreneur is one of two types, H and L, who are represented in the economy in proportions μ and $1 - \mu$. The H-type entrepreneurs have a good project with probability P_H, and L-type entrepreneurs have a good project with probability $P_L < P_H$. Entrepreneurs know the value of all parameters, and they know their own type, but they do not know the quality of the project they have chosen.

There is a continuum of banks, which are perfectly competitive and face a perfectly elastic supply of funds at the interest factor $\bar{R} < X$. Banks, which are risk-neutral profit maximizers, offer debt contracts to entrepreneurs. Banks know the values of all model parameters, but they don't know either the type of their credit applicants or the quality of their projects. However, if they so choose, banks can ascertain the quality of an applicant's project by screening it at a fixed cost of S. After it either screens or decides not to screen, the bank must choose to either approve the loan application or reject it.

Let $\langle R, C \rangle$ represent a standard debt contract with repayment R and collateral C. Because projects return either X or zero, the contract $\langle R, C \rangle$ may be given an alternative interpretation as a combination of a fully collateralized debt in the amount C and an equity share with rights to the fraction $(R - C)/X$ of the proceeds of the project. In this model, the bank is protected from the consequences of a bad project only by collateralized debt, and it is only the extent of collateralized debt that will determine whether or not the bank will implement project screening. For this reason, it is not important whether the uncollateralized portion of the financial contract is interpreted as debt or equity.[6] Whatever the interpretation, both R and C are assumed observable and legally enforceable, and the liquidation of collateral C is assumed costless.

We will say that a debt contract is adopted if it is offered and draws at least one loan applicant. When a contract has been adopted, the bank must decide whether or not to screen applicants. Its screening decision is denoted by s, where $s = s^+$ when a bank chooses to screen and $s = s^-$ when it chooses not to screen. A profit-maximizing bank will approve a screened loan application if the project is revealed to be good and reject it if the project is bad; otherwise, the expense of screening would not have been justified. We assume, also, that banks would not offer a contract without the prospect of approving some applicants. This means that if a bank does not intend to screen the applicants for an offered contract, it is prepared to approve them unscreened.

Furthermore, a bank with an adopted contract can infer (from market conditions) the

[6] Note, also, that having the entrepreneur invest his own wealth in the project (inside equity) would have effects similar to that of posting it as collateral. For the entrepreneur, the wealth would be lost if the project failed—just as collateral would. For the bank, wealth reduces the size of the bank's investment, and this makes it less willing to incur the fixed screening cost S.

probability p that a random member of its pool of applicants has a good project, and it can base its screening and loan-approval decisions on that value of p.

For each adopted contract $\langle R, C\rangle$, we can use the above notation to define a corresponding *contract outcome* $\langle R, C, s, p\rangle$, which describes the responses to the offered contract, as well as the contract itself. The first three elements of the contract outcome describe the relevant strategic behavior of the bank that offers the contract, and the last element describes the relevant strategic response of entrepreneurs as a group. Clearly, $p = P_H$ when the contract draws only H-type applicants, $p = P_L$ when the contract draws only L-type applicants, and $P_H > p > P_L$ when the contract draws some of each type.

We assume that all entrepreneurs are *creditworthy*: the expected return to every borrower's desired investment is greater than the cost of capital. Inasmuch as H-types must be creditworthy if L-types are, our assumption is equivalent to the inequality

$$X > \frac{\bar{R}}{P_L}. \tag{1}$$

Let Y_j denote the expected net payoff of a project to a j-type entrepreneur from a contract $\langle R, C\rangle$ and let p_j be the probability that his project is good. Then, the entrepreneur's expected payoff would be $p_j(X - R)$ with screening and $p_j(X - R) - (1 - p_j)C$ without screening, so that

$$Y_j = \begin{cases} p_j(X - R) & \text{for } s = s^+ \\ p_j(X - R) - (1 - p_j)C & \text{for } s = s^-. \end{cases} \tag{2}$$

Let Π denote a bank's expected profits from a contract outcome $\langle R, C, s, p\rangle$, which is given by

$$\Pi = \begin{cases} pR + (1 - p)C - \bar{R} + \left[(1 - p)(\bar{R} - C) - S\right] & \text{for } s = s^+ \\ pR + (1 - p)C - \bar{R} & \text{for } s = s^-. \end{cases} \tag{3}$$

This representation of Π corresponds to the notion that screening recovers the expected loss from bad projects at a cost of S.

Our aim in this article is to show that in order to separate from L-types, H-types will offer collateral even at the cost of losing screening services. Consequently, for now we restrict our attention to values of S for which screening the projects of H-types would be desirable in a full-information environment. Formally, let $\bar{S}$ denote the expected social loss from an H-type's project when it is unscreened, i.e.,

$$\bar{S} \equiv (1 - P_H)\bar{R}. \tag{4}$$

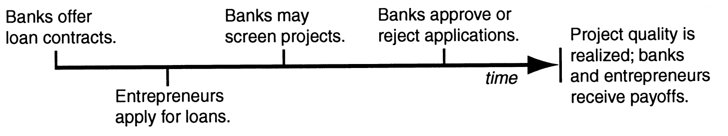
For $S < \bar{S}$, it is efficient to screen the projects of H-types (and of L-types as well, because they are even more prone to failure). Furthermore, from (3) we know that it is privately profitable for banks to screen the projects of known H-types if $S < \bar{S}$ and no collateral is posted. In the next section we characterize market equilibria for values of $S < \bar{S}$.

□ **Competitive credit-market equilibria.** As illustrated in Figure 1, banks and entrepreneurs act as follows:

(i) Each bank offers debt contracts of the form $\langle R, C\rangle$.
(ii) Each entrepreneur applies to one bank for one loan contract.
(iii) Each bank decides whether or not to screen the applicants that apply for a given contract.
(iv) Banks approve or reject applications.
(v) Approved applications are funded. Funded good projects yield X, from which the entrepreneur repays R to the bank. Funded bad projects yield zero, and collateral of value C is liquidated and paid to the bank.

As is generally the case in the real world, we assume that banks are careful not to give loan applicants verifiable evidence of a positive screening outcome until a loan contract is signed.

FIGURE 1
TIME LINE



Otherwise, the applicant could use that evidence to get a cheap loan from another bank without the need for further screening. Indeed, if banks could free-ride on the screening activities of their competitors, screening would be severely and inefficiently curtailed, whether or not collateral had been posted.

We do not allow an entrepreneur to apply for two contracts simultaneously or apply to another bank after the first bank acts on his loan application. An entrepreneur would have no incentive to apply to another bank if his application were approved, because without verifiable evidence of the approval, he could not receive a lower rate. A rejected application could result only from a negative screening outcome. But no bank would finance the project of an entrepreneur whose loan application is known to have been previously rejected. If banks share information about loan applications (as we assume), then entrepreneurs will not apply to another bank upon rejection.

A *competitive credit-market equilibrium* is defined as a set of contract outcomes Ω that meet the following conditions:

E1: No exit. Each member of Ω yields nonnegative profits to the bank.

E2: Profit maximization. For each contract outcome $\langle R, C, s, p\rangle$ in Ω the bank's screening decision, indicated by s, is profit maximizing.

E3: Participation constraint. Each contract outcome yields a nonnegative payoff to the entrepreneur.

E4: Payoff maximization. Every entrepreneur adopts a debt contract with an outcome in Ω that maximizes his payoff among all contract outcomes in Ω.

E5: No entry. There are no viable entrants that can attract entrepreneurs away from contracts with outcomes in Ω. We will say that a contract $\langle R, C\rangle$ is a *viable entrant* if there is a contract outcome $\langle R, C, s, p\rangle \notin \Omega$ with the following properties:

(i) $\langle R, C, s, p\rangle$ earns the bank nonnegative profits.[7]

(ii) $\langle R, C, s, p\rangle$ provides at least one entrepreneur with a strictly higher payoff than does every contract outcome in Ω.

(iii) p is consistent with the set of all entrepreneurs for which E5(ii) is true.

Consequently, for the no-entry condition to be satisfied, at least one of the above properties must be violated for every contract outcome $\langle R, C, s, p\rangle \notin \Omega$.

We now proceed to demonstrate that there is a range of parameter values for which some projects will not be screened in equilibrium even though screening would be efficient. To do this, we apply the above equilibrium conditions in order to characterize the contents of Ω in equilibrium. Immediately, we see the following:

Proposition 1. Every equilibrium contract outcome earns zero profits for the bank. Further, for every equilibrium contract,

$$C \leq \bar{R} \leq R. \tag{5}$$

Proof. The combination of the no-entry condition E5 and the no-exit condition E1 implies the first statement, for if profits were positive for a given contract outcome, then a contract with a

[7] Note that this is equivalent to requiring positive profits, because positive profits could be achieved by a sufficiently small reduction in R or C without violating E5(ii).

sufficiently small decrease in R would be a viable entrant. Equation (5) now follows from our assumption that $C \leq R$, because $C \leq R \leq \bar{R}$ would guarantee negative profits and $\bar{R} \leq C \leq R$ would guarantee positive profits, whether or not the project turns out to be good. *Q.E.D.*

Condition E2 requires that $s = s^+$ if $(1 - p)(\bar{R} - C) - S$ is positive (see (3)) and that $s = s^-$ if that expression is negative. Equating the expression to zero and solving for C yields the bank's point of indifference, $\hat{C}(p)$, between screening and not screening as a function of p. Given that $S < \bar{S}$, we have

$$\hat{C}(p) = \bar{R} - \frac{S}{1-p} > 0. \tag{6}$$

Equilibrium screening must take place if $C < \hat{C}(p)$ but not if $C > \hat{C}(p)$, so that $\tilde{s}$, the equilibrium value of s, is given by the correspondence

$$\tilde{s}(C, p) = \begin{cases} s^+ & C \in [0, \hat{C}(p)) \\ s^+ \text{ or } s^- & C = \hat{C}(p) \\ s^- & C \in (\hat{C}(p), \bar{R}]. \end{cases} \tag{7}$$

Given C and p, let $\tilde{R}$ denote the value of R that earns zero profits for the bank. We have

$$\tilde{R}(C, p) = \begin{cases} \bar{R} + \dfrac{S}{p} & \text{for } C \in [0, \hat{C}(p)] \\ \dfrac{\bar{R} - (1-p)C}{p} & \text{for } C \in (\hat{C}(p), \bar{R}]. \end{cases} \tag{8}$$

Note that when $C = \hat{C}(p)$, the two formulas in (8) are equivalent, so we arbitrarily include $C = \hat{C}(p)$ with the former case. At this point, we have the following:

Proposition 2. A contract outcome will yield zero profits and satisfy the profit-maximization condition E2 if and only if it is of the form $\langle \tilde{R}(C, p), C, \tilde{s}(C, p), p \rangle$ for some C and p.

Suppose that a contract $\langle R, C \rangle$ attracts a combination of H-type and L-type entrepreneurs yielding p as the probability that a project is good. Then, according to the proposition, it is an equilibrium contract only if the value of R it specifies is equal to $\tilde{R}(C, p)$. We use this necessary condition to further narrow the set of candidate equilibria.

Given (2), we can now express the expected payoff of any equilibrium contract to a j-type entrepreneur as follows:

$$\tilde{Y}_j(C, p) = \begin{cases} p_j \left(X - \bar{R} - \dfrac{S}{p} \right) & \text{for } C \in [0, \hat{C}(p)] \\ p_j \left(X - \dfrac{\bar{R} - C}{p} \right) - C & \text{for } C \in (\hat{C}(p), \bar{R}]. \end{cases} \tag{9}$$

We see from (7), (8), and (9) that if $0 \leq C \leq \hat{C}(p)$, that is, if screening is profit maximizing, neither banks' profits nor entrepreneurs' payoffs depend on the value of C, whatever the quality of the project. Consequently, for all equilibrium contract outcomes of the form $\langle R, C, s^+, p \rangle$, all values of C in the interval $[0, \hat{C}(P_L)]$ are *operationally equivalent*, because within that range C does not affect the profit-maximizing screening decision, payoffs to each type of entrepreneur, or profits. Uniqueness of equilibria will be defined only up to this equivalence. In the propositions that follow, we shall use $C = 0$ as the representative value of collateral for C in the interval $[0, \hat{C}(P_L)]$.

We are now in a position to further refine the possible configurations of Ω in equilibrium. First we need to develop some terminology. We will say that a member of Ω is an $\mathcal{H}$-contract outcome if it is adopted only by H-type entrepreneurs ($p = P_H$); that it is an $\mathcal{L}$-contract outcome if it is adopted only by L-type entrepreneurs ($p = P_L$); and that it is a $\mathcal{P}$-contract outcome if it is adopted by both types of entrepreneurs ($P_H > p > P_L$).

Let $\bar{P}$ be defined as the probability that a random member of the entire population has a good project, so that

$$\bar{P} = \mu P_H + (1 - \mu) P_L. \tag{10}$$

We can then characterize pooling equilibria with the following proposition, which is proved in the Appendix:

Proposition 3. In a competitive credit-market equilibrium with $S < \bar{S}$, the following must be true about $\mathcal{P}$-contracts and contract outcomes:

(i) Every $\mathcal{P}$-contract pays L-type entrepreneurs at least $P_L(X - \bar{R}) - S$.
(ii) Every $\mathcal{P}$-contract provides screening.
(iii) A $\mathcal{P}$-contract cannot coexist with $\mathcal{L}$-contracts or $\mathcal{H}$-contracts.
(iv) Every $\mathcal{P}$-contract attracts the same proportion of H-types to L-types as in the population, so that for every $\mathcal{P}$-contract outcome, $p = \bar{P}$.
(v) All equilibrium $\mathcal{P}$-contract outcomes have the form $\langle \bar{R} + S/\bar{P}, 0, s^+, \bar{P} \rangle$, or its equivalents with $C \leq \hat{C}(\bar{P})$.

On the one hand, because $\mathcal{P}$-contracts cannot coexist with other contracts (point (iii) above), they must appear alone when offered in equilibrium. On the other hand, $\mathcal{H}$-contracts and $\mathcal{L}$-contracts must always appear together, because all entrepreneurs must be served in equilibrium. More formally,

Proposition 4. Only two configurations of Ω are consistent with the definition of competitive equilibria: those containing $\mathcal{P}$-contracts only and those containing both $\mathcal{H}$- and $\mathcal{L}$-contracts only. Consequently, there are no partial-pooling equilibria.

Now we ask when H-type entrepreneurs will want to pool with L-types and when they will want to separate from them. As indicated previously, we can consider without loss of generality all equilibrium $\mathcal{P}$-contract outcomes to be operationally equivalent to the zero-collateral-contract outcome $\langle \bar{R} + S/\bar{P}, 0, s^+, \bar{P} \rangle$, and later we show that all separating contracts for H-types yield them the same payoff as the full-collateral unscreened contract $\langle \bar{R}, \bar{R} \rangle$. We know that H-types will be indifferent between pooling and separating if the expected cost of screening when pooling, $P_H S/\bar{P}$, equals the expected losses from the absence of screening, $(1 - P_H)R$. Thus $\hat{S}$, the value of S that makes H-types indifferent to pooling with L-types and separating, is given by

$$\hat{S} \equiv \frac{(1 - P_H)}{P_H} \bar{P}\, \bar{R}. \tag{11}$$

The threshold $\hat{S}$ is less than $\bar{S}$, the maximum value of S for which screening H-types is efficient. This follows from (4) and the fact that $\bar{P}/P_H < 1$. Let Ω_P and Ω_S denote pooling and separating equilibria.

The following proposition, proved in the Appendix, establishes the existence of a unique[8] pooling equilibrium for low values of the screening cost, $S \leq \hat{S}$.

Proposition 5. A unique pooling equilibrium exists for S in the range $0 \leq S \leq \hat{S}$. In that equilibrium, all entrepreneurs adopt the zero-collateral contract $\langle \bar{R} + S/\bar{P}, 0 \rangle$ (or one of its operational equivalents), so that $\Omega_P \equiv \{\langle \bar{R} + S/\bar{P}, 0, s^+, \bar{P} \rangle\}$. All proposed projects are screened. No pooling equilibrium exists for S in the range $\hat{S} < S \leq \bar{S}$.

Next, we proceed to establish that a unique separating equilibrium exists for high values of the screening cost. To do this, we characterize contracts that in equilibrium will attract only L-types or only H-types. With respect to L-types, in the Appendix we prove the following:

[8] Up to the operational equivalence previously explained.

Proposition 6. The only equilibrium $\mathcal{L}$-contract outcomes are $\langle \bar{R}+S/P_L, 0, s^+, P_L\rangle$ and its equivalents with $0 < C \leq \hat{C}(P_L)$. These contracts all provide screening.

With respect to H-types, we show the following:

Proposition 7. The contract outcome $\langle \bar{R}, \bar{R}, s^-, P_H\rangle$ and outcomes of the form $\langle [\bar{R} - (1 - P_H)C]/P_H, C, s^-, P_H\rangle$ with C sufficiently close to $\bar{R}$ are the only $\mathcal{H}$-contract outcomes that can exist in a separating equilibrium.

Each of the two preceding propositions characterizes a family of contract outcomes. The members of each family are operationally equivalent to each other in the sense that the banks's optimal screening decision and profits, and payoffs to the entrepreneurs that adopt them, are invariant. Consequently, we need work with only a single representative contract of each family. In what follows, we use $C = 0$ as the representative collateral value in the former case, and we use $C = \bar{R}$ as the representative collateral value for the latter.

Proposition 8. A separating equilibrium $\Omega_S \equiv \{\langle \bar{R}, \bar{R}, s^-, P_H\rangle, \langle \bar{R}+S/P_L, 0, s^+, P_L\rangle\}$ exists for S in the range $\hat{S} \leq S < \bar{S}$. This equilibrium is unique up to the operational equivalence described above. No separating equilibrium exists for S in the range $0 \leq S < \hat{S}$.

The following proposition, also proved in the Appendix, integrates the previous findings and characterizes the equilibria as a function of screening cost.

Proposition 9. (i) For $0 \leq S < \hat{S}$, there is a unique competitive credit-market equilibrium $\Omega_P \equiv \{\langle \bar{R} + S/\bar{P}, 0, s^+, \bar{P}\rangle\}$ (or its operational equivalent). In this equilibrium, both entrepreneurial types are pooled and all proposed projects are screened.

(ii) For $\hat{S} < S < \bar{S}$, there exists a unique competitive credit-market equilibrium $\Omega_S \equiv \{\langle \bar{R}, \bar{R}, s^-, P_H\rangle, \langle \bar{R} + S/P_L, 0, s^+, P_L\rangle\}$ (or their operational equivalents). In this equilibrium, the two entrepreneurial types are separated, with H-types adopting $\langle \bar{R}, \bar{R}\rangle$ and L-types adopting $\langle \bar{R} + S/P_L, 0\rangle$. Only the projects of L-type entrepreneurs are screened.

(iii) At $S = \hat{S}$, both the pooling and separating competitive credit-market equilibria exist.

The main result of the article now follows from the fact that screening is always efficient for $S < \bar{S}$.

Proposition 10. For screening costs S in the interval $(\hat{S}, \bar{S})$, the unique competitive credit-market equilibrium is characterized by insufficient screening.

Up to now, we focused on values of S that were less than $\bar{S} \equiv (1 - P_H)\bar{R}$, the value at which screening becomes inefficient for H-types. Let us now briefly consider values of S greater than $\bar{S}$ (see Table 1). For $S \in [\bar{S},\ (1 - P_L)\bar{R})$, screening is efficient for L-types but not for H-types. The credit market has the same separating equilibrium as it does for $S \in (\hat{S}, \bar{S})$, and as in that case, H-types are not screened. In the region $[\bar{S},\ (1 - P_L)\bar{R})$, however, there is no efficiency loss. For $S \in [(1 - P_L)\bar{R},\ \bar{R}]$ it is not efficient to screen either type, and in equilibrium, no screening occurs.

TABLE 1 Screening Efficiency

For S in the Interval		Screened in Equilibrium		Screening Is Efficient	
From	To	L-types	H-types	L-types	H-types
0	$\hat{S}$	Yes	Yes	Yes	Yes
$\hat{S}$	$\bar{S}$	Yes	No	Yes	Yes
$\bar{S}$	$(1 - P_L)\bar{R}$	Yes	No	Yes	No
$(1 - P_L)\bar{R}$	$\bar{R}$	No	No	No	No
$\bar{R}$	∞	No	No	No	No

Because $\bar{R}$ is the social cost and maximum possible private cost of project failure, screening will never occur or be socially useful when $S > \bar{R}$. Consequently, efficiency losses take place only for S in the range $[\hat{S}, \bar{S})$.

At this point we turn to a somewhat different question: Under what conditions are social losses caused by insufficient screening likely to be large? It will be useful to discuss this matter without fixing the size of S relative to $\bar{R}$. Rather, we allow S to vary according to the sector and other observable characteristics of the investment project. This will enable us to compute an index of expected social losses that depends only on the parameters describing adverse selection in the credit market. We will use this index to perform comparative statics with respect to those parameters. For simplicity we assume that S is uniformly distributed between zero and $\bar{R}$.

The probability that S will lie in the inefficient range is given by $(\bar{S} - \hat{S})/\bar{R}$, so that from (4), (10), and (11), we have

$$\Pr\{S \in [\hat{S}, \bar{S}]\} \equiv (1 - \mu)\frac{1 - P_H}{P_H}(P_H - P_L). \tag{12}$$

This formula tells us, quite sensibly, that screening costs are more likely to fall in the region of inefficiency, the higher the proportion of bad types, the lower the quality of the good types, and the greater the difference between the good and bad types. Note, for example, that if μ is very small (many L-types; few H-types), the region of insufficient screening is likely to be large. This is because a small μ creates a strong incentive for the H-types to separate: otherwise, a small number H-types would have to subsidize the screening costs of a large number of L-types. However, this calculation ignores something important, because only H-types can remain unscreened. Thus, if μ is small so that there are few H-types, total social losses must be small, even when screening costs lie in the interval of inefficiency. This can be stated formally as follows:

Proposition 11. If S is distributed uniformly on the interval $[0, \bar{R}]$, the expected value of social losses is given by

$$E[\text{losses}] \equiv \frac{\mu}{2}\left(\frac{1 - P_H}{P_H}\right)^2 (P_H^2 - \bar{P}^2)\bar{R}. \tag{13}$$

Proof. This formula follows from (12), the fact that $(\hat{S}+\bar{S})/2$ is the expected value of S conditional on $S \in [\hat{S}, \bar{S}]$, and equations (4) and (11). *Q.E.D.*

Proposition 11 implies that expected social losses grow rapidly as the quality of H-type entrepreneurs (as measured by P_H) declines and as the difference in quality between the two types of entrepreneurs increases. The effect of μ is ambiguous, as one would expect it to be: as μ increases, the value of $\bar{P}$ draws closer to that of P_H so that the last term on the right-hand side of (13) declines, whereas the first term increases.

The intuition behind the results of this section was explained in its introduction, but we recapitulate it briefly here. On the one hand, in a separating equilibrium, high collateral protects banks against the default of H-type entrepreneurs, so that banks have insufficient incentive to screen their projects. On the other hand, when screening costs per loan applicant are sufficiently high, i.e., when $S > \hat{S}$, H-type entrepreneurs have an incentive to separate from L-type entrepreneurs. This is because screening costs per *approved* L-type loan applicant are higher than analogous costs per approved H-type loan applicant, so that by separating from L-types, H-type entrepreneurs can avoid paying a prorated share of these higher costs. In order to separate, H-type entrepreneurs adopt the high-collateral contract and thus forgo efficient screening.

It follows that when screening costs are high, limiting the maximum amount of collateral that can be posted in debt contracts (or, equivalently, limiting their enforceability in court) may increase efficient screening. For instance, if in this model the maximum legal collateral that could be posted in a debt contract were given by $\hat{C}(\bar{P})$, banks would offer and entrepreneurs would adopt only the pooling contract $\langle \bar{R} + S/\bar{P}, 0\rangle$ or its equivalent, which would lead banks to screen all projects. In other words, a regulation limiting collateral could induce the socially efficient level of screening. In formulating an appropriate public policy, this effect should be weighed against the role of high collateral in controlling borrower moral hazard.

3. The monopolistic banking model

■ So far, we have considered the performance of a perfectly competitive credit market. In this section we focus on a monopolistic banking industry to show that, perhaps surprisingly, market power makes it possible to achieve efficiency in our framework.

For a banking monopoly, the equilibrium conditions must be changed. The banks' no-exit condition E1, no-entry condition E5, and profit-maximization condition E2 are replaced by a new profit-maximization condition: if Ω is the set of contracts adopted in equilibrium, then, subject to the equilibrium conditions E3 and E4, no other set of contracts would earn greater profits for the bank. We can now show the following:

Proposition 12. In equilibrium, for $0 \leq S \leq \bar{S}$, a monopoly bank offers only one contract $\langle X, 0\rangle$ (or its equivalent, $\langle X, C\rangle$ with $C \leq \hat{C}(\bar{P})$) and screens all projects. Thus, a monopolistic banking industry is characterized by efficient screening.

Proof. Because (7) remains valid in this setting, the projects of all applicants for a low-collateral contract such as $\langle X, 0\rangle$ will be screened and, as before, loans will be approved only when those projects are good. Thus $\langle X, 0\rangle$ provides a zero payoff to both entrepreneurial types and satisfies entrepreneurs' participation constraints. Bank profits derived from an H-type entrepreneur who adopts $\langle X, 0\rangle$ are given by

$$\Pi_H(\langle X, 0\rangle) = P_H(X - \bar{R}) - S,$$

and from an L-type entrepreneur by

$$\Pi_L(\langle X, 0\rangle) = P_L(X - \bar{R}) - S.$$

A monopoly bank would not offer a low-collateral (screened) contract with $R < X$, because it would earn less profits for the bank than $\langle X, 0\rangle$ does, whereas a low-collateral contract with $R > X$ would violate entrepreneurs' participation constraint E3 and would not be adopted. Thus, $\langle X, 0\rangle$ is the only low-collateral contract that can be adopted in a monopolistic equilibrium.

So consider a high-collateral contract equivalent to $\langle R, R\rangle$. We show that any such contract adopted by a given entrepreneur would yield a lower bank profit than $\langle X, 0\rangle$ does. As in the previous sections, banks will have no incentive to screen projects associated with such contracts. The most profitable high-collateral contract for the bank that satisfies the participation constraint for an H-type entrepreneur sets $R = P_H X$, with profits given by

$$\Pi_H(\langle P_H X, P_H X\rangle) = P_H X - \bar{R}.$$

Likewise, maximum bank profits from a high-collateral contract adopted by an L-type entrepreneur are

$$\Pi_L(\langle P_L X, P_L X\rangle) = P_L X - \bar{R}.$$

We have

$$\Pi_H(\langle X, 0\rangle) - \Pi_H(\langle P_H X, P_H X\rangle) = (1 - P_H)\bar{R} - S$$

and

$$\Pi_L(\langle X, 0\rangle) - \Pi_L(\langle P_L X, P_L X\rangle) = (1 - P_L)\bar{R} - S.$$

By (4) and since $P_L < P_H$, both expressions are strictly positive for $S < \bar{S}$. Thus, with respect to both entrepreneurial types, low-collateral contracts equivalent to $\langle X, 0\rangle$ offer the monopoly bank greater profits than any high-collateral contract does. We may conclude that in equilibrium only $\langle X, 0\rangle$ or its equivalents (with $C \leq \hat{C}(\bar{P})$) will be offered. *Q.E.D.*

The intuition behind this result is straightforward. We know that for screening costs in the interval $[0, \bar{S})$, screening all projects maximizes social surplus. Given that the demand for capital is completely inelastic, high interest rates do not lead to lower lending volumes, and increased interest rates shift rents from entrepreneurs to the bank without causing any allocation distortion. Hence, the monopoly bank is able to appropriate all rents generated in the market and thus fully internalize the efficiency gain that derives from screening (provided, of course, that borrower moral hazard is not a significant consideration at levels of collateral $\hat{C}(P)$ or less). Consequently, the monopoly bank always screens, and it funds only those projects that are found to be good. By extracting all rents through high interest rates, the monopoly will be doing well by doing good.

Of course, this striking result depends to a large extent on our assumption that the demand for credit is inelastic. Yet even if the demand for credit were somewhat elastic, a certain amount of bank market power might be efficient in the presence of asymmetric information and noncontractible screening, because market power could give the banks the incentive they need to generate valuable information at a cost.

4. Empirical implications

■ The model has several empirical implications. First and most obviously, our model implies that there will be more screening activity in jurisdictions in which borrowers' ability to post collateral is restricted than in those in which creditors have extensive rights to repossess collateral. Although it is difficult to observe screening activity directly, we can observe the activity levels of venture capital firms and similar screening-intensive financial intermediaries. As Kaplan and Strömberg (2001) demonstrate, venture capitalists specialize in screening, which means that their fixed investments in the screening process are typically higher, and their marginal costs lower, than those of other financial intermediaries. Therefore, with competition on the margin between venture capitalists and other financial institutions, higher levels of screening activity ought to translate into greater reliance on venture capital.

Second, our model implies that the average debt default rate will be higher where creditor rights are more strictly enforced, because fewer projects will have undergone screening in that case. In spite of practical difficulties in obtaining an internationally comparable measure of the average default rate, Padilla and Requejo (2001) attempt to test this prediction. They proxy the default rate both by the fraction of nonperforming loans and by the ratio of bank provisions for loan losses to total loans, and they use the index of La Porta et al. (1997) as their measure of the protection of creditor rights. Their empirical results are ambiguous: in most of their specifications, the estimated coefficient of creditor-rights index is not statistically different from zero at conventional significance levels, possibly because of the poor quality of the proxies used for the default rate. In addition, our model predicts that in legal settings in which the use of collateral is discouraged, one should observe more credit denials, since banks would subject potential borrowers to a more intensive screening. This is supported by much of the literature discussed in the Introduction, for instance by the careful study of Berkowitz and White (2000). Our model suggests that at least some portion of these credit denials would be efficient.

A third testable implication of our model derives from the fact that in our inefficient equilibrium, collateral is posted by the best entrepreneurs, not by the low-quality ones—a result that is common to many other adverse-selection models (e.g., Bester, 1985; Besanko and Thakor, 1987a, 1987b; and Chan and Thakor, 1987). At first sight, this may appear to run against the grain of much empirical work that finds collateral to be required from high-risk borrowers.[9] In fact, our model is consistent with this empirical regularity: in our inefficient equilibrium, low-quality entrepreneurs are screened, so only those with good projects are funded, whereas high-quality entrepreneurs

[9] See the evidence reported by Orgler (1970), Hester (1979), Scott and Smith (1986), Berger and Udell (1990, 1992), Booth (1992), and Klapper (2001).

are not screened, so all of their projects are funded—including some bad ones. As a result, if one were to use borrowers' *ex post* performance to partition them into two classes—low risk and high risk—one would conclude that collateral is posted by the high-risk borrowers, which in fact are the high-quality, unscreened entrepreneurs. In other words, the screening activity of the bank uncouples the riskiness of borrowers from their intrinsic quality.

Finally, our model suggests that banks will require less collateral and screen more intensively in settings in which they can muster a greater degree of market power. This prediction is consistent with the findings of Petersen and Rajan (1995) that a higher market concentration allows banks to establish a closer long-term relationship with firms.

5. The wider picture

■ The argument offered in this article highlights a potential drawback of collateral: its protection may induce banks to be "lazy" and screen credit seekers insufficiently. It is worthwhile to step back and place this argument in perspective, considering how it fits into the debate on the costs and benefits of collateral and the degree of protection that should be afforded to creditor rights.

The main benefit of collateral in debt contracts is to temper moral hazard on the debtor's side. Debtors have the incentive to engage in opportunistic behavior at their creditors' expense, such as asset substitution, inadequate supply of effort, and underinvestment, as shown by Myers (1977), Smith and Warner (1979), and Stulz and Johnson (1985), among others.

But incentive problems may also arise on the creditors' side. On the one hand, as in our model, banks may lack sufficient incentives to screen and monitor their debtors at the efficient level. On the other hand, in the context of a dynamic model with multiple creditors, Rajan and Winton (1995) show that a bank's ability to demand *additional* collateral when the debtor's prospects deteriorate may raise the bank's *ex ante* incentives to monitor. Their argument proceeds as follows. Compared to other creditors, banks have a comparative advantage in monitoring the entrepreneur's project, and therefore to liquidate the project when things go badly. However, in order to have the incentive to invest in monitoring, banks must have the ability to take increased collateral when the borrower is in difficulty, as this confers effective priority to the bank at the liquidation stage. This can be advantageous to the other creditors as well, since by requiring additional collateral the bank will indirectly "sound the alarm bell" and induce efficient liquidation that would not have taken place otherwise.

A borrower's willingness to post collateral can also convey useful information concerning his type in the context of adverse-selection models: Bester (1985), Besanko and Thakor (1987a, 1987b), and Chan and Thakor (1987) show that this information can improve the allocation of credit in equilibrium, tempering the adverse-selection problems illustrated by Stiglitz and Weiss (1981).

Back on our side of the ledger, others before us have warned against the potential shortcomings of creditors' reliance on collateral protection. Some have warned against the *ex post* inefficiencies associated with collateral liquidation. Being more interested in recovering their money than in the overall company's value, holders of collateral may strip the company of key assets and force its inefficient liquidation. Bolton and Scharfstein (1996) show that such *ex post* inefficiency is particularly severe when there are many creditors, each of whom typically has less incentive to renegotiate the loan than would a single lender.

Some authors have stressed that collateral exemptions mitigate the cost of failure and thereby raise entrepreneurial incentives to take risk and exert effort, without necessarily increasing the bankruptcy rate. For instance, Posner (1992, p. 400) notes:

> Some states have generous household exemptions for insolvent debtors, others chintzy ones. In the former states, the risk of entrepreneurship is reduced because the cost of failure is less, but interest rates are higher because default is more likely and the creditor's position in the event of default is weaker. And note that higher interest rates make default all the more likely. Cutting the other way, however, is the fact that in the low-exemption states lenders' risk is less, which induces lenders to make more risky loans, i.e., loans likelier to end in bankruptcy. It is therefore unclear as a theoretical proposition whether there will be more bankruptcies in the high-exemption states or in the low-exemption ones.

One may object that failure-cost mitigation is better left to private contracting and renegotiation in case of borrower's distress than to legal limitations on the amount of collateral that can be legally pledged. But there are reasons to believe that private contracting can result in funding too many unsuccessful projects relative to the socially efficient level, and collateral exemptions can correct this bias. In this article we have provided one such reason (insufficient screening by banks), but there are others. If entrepreneurs are overoptimistic about their probability of success, the possibility of posting collateral increases their ability to obtain funding for unworthy projects by insulating banks from downside risk (see Manove and Padilla, 1999). Moreover, if borrowers are insured by social security or some other social "safety net," they have an incentive to invest in excessively risky projects and banks may have no incentive to restrain or monitor them when they are fully protected by collateral. Jackson (1986, p. 231) makes this point very effectively:

> If there were no right of discharge, an individual who lost his assets to creditors might rely instead on social welfare programs. The existence of those programs might induce him to underestimate the true cost of his decisions to borrow. In contrast, discharge imposes much of the risk of ill-advised credit decisions, not on social insurance programs, but on creditors. The availability of unlimited non-waivable right of discharge in bankruptcy therefore encourages creditors to police extensions of credit and thus minimizes the moral hazard created to safety-net programs. Because creditors can monitor debtors and are free to grant or withhold credit, the discharge system contains a built-in checking mechanism. The importance of encouraging creditor monitoring in a society that provides other safety nets may help explain why the right of discharge is not waivable.

The debate about the pros and cons of collateral exemptions is part of the wider debate about the balance to be struck between the protection of creditor rights and the safeguard of debtor incentives. This debate is especially intense in connection with the possible reform of bankruptcy procedures in the United States.

One of the central issues in that debate has been the extent to which the priority of secured creditors should be preserved, or rather deviations from absolute priority should be allowed, as happens *de facto* in the context of the Chapter 11 procedure in the United States. Although some analysts staunchly defend absolute priority as a prerequisite to cheap and abundant funding to entrepreneurs, Bebchuk and Fried (1996, 1997) point out that absolute priority also entails inefficiencies, among which reduced monitoring and enforcement by the creditor. Moreover, Bebchuk and Picker (1993) argue that deviations from absolute priority raise the incentives of owner-managers to make investments in managerial human capital. Similarly, according to Berkovitch, Israel, and Zender (1997), optimal bankruptcy law must also take into account the incentives of managers to invest in firm-specific human capital.

A similar tradeoff is present in the question of whether or not debtors should be freed from their residual unpaid obligations at the end of a bankruptcy procedure. On the one hand, such debt discharge reduces the extent to which creditors can recoup their debt. But on the other, discharge eliminates the perverse effect on the debtor's incentives caused by the "debt overhang."

In commenting on current proposals to restrict access to the relatively lenient U.S. bankruptcy procedure, *The Economist* (July 4, 1998, p. 85) vividly portrays this tradeoff:

> On the face of it, the economic case for giving debtors extensive protection is easily dismissed. Other things equal, the easier it is for a borrower to escape from its obligations to pay interest and, ultimately, repay a loan, the more likely it is that creditors will lose some of the money they lend, and so the less willing they will be to extend credit. Less plentiful credit means less economic activity. Against this should be set important benefits that can result from bankruptcy law, says Lawrence Ausubel . . . When someone is too deeply in debt, he may have little incentive to work, or, at least, to do any work that is legal, as any income earned will have to go to creditors. Free him from his debts and his incentives to work (legally) are restored. In a sense, the right to go bust is an insurance policy against financial disaster.

This insurance aspect of lenient debtor treatment is particularly important in high-risk, innovative sectors, where entrepreneurial success cannot be easily obtained without a previous string of failures. In R&D-intensive industries, there is often considerable learning value to failures, so that in the presence of capital market imperfections, lenient treatment and immediate rehabilitation of defaulting borrowers can provide entrepreneurs with crucial "insurance" against business failure. In fact, the European Commission, in its April 1998 report *Risk Capital: A Key to Job Creation in Europe*, put forward plans to make European bankruptcy laws more lenient (closer to the current U.S. standard), precisely to encourage more innovative European entrepreneurship.

In conclusion, both the literature and the policy debate highlight that, while protecting creditor rights both via collateral and in bankruptcy procedures is essential for the availability of cheap credit, there are sound efficiency reasons to avoid pushing this protection too far, and instead strike a careful balance with the protection of debtors' rights. Our argument that unfettered reliance on collateral may lead banks to underinvest in screening and allocate social resource inefficiently should be seen as a further argument in this direction.

6. Conclusion

■ In this article we have shown that when banks behave competitively in the presence of asymmetric information, the use of collateral in debt contracts may reduce the screening effort of banks below its socially efficient level (in the sense of diminishing social surplus) and lead them to fund too many worthless investment projects.

In our model, cash-constrained entrepreneurs apply to banks for funding. Entrepreneurs differ in their ability to identify and develop profitable investment projects. Each entrepreneur knows his own ability when choosing a project, but he does not know the quality of the project that he has chosen. Banks do not know either the type of their credit applicants or the quality of their projects, but they can learn the latter through costly screening. Yet screening is noncontractible, so banks will only screen projects as part of a loan approval procedure when the direct benefit of the information obtained exceeds the screening cost. This has two implications when the banking industry is competitive. First, banks with highly collateralized loans have no incentive to screen, even when the screening costs are low enough that screening is socially efficient. Second, entrepreneurs whose loans are approved pay not only their screening costs, but also a prorated share of the screening costs of those applicants whose loans are denied. In this setting, we show that in any competitive pooling equilibrium no entrepreneur posts collateral and all projects are screened, so that only good projects will be funded. However, with pooling, able entrepreneurs will pay a share of the screening costs from nonapproved loans not only of able applicants but of less-able entrepreneurs as well. Because the latter costs are higher, able entrepreneurs have an incentive to separate by posting sufficient collateral. But this in turn removes the incentives of banks to screen the projects of the able entrepreneurs. Indeed, we show that for an intermediate range of the screening costs, banks underinvest in project evaluation. Too many bad projects are funded and too many able entrepreneurs experience bankruptcy.

Our model implies that this inefficiency can be tempered by use of collateral exemptions, or equivalently, by the mandated use of partial equity financing. In the wider perspective of the current controversy about the desirable degree of creditor-rights protection, our article provides an additional argument to the reasons so far adduced for limiting creditor rights. In fact, the need to balance the protection of creditor rights, on the one hand, with the promotion of entrepreneurial activity and the maintenance of quality standards for investment projects, on the other, is an issue that is central to the current debate on bankruptcy law on both sides of the Atlantic.

Appendix

■ Proofs of Propositions 3 and 5–9 follow.

Proof of Proposition 3. (i) Otherwise, we can construct a viable entrant. Consider the contract $\langle \bar{R} + S/P_L, 0\rangle$, which features zero collateral, and the contract outcome $\langle \bar{R} + S/P_L, 0, s^+, p\rangle$, where p is fixed so as to satisfy E5(iii). From (3), we see that bank profits for this contract outcome are given by $(p/P_L - 1)S$, which must be positive for any pooling contract, because $p > P_L$. Thus, E5(i) is satisfied. Finally, this contract yields the payoff $P_L(X - \bar{R}) - S$ to L-types, which means that if Proposition 3(i) fails to hold, condition E5(ii) must be satisfied.

(ii) Suppose otherwise, and consider an equilibrium $\mathcal{P}$-contract outcome $\langle R, C, s^-, p\rangle$. Equilibrium condition E2 implies that $C > \hat{C}(p)$ for such a contract. The supposition of this proposition that $S < \bar{S}$ implies that

$$P_L(X - \bar{R}) - S > P_L X - \bar{R}. \tag{A1}$$

Recall that from (5), $C \leq \bar{R}$ in equilibrium. If $C = \bar{R}$ in the $\mathcal{P}$-contract, then from (9) and (A1) we can see that L-types would strictly prefer an $\mathcal{L}$-contract with $C = 0$, such as $\langle \bar{R} + S/P_L, 0\rangle$, so that the no-entry condition would be violated as above. Suppose, instead, that in the equilibrium $\mathcal{P}$-contract $\hat{C}(p) < C < \bar{R}$. Then we see from (9) that the payoff to the H-types increases in C. Thus, the contract $\langle \bar{R}, \bar{R} \rangle$ would attract all H-types, and the corresponding contract outcome $\langle \bar{R}, \bar{R}, s^-, P_H \rangle$ would establish the existence of a viable entrant, so that E5 would again be violated.

(iii) From (9), we see that for zero-profit contract outcomes with screening, the expected payoff to all entrepreneurs is independent of C and increasing in p. Therefore, inasmuch as equilibrium $\mathcal{P}$-contracts always provide screening, we know that any $\mathcal{P}$-contract would be strictly preferred to any $\mathcal{L}$-contract, so that by E4, both cannot coexist. Furthermore, suppose both an $\mathcal{H}$-contract and a $\mathcal{P}$-contract were present in equilibrium. Then, with a sufficiently small reduction in the interest rate of the $\mathcal{P}$-contract, a bank could attract all of the entrepreneurs from the $\mathcal{H}$-contract, have an increased proportion of H-type entrepreneurs as compared to that of the original $\mathcal{P}$-contract, and so earn a profit while providing increased payoffs to entrepreneurs. This implies that the new contract outcome would be a viable entrant in violation of equilibrium condition E5.

(iv) If the values of p differed among zero-profit contract outcomes with screening, then those with the highest value of p would provide higher payoffs to entrepreneurs than the others would, in violation of E4. Consequently, p must be the same in every $\mathcal{P}$-contract. Because $\mathcal{P}$-contracts can coexist only with other $\mathcal{P}$-contracts, and because all entrepreneurs must be served in equilibrium (otherwise entry would be possible), we have $p = \bar{P}$.

(v) This follows immediately from (7), (8), and Proposition 3(ii) and 3(iv). *Q.E.D.*

Proof of Proposition 5. We already know from Proposition 3(v) that the contract outcomes in any pooling equilibrium must have the form $\langle \bar{R} + S/\bar{P}, 0, s^+, \bar{P} \rangle$. Now we show that $\Omega_P \equiv \{\langle \bar{R} + S/\bar{P}, 0, s^+, \bar{P} \rangle\}$ is a pooling equilibrium if $0 \leq S \leq \hat{S}$. The no-exit condition E1 and profit-maximization E2 follow from Proposition 2. Payoff-maximization E4 is trivially satisfied, because Ω_P contains only one contract. The participation constraint E3 requires only that the contract outcome $\langle \bar{R} + S/\bar{P}, 0, s^+, \bar{P} \rangle$ yield a positive payoff to entrepreneurs, which is always the case since only good projects are funded and banks just break even.

To demonstrate the no-entry condition E5, we must explore the possibility of viable entrants. Any screened contract with $R < \bar{R} + S/\bar{P}$ would attract all entrepreneurs away from the candidate pooling contract, but it would create negative profits for the bank, in violation of E5(i). Moreover, any screened contract with $R > \bar{R} + S/\bar{P}$ would attract no entrepreneurs, in violation of E5(ii). So consider unoffered contracts with outcomes that provide no screening. By comparing the payoffs from the candidate equilibrium pooling contract with those given in (9) for a general contract without screening, it is clear that if any viable entrants without screening exist, then there must be a viable entrant without screening that attracts all H-types. Because $\langle \bar{R}, \bar{R}, s^-, P_H \rangle$ provides L-types with a smaller payoff than the pooling contract outcome, and it provides H-types with the same payoff as any other $\mathcal{H}$-contract without screening, we need determine only whether or not the contract outcome $\langle \bar{R}, \bar{R}, s^-, P_H \rangle$ supports a viable entrant. But for H-types, the payoff from $\langle \bar{R}, \bar{R} \rangle$ is $P_H X - \bar{R}$, and the payoff from the candidate equilibrium $\mathcal{P}$-contract is $P_H(X - \bar{R} - S/\bar{P})$. Equating these expressions and solving for S yields the threshold $\hat{S}$ between the interval of screening costs with pooling equilibria and the interval with separating equilibria, as defined in (11). It is straightforward to show that for $S \leq \hat{S}$, $\langle \bar{R}, \bar{R} \rangle$ will not attract H-types away from the pooling equilibrium in violation of E5(ii). But for $S > \hat{S}$, all H-types would be attracted to $\langle \bar{R}, \bar{R} \rangle$, which can then be shown to be a viable entrant. *Q.E.D.*

Proof of Proposition 6. From (9), we see that the payoff to L-types who adopt an $\mathcal{L}$-contract is given by

$$\tilde{Y}_L(C) = \begin{cases} P_L(X - \bar{R}) - S & \text{for } C \leq \hat{C}(P_L) \\ P_L X - \bar{R} & \text{for } C > \hat{C}(P_L). \end{cases} \tag{A2}$$

Therefore, from (A1) we may conclude that any $\mathcal{L}$-contract in Ω specifies a level of collateral $C \leq \hat{C}(P_L)$; otherwise E5 or E4 would be violated. The proposition now follows immediately from (7) and (8). *Q.E.D.*

Proof of Proposition 7. First we eliminate the possibility of screening in equilibrium $\mathcal{H}$-contract outcomes. From (9) it is evident that a zero-profit $\mathcal{H}$-contract ($p = P_H$) with screening would provide L-types with a higher payoff than would any other equilibrium contract. Consequently, the payoff-maximization condition E4 would require that L-types choose the $\mathcal{H}$-contract, which contradicts the definition of the latter.

Thus we are left with contracts that have $C \geq \hat{C}(P_H)$, so that a decision not to screen is profit-maximizing for banks. Then, the general form of an equilibrium $\mathcal{H}$-contract outcome follows immediately from the second part of (8). In addition, we impose a second lower bound on C, given by

$$C > \frac{P_H(S + P_L\bar{R}) - P_L\bar{R}}{P_H - P_L}, \tag{A3}$$

in order to avoid having $\mathcal{H}$-contracts yield a higher payoff to L-types than does the $\mathcal{L}$-contract specified by Proposition 6. This lower bound goes to $\bar{S}$ as S goes to $\bar{S}$. *Q.E.D.*

Proof of Proposition 8. From Propositions 6 and 7 we know that if a separating equilibrium exists, it must take the form $\Omega_S \equiv \{\langle \bar{R}, \bar{R}, s^-, P_H \rangle, \langle \bar{R} + S/P_L, 0, s^+, P_L \rangle\}$ (or their equivalents), because these two contract outcomes are the only ones that satisfy the zero-profit condition (and thus E1) and the profit-maximizing screening choice, E2, for H-types and L-types, respectively.

Next, to show that Ω_S is a separating competitive equilibrium for $\hat{S} \leq S < \bar{S}$, we confirm the remaining equilibrium conditions. From (2) we see that the payoff for H-types who adopt $\langle \bar{R}, \bar{R} \rangle$ is $P_H X - \bar{R}$. This must be positive by (1), which embodies the assumption that all entrepreneurs are creditworthy. Equations (A1) and (1) imply that the contract $\langle \bar{R} + S/P_L, 0 \rangle$ yields positive expected payoffs to L-types, and it follows that the participation constraint E3 is satisfied.

The lower bound on C described by (A3) implies that the payoff-maximization condition E4 is satisfied for L-types. The payoff-maximization condition for H-types requires that their payoff from $\langle \bar{R}, \bar{R} \rangle$ (or its equivalents) be no less than their payoff from $\langle \bar{R} + S/P_L, 0 \rangle$, but as is made clear in the next paragraph, this must always be true for $\hat{S} \leq S < \bar{S}$.

It remains to consider the no-entry condition E5 for S in the region $\hat{S} \leq S < \bar{S}$. The proof of Proposition 7 demonstrates that there can be no unoffered contract without screening and with nonnegative bank profits that yields to either H-types or L-types larger payoffs than do the respective members of Ω_S. Similarly, no unoffered nonnegative-profit contract with screening can yield higher payoffs to L-type entrepreneurs than $\langle \bar{R} + S/P_L, 0, s^+, P_L \rangle$ does. Finally, let us consider contracts with screening that are capable of attracting H-type entrepreneurs as well as L-types, while earning nonnegative profits for banks. Of these, the contract most attractive to all entrepreneurs is the pooling contract $\langle \bar{R} + S/\bar{P}, 0 \rangle$. But when $\hat{S} \leq S < \bar{S}$, this is weakly dominated for H-type entrepreneurs by $\langle \bar{R}, \bar{R} \rangle$, in violation of E5(ii). Thus the no-entry condition E5 is satisfied for $\hat{S} \leq S < \bar{S}$ and Ω_S is an equilibrium there. However, for $0 \leq S < \hat{S}$, the contract $\langle \bar{R} + S/\bar{P}, 0 \rangle$ provides H-type entrepreneurs with a larger payoff than does $\langle \bar{R}, \bar{R} \rangle$ and yields nonnegative profits to banks. This means that no-entry fails in this region, and a separating equilibrium cannot exist there. *Q.E.D.*

Proof of Proposition 9. (i) Proposition 4 rules out the existence of partial pooling equilibria. By Proposition 5, we know that a unique pooling equilibrium exists on $[0, \hat{S})$, and by Proposition 8 we know that there are no separating equilibria there. The remainder of the first paragraph of the current proposition is implied by Proposition 5. Sections (ii) and (iii) are demonstrated analogously. *Q.E.D.*

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