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Beneficial "Firm Runs"

by Stanley D. Longhofer

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Introduction

Recent research in law and corporate finance suggests that existing bankruptcy rules have evolved to eliminate inefficiencies that result when lenders rush to retrieve their assets from a firm in financial distress. In contrast, first-come, first-served (FCFS) rules, often considered a benchmark in the absence of other bankruptcy rules, are commonly thought to be inefficient because they reduce the value of the defaulting firm's assets. This, however, may not always be the case. Moral hazard problems associated with the choice of project may make the act of running on a firm desirable, since it can help align investment incentives.

This paper looks at the problem of an entrepreneur who must raise outside funds to finance one of two investment alternatives. One of them is risky, and the bankruptcy costs expected to result from this project make it less desirable socially than the alternative, riskless project. Nevertheless, the firm is unable to commit to the less risky enterprise.

FCFS rules act to diminish this moral hazard problem. I derive a mixed-strategy equilibrium in which lenders monitor the firm with some positive probability. When the firm is caught investing in the risky project, it is liquidated; otherwise, it is allowed to continue. Although this mixed-strategy equilibrium may exist under both a FCFS rule and a proportionate priority rule (PPR), I demonstrate that it is less likely to exist under the PPR, and that when it does, the FCFS equilibrium is Pareto superior.

The fact that lenders can run on the firm when they observe that it has chosen the risky project helps keep the firm honest. The FCFS aspect of asset distribution keeps lenders from wanting to free ride on the monitoring efforts of others because the lenders who monitor are first in line to receive their claim on the firm's assets and are thus likely to be paid in full. Lenders who wait to observe the monitoring of others are less likely to receive anything if the firm goes under. This process is similar to that described in Calomiris and Kahn (1991), where demandable debt is used to control the banker's moral hazard problem, while sequential service prevents depositors from free riding on the monitoring efforts of others.

The key idea here is that *bankruptcy institutions should reward monitors when and only when they have performed their duties.* A similar argument has been made by Rajan and Winton (1995), who analyze how the choice of different priority and term structures in loan contracts affects lenders' incentives to monitor the firm. They argue that information conditions determine which structures provide the best monitoring incentives, meaning that the firm's capital structure can be used to achieve outcomes that are not directly contractible. In other words, ex ante efficiency is improved by choosing a capital structure that properly rewards monitors. This paper differs from Rajan and Winton, however, in that it focuses directly on the structure of the bankruptcy institution, outside of which private agents are not allowed to contract by law.

Although FCFS rules are beneficial in my model, there are other factors I have ignored that work in the opposite direction. Longhofer and Peters (1997) examine the coordination problem discussed above and show how lenders might fail to coordinate their liquidation decisions, even when doing so would be a Pareto-superior outcome. As a result, mandatory bankruptcy procedures (which implicitly enforce a PPR) can be socially desirable, since they enable lenders to coordinate in states of the world where they would not otherwise do so.

In many respects, the work of Longhofer and Peters represents the opposite side of this analysis. Notably, their paper assumes that FCFS rules entail a deadweight social cost, while ignoring the potential impact of such rules on a lender's monitoring incentives. This paper does exactly the opposite, focusing on how FCFS rules can ameliorate the firm's moral hazard problem. A more complete model would attempt to capture both effects of a FCFS rule: the benefits associated with improved monitoring incentives and the costs associated with inefficient default.

The next section summarizes traditional bankruptcy analyses. Here, I outline some of the standard arguments in favor of an alternative to a FCFS rule in bankruptcy law and question whether they are valid in all circumstances. I then use this background to analyze other studies of bankruptcy. I introduce my model in section II and show that under certain conditions, a firm may be unable to obtain financing because it cannot commit ex ante to a low-risk project; possible solutions to this problem are analyzed. In particular, I show that there exists a mixed-strategy equilibrium in which the firm is able to find lenders. Section III looks at the effect different bankruptcy rules may have on the equilibrium of this game. I show that a PPR reduces lenders' incentives to monitor the firm, thus raising the social cost of these contracts. I conclude in section IV, relegating all proofs to the appendix.

I. Justifications for PPRs

Most discussions of bankruptcy institutions start with the assumption that a formal procedure is needed for distributing an insolvent firm's assets, and then focus on the specific form such a procedure should take. It is not clear, however, that this assumption is valid in all cases. To see this, consider some of its standard justifications.

In the absence of bankruptcy laws, assets are distributed to creditors in the order in which they have staked their claims. Thus, the first lender to request repayment is generally the first to receive it. Lenders who end up last in line are paid last and quite possibly receive nothing.[1] For this reason, these default bankruptcy proceedings are typically called FCFS rules.

Traditional rationales for a more orderly mechanism cite several potential problems with FCFS rules. First, lenders may wish to protect their position by expending excessive resources to monitor the firm's condition. If a lender does not do this, the argument goes, he will certainly be the last to know when the firm is about to default, and consequently be the last in line to collect his claim. Furthermore, since all lenders are engaged in this monitoring, no one will get a better place in line than he would if none of them monitored, so these resources are spent in vain. This game looks much like the classic prisoners' dilemma, in which the Pareto-superior outcome with no monitoring is not a Nash equilibrium. It is argued that an orderly bankruptcy procedure allows lenders to avoid these costs, making all of them better off.

A second argument against FCFS rules is the classic "common pool" problem. Here, it is claimed that in their rush to be paid, lenders might reduce the total liquidation value of the firm by separating assets that would be more valuable together.[2] An orderly liquidation, on the other hand, would ensure that the firm's assets are put to their most productive uses, maximizing their value to the creditors. Worse yet, lenders might actually run too soon and foreclose on illiquid but otherwise viable firms. Again, formal bankruptcy rules should help prevent these inefficient liquidations.

1 This can be true even when some lenders insert seniority covenants into their loan agreements. Once the first lender removes his assets from the firm, a later lender's seniority provision no longer carries much benefit. Effectively, under a FCFS rule, lenders can assign seniority to themselves ex post by being the first to request repayment.

2 See Longhofer and Peters (1997).

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Jackson (1986, p. 10) summarizes the intuition behind these arguments: "The basic problem that bankruptcy law is designed to handle ... is that the system of individual creditor remedies may be bad for the creditors *as a group* when there are not enough assets to go around."

With these (often implicit) assumptions, modern studies of bankruptcy rules investigate what shape formal liquidation rules should take. For example, many authors have looked at the relative efficiency of the absolute priority rule (where the order of repayment is determined ex ante by assigning each lender a priority level) and PPRs.[3] Under various assumptions, they all conclude that these rules are inefficient with regard to both the liquidation/continuation decision and the decision to make new investments. Numerous other studies analyze Chapter 11 of the Bankruptcy Code and show that, in general, it does not provide efficient investment or liquidation incentives either. None of these studies, however, examines the *relative* efficiency of various bankruptcy rules compared to the natural default—FCFS rules—a necessary starting place for bankruptcy analyses.

In addition, most models analyze the effects of bankruptcy *ex post.* They begin with a firm whose existing capital structure cannot meet its current debt obligations. These models focus on whether different bankruptcy rules provide proper incentives so that creditors will foreclose if and only if the firm is insolvent, and will extend new credit to the firm for and only for positive net present value projects. It is certainly interesting to ask whether bankruptcy rules provide for decisions that are efficient ex post. But debt contracts are designed to resolve ex ante uncertainty, and their efficiency must therefore be measured from the viewpoint of the initial contracting problem. The proper question, then, is how different bankruptcy rules affect the social cost of debt contracts *at the time they are written*.

Boyes, Faith, and Wrase (1991) is one of only a few papers that address both these issues.[4] Its authors compare the ex ante social cost of debt contracts under PPRs and under FCFS rules, concluding that the PPR found in Chapter 7 is more efficient than FCFS rules, since it reduces the cost of contracting. Their result depends on their assumption that rushing to liquidate the firm is costly, whereas formal bankruptcy proceedings are not. In a FCFS world, lenders must pay to enter a queue to obtain the firm's assets. If they allow a firm to continue despite the fact that its expected return is negative, they will avoid these queuing costs some of the time (when the firm does well). Thus, lenders have an incentive to allow some firms with negative net present value to continue.[5]

The model of Boyes, Faith, and Wrase differs from this one in several important respects. First, they assume that a FCFS rule is costlier to implement than is a PPR.[6] More important, in my model the firm chooses between two different investment projects. This choice is the firm's private information, creating a moral hazard problem that requires lenders to monitor the firm. When there are many lenders, they may wish to free ride on one another's monitoring efforts. I propose that FCFS rules can serve to ameliorate this problem.

II. The Model

Consider a two-period world in which a risk-neutral firm has the opportunity to invest in one of two projects in period 0, either of which will mature in period 2. The first, project B, has a random return, paying x_h in period 2 with probability p and x_l with probability $(1-p)$. In contrast, project G is a safe project, returning $\bar{x} = px_h + (1-p)x_l$ in period 2 with certainty.[7]

Either project requires an investment of I to undertake. Because the firm has no resources of its own, it must borrow these funds from outside investors. I assume the loan market is composed of a large number of identical, risk-neutral agents. In equilibrium, competition will always drive down the interest rate, R, to ensure that all lenders earn zero profits. Assume that $\bar{x}$ is high enough always to enable the firm with the riskless project to make its promised payments in period 3. In contrast, $I > x_l$, so that if the firm chooses project B, it can meet its obligations only when the project is successful. When the firm is unable to repay its loans, default costs of d are incurred.

3 See, for example, Bulow and Shoven (1978), White (1980, 1983), and Gertner and Scharfstein (1991).

4 See also Longhofer and Peters (1997).

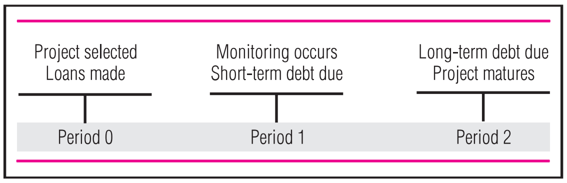
5 The authors also acknowledge that FCFS rules may result in inefficient liquidations of firms that have a positive net present value and claim that this further supports their argument that PPRs are more efficient. They ignore, however, the possibility that these two effects may offset each other, reducing the net inefficiency of FCFS rules.

6 If they were to assume that both types of rules entailed the same costs, their model would indicate a preference for FCFS rules, which involve these costs only a fraction of the time, rather than PPRs, which always do.

7 More generally, I could assume that G is second-order stochastic dominant over B.

FIGURE 1

Sequence of Events



SOURCE: Author.

Assume that the choice of project is costlessly observable by the firm. Outsiders, however, must monitor the firm in period 1 in order to discover its project choice. Let c denote the cost of doing so. Although the results of this monitoring provide a perfect signal of the firm's project choice, I assume that this information cannot be verified in court, making it impossible for contracts to depend on the choice of project.[8]

To analyze the effects of priority on the efficiency of financial contracting, I assume that the firm must borrow from multiple lenders.[9] For simplicity, assume that the firm borrows $I/2$ from each of two lenders. Figure 1 shows the order of events in this economy.

Long-term Debt

To finance either of these projects, the firm could issue long-term debt—that is, debt that comes due in period 2. On the basis of their beliefs about the firm's project choice, prospective lenders will demand a default premium commensurate with that project's anticipated risk. If they believe the firm will choose to invest in the riskless project G, each lender will simply charge the zero-profit interest rate, $R_G^* = I/2$. On the other hand, if they anticipate the firm will choose project B, each lender's expected return is

$$(1) \qquad pR + (1-p)\frac{x_l - d}{2} - \frac{I}{2},$$

implying a zero-profit interest rate, $R_B^* = [I - (1-p)(x_l - d)]/2p$; it is straightforward to verify that $R_B^* > R_G^*$.

Of course, the firm is concerned about the interest rate it pays only to the extent that its profits are affected. Given any promised payment, R, the firm's period-2 profit from project G is $\bar{x} - 2R$ with certainty. In contrast, its profit from project B is $p(x_h - 2R)$. Because there are deadweight costs associated with default, it is certain that, if both projects were priced competitively, the firm would earn a higher expected return from project G. Nevertheless, it is easy to show:

PROPOSITION 1. *Given any fixed promised repayment R, the firm will always choose to invest in project B.*

This proposition implies that long-term debt prevents the firm from credibly promising to invest in the riskless project in equilibrium. Once it receives the (relatively low) interest rate associated with project G, it would like to go ahead and invest in B, since it suffers none of the losses associated with the project's increased variability. If long-term debt is the only option, no lender will accept any interest rate below R_B^*, and the firm will invest in project B.

This inability to commit to the riskless project obviously entails social costs. Because lenders earn zero profits in equilibrium, these costs can be measured by comparing the profits the firm would have earned had it been able to commit to project G with those it earns from project B. This ends up equaling the expected deadweight default costs associated with project B: $d(1-p)$.

Short-term Debt

Is it possible to avoid such costs? One solution to this moral hazard problem is a maturity mismatch with short-term debt.[10] Suppose the firm must make a payment to its lenders in period 1. Since it has no revenues until period 2, it must either default or convince the lenders to roll over its debt. Before renewing the debt, however, lenders can monitor the firm and determine which project has been selected.

If lenders could credibly commit to monitoring the firm in period 1, short-term debt would give the firm an incentive to invest in project G.

8 If contracts could depend on the specific contract chosen, the first–best outcome would occur, in which the firm always chooses project *G*.

9 I do not formally motivate this assumption here. See Bolton and Scharfstein (1996) for a formal model motivating the use of multiple creditors.

10 It would be formally identical if we continued to consider long-term contracts with covenants that allow lenders to demand repayment in period 1. Note, however, that such covenants would not explicitly depend on the choice of project, since we have assumed this choice is not verifiable in court.

I assume, however, that such commitment is not possible. As a result, once project G is chosen, lenders no longer have any incentive to monitor the firm. Of course, the firm can anticipate that this will happen, and will once again choose project B. Thus, the pure-strategy equilibrium is the same with short- and long-term debt contracts; the firm chooses project B, while lenders charge R_B^* and never monitor the firm.

Thus, to find an equilibrium in which the firm invests in the riskless project, we must focus on mixed strategies, in which the firm chooses each of the projects with some positive probability, and lenders randomly monitor this choice.

After financing is provided in period zero, the firm must decide how often it will invest in each of the two projects, and the bank must decide how often it will monitor. Let $\pi \in (0,1)$ be the probability that the firm selects project B, and $\alpha \in (0,1)$ be the probability that each lender monitors the firm in period 1. Since I am looking for a symmetric equilibrium, the total probability that the firm is monitored is $1 - (1 - \alpha)^2$.[11] Finally, let R denote the face value of the debt owed to each lender, so that the firm's total debt is $2R$.

Conditional on the results of its monitoring in period 1, each lender must decide whether to roll over its debt or to demand immediate repayment of its loan. Assume that the firm has no cash assets in period 1, so that it must be liquidated whenever either lender demands repayment, and that all debt contracts contain cross-default clauses, stipulating that the loan is in default whenever another creditor demands early repayment of its debt. Let z be the post-bankruptcy-cost, period-1 liquidation value of the firm. I assume that $z < I/2$, so that this value is insufficient to pay off either of the firm's creditors. Lenders who monitor the firm are first in line for its assets when it is liquidated in period 1, since they are the first to be aware that the firm has cheated. Thus, under a FCFS rule, the firm's assets, z, are distributed only to lenders who actually monitor the firm; since $z < I/2$, nothing remains for a nonmonitoring lender. In contrast, under the PPR, each lender receives $z/2$ when the firm is liquidated in period 1, whether it monitored the firm or not.

Finally, if the firm is not liquidated in period 1, its project matures and revenues are received in period 3. If the firm's project is successful, it pays off its lenders and keeps the balance of its revenues as profit; otherwise, it is liquidated and its assets $(x_l - d)$ are divided equally between the two creditors.

Derivation of an Equilibrium

Since we are looking for a symmetric, mixed-strategy Nash equilibrium, α and π must be chosen so as to make the firm and the lenders, respectively, willing to randomize. That is, each lender's probability of monitoring, α, must be such that the firm earns the same expected return regardless of which project it chooses:

$$(2) \qquad \bar{x} - 2R = (1 - \alpha)^2 \, p \, (x_h - 2R)$$

or

$$(3) \qquad \alpha^* = 1 - \sqrt{\frac{\bar{x} - 2R}{p\,(x_h - 2R)}} \; .$$

Direct differentiation of α^* shows that it is increasing in R. In other words, the firm's moral hazard problem worsens as R gets larger, implying that more monitoring is required to keep it indifferent between the two projects when the interest rate is high.

Similarly, π must be chosen to ensure that lenders are indifferent between monitoring and not monitoring the firm. The competitive loan market imposes the additional constraint that each lender must earn zero expected profit. It follows that π^* and R^* must be jointly chosen to solve

$$(4) \qquad (1 - \pi)R + \pi\left[\alpha\frac{z}{2} + (1 - \alpha)\lambda_1\right] - c - \frac{I}{2} = 0$$

and

$$(5) \qquad (1 - \pi)R + \pi\left\{\alpha\lambda_2 + (1 - \alpha)\left[pR + (1 - p)\frac{x_l - d}{2}\right]\right\} - \frac{I}{2} = 0,$$

where λ_1 and λ_2 are a lender's payoffs from early liquidation when it is the only one to monitor and when it does not monitor, respectively. These two payoffs depend on the bankruptcy rules in effect.

The intuition behind each of these expressions is clear. Equation (4) is a lender's expected return when it monitors the firm. If it discovers that the firm selected the riskless project (which happens with probability $1 - \pi$), it allows the firm to continue until period 2 and receives its

11 I focus on a symmetric equilibrium because of its analytical tractability. The same basic conclusions would follow from a model in which one lender was designated to monitor more frequently than the other.

promised payment R at that time. On the other hand, if it finds that the firm chose project B, it demands immediate repayment.[12] If the other lender also monitored (which happens with probability α), the two lenders divide z equally. On the other hand, if the other lender did not monitor the firm, then the monitoring lender's payoff is λ_1 and depends on the bankruptcy rule in effect. Under FCFS rules, the sole monitor is entitled to all of the firm's liquidation value, while these assets are divided equally under a PPR. Thus, $\lambda_1^{FCFS} = z$, and $\lambda_1^{PPR} = z/2$. Finally, note that the lender's total costs in this case include the monitoring expenses it incurs, c, and its original investment in the firm, $I/2$.

A similar intuition is behind equation (5), the lender's expected return when it does not monitor. With probability $1 - \pi$, the firm chooses the riskless project, and the lender earns R with certainty. With probability π, the firm chooses project B. With probability α, the other lender monitors the firm and demands immediate repayment. In this last case, the *non*monitoring lender receives λ_2, where $\lambda_2^{FCFS} = 0$ and $\lambda_2^{PPR} = z/2$. On the other hand, if neither lender monitors the firm, its project is allowed to mature. With probability p, the project succeeds, paying each lender R. With probability $1 - p$, it fails, and the two lenders split $x_l - d$ between them. Finally, since no monitoring costs are incurred in this case, the interest rate must simply recoup the firm's investment, $I/2$.

Given this setup, we have the characterization of equilibrium in

PROPOSITION 2. *The following strategies constitute a mixed-strategy, sequential Nash equilibrium with short-term debt:*

a) *The firm chooses project B with probability π^* and project G with probability $1 - \pi^*$;*

b) *Each lender chooses to monitor the firm with probability α^* and refuses to renew its loan only after observing the firm has chosen project B; and*

c) *Lenders never liquidate the firm in period 1 when they do not monitor.*

Proposition 2 tells us that short-term debt may be one device for mitigating the firm's incentive to invest in the risky project, B, and that it holds regardless of which bankruptcy rules are in effect. The possibility that it might be monitored and liquidated by one of its lenders gives the firm an incentive to invest in the safe project with some positive probability. Since the deadweight costs of default associated with project B are incurred less often, the firm's ex ante profits are higher.

III. The Relative Efficiency of Bankruptcy Rules

In the last section, I showed how short-term debt with monitoring can be used to lessen a firm's moral hazard problem, improving the efficiency of financial contracting. In this section, I focus on how the institutional structure used to divide the assets of a financially distressed firm can affect the efficiency of these contracts.

The equilibrium derived in the last section was equally consistent with FCFS rules and PPRs. My goal in this section is to show that this mixed-strategy equilibrium is less likely to exist under PPRs, and that when it does exist, the total social cost of the contract will be higher with PPRs. I do this by examining the interest rate in the problem under each of these rules.

For a mixed-strategy equilibrium to exist, R^* and π^* must jointly solve (4) and (5). In addition, the following conditions must be satisfied: $\alpha^* \in (0,1)$, $\pi^* \in (0,1)$, and $R^* \leq \bar{x}/2$.[13]

Because I have assumed that the loan market is perfectly competitive, it is straightforward to measure the relative efficiency of bankruptcy rules by calculating the difference between the firm's expected profits under each of them. Because α^* is chosen to make the firm indifferent between the two projects, the firm's expected profit is simply equal to

$$(6) \quad \bar{x} - 2R.$$

Expression (6) makes it clear that the preferred bankruptcy rule will be the one that minimizes the total face value of the firm's debt.

I am now able to prove the primary result of this paper:

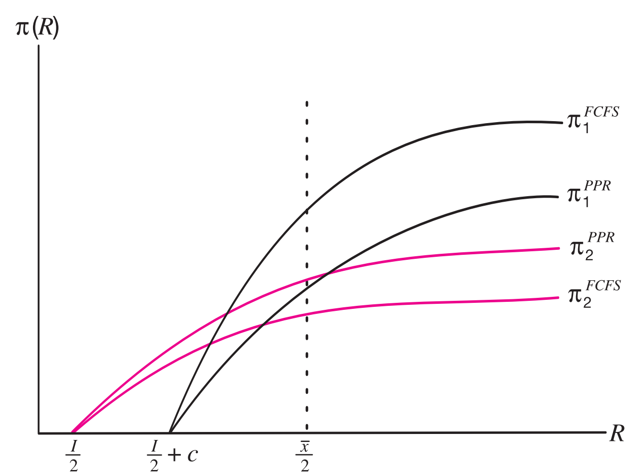
PROPOSITION 3. *The total face value of the firm's debt is lowest under the FCFS rule, meaning that social welfare is highest under this bankruptcy rule.*

12 This is simply assumed in the formulation of expression (4) and is formally proven in proposition 2.

13 If this final condition is violated in any candidate equilibrium, the firm will have no incentive to choose the riskless project ($\pi^* = 1$), giving the lender no incentive to monitor the firm. As the previous section showed, this degenerates to the (inefficient) long-term debt solution.

FIGURE 2

Advantage of FCFS Rules



SOURCE: Author.

Proposition 3 is illustrated in figure 2. Let π_1 be the locus of (π, R) pairs that solve (4), and π_2 the locus solving (5). The leftmost intersection of these loci is the equilibrium.[14]

When the firm is caught investing in project *B*, a FCFS rule gives more to lenders who monitor than does a PPR. Thus, π_1^{FCFS} is everywhere *above* π_1^{PPR}. Similarly, when the firm is caught cheating, lenders who monitor have a higher expected return under a PPR than under a FCFS rule. Hence, π_2^{FCFS} is everywhere *below* π_2^{PPR}. Together, these two facts imply that the first intersection of the two curves under a PPR must be to the right of their first intersection under a FCFS rule. Consequently, the equilibrium under a FCFS rule must entail a lower interest rate.

Proposition 3 affirms that, contrary to the generally accepted view, a bankruptcy institution in which lenders may run on a firm in default to collect their assets can actually be socially preferred to an institution prohibiting such runs. Essentially, PPRs encourage lenders to free ride on the monitoring efforts of others, since these rules give each lender—whether it monitors or not—the same claim on the firm's assets. With FCFS rules, lenders have more incentive to monitor because they get first call on the defaulting firm's assets. This reduces the interest rate needed to give lenders zero expected profits, letting the firm earn a higher return.

Proposition 3 has an immediate corollary:

PROPOSITION 4. *A mixed-strategy equilibrium is less likely to exist under a PPR than under a FCFS rule.*

Proposition 4 implies that equilibrium under PPRs is more likely to degenerate to the pure-strategy, long-term debt equilibrium in which the firm always invests in project *B*. To understand this proposition, note that the largest value that *R* can take in any mixed-strategy equilibrium is $\bar{x}/2$; for any larger *R*, the firm would never choose to invest in project *G*, since doing so would provide it with a negative return. Basically, the shifts in π_1 and π_2 resulting from a move to a PPR make it less likely that the intersection between these two curves will occur within this relevant range.

To summarize, FCFS rules can be beneficial for two reasons. First, socially desirable debt contracts are more likely to be feasible under FCFS rules than when PPRs govern default. Second, the total cost of this debt is lower under FCFS rules, increasing the firm's ex ante expected profit. In short, allowing lenders to run on the firm can be beneficial because it improves lenders' monitoring incentives by compensating them when, and only when, they perform this socially desirable activity.

IV. Concluding Thoughts

This paper questions the standard assumption that preventing lenders from running on a firm is always necessary in bankruptcy. In the model presented here, a moral hazard problem makes the act of monitoring a socially beneficial public good. As a result, the total cost of debt contracting is reduced when the bankruptcy procedure compensates those lenders who monitor a misbehaving firm. Allowing creditors to run on a financially distressed firm to retrieve their assets serves to implement just such a compensation mechanism.

Lately, there has been extensive debate about whether bankruptcy laws should be reformed, and if so, how. One proposal receiving significant attention is by Aghion, Hart, and Moore (1992).[15] They suggest that each of a

14 Since any such intersection provides lenders with zero expected profit, the leftmost intersection results in the lowest possible interest rate for the borrower, making it the equilibrium.

15 See also Roe (1983) and Bebchuk (1988).

firm's creditors should be given an option to purchase the firm's assets from more senior claimants at the value of their claims. This system would guarantee that a distressed firm's assets end up with the individual or group that values them most, and would ensure that economically viable firms will continue. While this proposal would do much to eliminate the ex post inefficiencies associated with modern bankruptcy proceedings, it does not resolve the basic concerns addressed in this paper. Like the PPR I discuss above, their proposal does not consider the impact a proper compensation scheme can have on the probability that bankruptcy will occur in the first place.

The main point of this model with respect to the debate over bankruptcy reform is that policymakers should consider the impact of bankruptcy rules not only on the distribution of a financially distressed firm's assets, but also on the terms of debt contracts. It is this latter influence that has the largest effect on social welfare.

Appendix

Proof of Proposition 1. Holding the interest rate constant, the difference between the firm's profit from project B and project G is $(1-p)(2R-x_l)$. In any equilibrium, $2R \geq I > x_l$, showing that this difference must be positive. ■

Proof of Proposition 2. R^* and π^* are defined in the text so as to ensure that lenders are willing to randomize, and α^* is defined to ensure that the firm is willing to randomize. Thus, it remains to be shown only that 1) lenders will liquidate the firm after monitoring and observing project B; 2) lenders will not liquidate after monitoring and observing project G; and 3) lenders will not liquidate the firm in period 1 when they do not monitor.

1) Upon observing project G, the lender's expected return from liquidating the firm is $z/2$ under a PPR. Thus, for a lender to be willing to liquidate a risky firm under a PPR, it must be the case that

$$(7) \quad \frac{z}{2} > \alpha \frac{z}{2} + 1 - \alpha)\left[pR + (1-p)\frac{x_l - d}{2}\right]$$

$$= \frac{I/2 - (1-\pi)R^*}{\pi} \text{ (by expression [5])}$$

$$= \frac{z}{2} - \frac{c}{\pi} \text{ (by expression [4]),}$$

which must hold since c is positive. An analogous argument shows that the lender will always want to liquidate the risky firm under FCFS rules.

2) The lender's expected return from allowing the riskless project to mature is $R^* > I/2 > z$, verifying that lenders will not force early liquidation in this case.

3) The most a lender can hope to earn from liquidating a firm that it does not monitor is z, which is (by assumption) less than $I/2$, the expected return from allowing this firm's project to mature (by expression [5]). Thus, lenders will allow the firm's project to mature in this case as well. ■

Proof of Proposition 3. Solving (4) and (5) for π as functions of R gives us

$$(8) \quad \pi_1(R) = \frac{R - c - I/2}{R - \alpha z/2 - (1-\alpha)\lambda_1}$$

and

$$(9) \quad \pi_2(R) = \frac{R - I/2}{R - \alpha\lambda_2 - (1-\alpha)[pR + (1-p)(x_1 - d)/2]}.$$

The intersection of these two functions in the positive orthant gives the (π, R) pairs that simultaneously solve (4) and (5). If these curves intersect more than once, the first such intersection is the candidate for equilibrium, since it entails the lowest interest rate.

Now, $\pi_1(R) = 0$ when $R = I/2 + c$, and $\pi_2(R) = 0$ when $R = I/2$. As R gets larger, each of these must move into the positive orthant, since π is a convex weight. As noted in the text, λ_1 is smaller under a PPR than under a FCFS rule. Thus, π_1^{PPR} minorizes π_1^{FCFS}.[16] Similarly, λ_2 is larger under a PPR than under a FCFS rule, implying that π_2^{FCFS} minorizes π_2^{PPR}. This implies that the first intersection of π_1^{PPR} and π_2^{PPR} must lie to the right of the first intersection of π_1^{FCFS} and π_2^{FCFS} (see figure 2). Compared to a FCFS rule, then, a PPR must entail a higher interest rate. ■

■ 16 That is, for every R, $\pi_1^{PPR}(R) < \pi_1^{FCFS}(R)$.

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