

Optimal Resolutions of Financial Distress by Contract

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Abstract

In a financial contracting model, we characterize which debt structures can optimally resolve financial distress as a function of investor protection against tunneling. If investor protection is strong, the first best can be implemented under a debt structure consisting of two classes of debt: one that gives control upon default to a large creditor and induces him to internalize the upside of efficient reorganization, and a second, fully dispersed debt class without control rights. If instead investor protection is low, the second best can be implemented by dispersing control rights among creditors lending under standard “straight debt” contracts. Floating charge financing successfully combines the features of our optimal debt structure in countries with strong investor protection and no restrictions to private contracting on bankruptcy.

JEL classification: G33, K22.

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1 Introduction

The institution of bankruptcy is of central importance for the economy-wide reallocation of resources, especially in downturns when financial distress is pervasive. The traditional economic approach to bankruptcy posits that a state provided bankruptcy procedure is needed to attain an efficient resolution of financial distress (e.g. Hart 2000). The key assumption behind this approach is that firms set their ex ante debt structure without taking financial distress into account. As a result, in the absence of some form of government intervention, ex post conflicts among creditors and between the debtor and the creditors would lead to inefficient reorganization and liquidation, as well as under- and over-investment (Bulow and Shoven 1978).

For many countries, the assumption that ex ante debt structures would give rise to such inefficiencies is justified by the existence of mandatory bankruptcy codes that override private contracts upon default (Djankov et al. 2006, Smith and Strömberg 2005). For example, U.S. Chapter 11 specifies a set of rules governing debt renegotiation that heavily shape the outcome of financial distress. However, in many other countries the parties enjoy greater contractual freedom and often choose to resolve financial distress by way of ex ante contracts. As Franks and Sussman (2005) document for the U.K., one common way to do so is to use floating charge financing. In its basic version a large creditor, typically a bank, lends under both a “fixed charge” (i.e. physical collateral), and a “floating charge”, which is a collateral to the whole reorganized firm, including working capital, intangibles and future cash flows. Upon default, the floating charge holder has the *exclusive* right to reorganize or liquidate the firm. The rest of the lending is dispersed among secured and unsecured claims. Well beyond the U.K., Djankov et al. (2006) confirm that, when legally allowed, floating charge financing is widely used and works well.

Floating charge financing has been surprisingly neglected by the theoretical literature on bankruptcy, which has focused instead on ex post procedures. On the other hand, financial contracting models typically find that creditor control comes with a bias towards liquidation. However, the wide use of floating charge financing suggests that before dismissing the possibility for private contracting to work we need to answer two key questions: What are the economic properties of floating charge financing? Under which conditions can creditor control avoid a liquidation bias and yield an efficient resolution of financial distress?

We address these questions in a model where the firm’s debt structure is set by taking the possibility of financial distress into account. In line with the financial contracting literature (Aghion

and Bolton 1992, Hart and Moore 1998), we assume that contracting is limited, as debt contracts can only allocate control rights over the reorganization v. liquidation decision, and cash flows are less pledgeable than liquidation proceeds. The distinctive features of our approach are to use multiple creditors to counter the controlling creditor(s)' liquidation bias, and to let the extent of cash flows pledgeability to vary.¹ Crucially, we interpret this latter parameter as a proxy for investor protection, inspired by the evidence documenting the strong impact of investor protection on international financing patterns (e.g. La Porta et al. 1998, 2006). In such a setup we ask: How do optimal debt structures resolve financial distress?

We find that the investor protection parameter plays a key role in our analysis. Provided investor protection is strong, the first best can be attained under a debt structure consisting of two classes of secured creditors. One class lends under a security that upon default gives its holders exclusive control over the liquidation v. reorganization decision and pledges them both physical collateral and an equity stake in the reorganized firm. The other class has no control rights but is entitled to cash in some liquidation proceeds. Then, in the optimal debt structure, the former class is fully concentrated on a large lender while the latter is fully dispersed. Thus, as in floating charge financing, upon default control rights are concentrated on a single creditor that has the right to repossess collateral and is also residual claimant to the firm's reorganization value; the rest of the lending is dispersed. Section 4 shows that this debt structure also induces the efficient undertaking of new investment opportunities upon default provided the large lender is given the additional, exclusive right to approve any supra-priority financing. As investor protection becomes weaker only a second best outcome can be attained where the firm is efficiently reorganized but – to ensure break even – some profitable investment opportunities must be passed to prevent the debtor from tunneling most of the resulting cash flows away. Finally, when investor protection is low, committing to liquidation ex post is the only way for the debtor to ensure break even ex ante. Crucially, the debtor can implement this third best outcome by a simple debt structure consisting of one single class of standard “straight debt” contracts whereby each creditor can unilaterally foreclose on (a fraction of) the firm's assets.

The logic of the optimal debt structure prevailing at high levels of investor protection turns out to be particularly insightful. Giving the holder of control rights both physical collateral and equity

¹A few recent papers study bankruptcy from an ex ante perspective, but they either do not consider creditor multiplicity (Ayotte and Yun 2006) or investor protection (Berglöf, Roland and von Thadden 2003), or both (Berkovitch and Israel 1999).

in the reorganized firm provides him with efficient incentives, removing any liquidation and/or under-investment bias on his part. Crucially, this incentive mechanism works best in the presence of a second debt class. Indeed, since liquidation proceeds are easier to pledge than reorganization cash flows, some liquidation proceeds must be redistributed away from the holder of control rights to remove his liquidation bias. Distributing such liquidation proceeds to the second class of creditors without control rights, as opposed to the entrepreneur or to “burn” them, allows to maximize total repayment to *all* creditors.² Then, to avoid collusion among these two classes, control rights are best kept concentrated on a single large lender, while the second class is best dispersed among many small creditors.

The different extent of concentration of our two debt classes is novel to the literature on debt concentration, which has focused on a single debt class (e.g. Bolton and Scharfstein 1996, Diamond 2004). Moreover, while in those papers debt dispersion helps prevent strategic default when cash flows are not pledgeable, in our model debt dispersion helps prevent over-liquidation at relatively high levels of investor protection by avoiding collusion with the large investor. To the extent that such large investor in control in financial distress is interpreted as a “bank”, for example because banks have a comparative advantage in monitoring (e.g. Diamond 1984), our model can thus rationalize the coexistence of “bank” and “arm’s length” debt in a firm’s debt structure and predicts that such coexistence should be observed at relatively high levels of investor protection.³

Broadly speaking, our model shows that stronger investor protection facilitates the use of more flexible debt structures allowing parties to resolve financial distress more efficiently. In this sense, creditor runs and under-investment in financial distress may simply be the unavoidable by-product of poor investor protection. This prediction is consistent with the evidence by Djankov et al. (2006) on resolutions of financial distress around the world and with the evidence in Lerner and Schoar (2005) and Qian and Strahan (2007) on the use of flexible financial contracts around the world. More specifically, we show that provided investor protection is high a purely contractual mechanism such as floating charge financing, which shares many features of our optimal debt structure, has

²Dewatripont and Tirole (1994) rationalize the mix of equity and debt, and Berglöf and von Thadden (1994) rationalize the mix of short and long term debt. The key novelty of our approach is to derive the optimality of multiple securities in a model without managerial effort and to study how the optimality of multiple securities depends on investor protection.

³Arm’s length investors can be interpreted both as bondholders and as dispersed trade creditors. We are not aware of papers that derive the optimality of two differently concentrated debt classes from first principles in a model with ex ante homogenous investors. Existing analyses of bank and arm’s length debt [e.g. Diamond (1991, 1993) and Rajan (1992)] either study the choice between the two as opposed to their optimal mix in an optimal debt structure, or assume that investors are ex ante different, or both.

the potential for solving all the major ex post conflicts stressed by bankruptcy scholars such as inefficient creditor runs (Jackson 1986), the “lazy creditor” problem (Hart 1995) – both inducing secured creditors to over-liquidate – and conflicts between new and old creditors, which may lead to over- and under-investment (e.g. Gertner and Scharfstein 1991). Of course, this result is not meant to dismiss the role of state provided bankruptcy procedures. Rather, it identifies conditions under which, *even if contracting is limited*, ex ante debt structures can implement an efficient resolution of financial distress. In this spirit, in the Conclusions we discuss some implications of our findings for bankruptcy reform in developed and emerging economies.

2 The Model

We describe the basic setup in Section 2.1 and the contracting frictions in Section 2.2.

2.1 The Basic Setup

We study a model of credit in the spirit of Aghion and Bolton (1992) and Hart and Moore (1998). A two-period firm requires an initial outlay of $K > 0$ for the purchase of a physical asset. The firm is run by a penniless entrepreneur whose human capital is indispensable. In period 1, with probability π the firm is liquid and produces a cash flow $y_1 > 0$; with probability $1 - \pi$ the firm is in financial distress and its cash flow is 0. If the firm was liquid in period 1, its period 2 cash flow is \bar{y}_2 ; if instead the firm was in financial distress, with probability μ the firm is viable as a going concern and its period 2 cash flow is \bar{y}_2 , while with probability $1 - \mu$ the firm is also in economic distress and its period 2 cash flow is \underline{y}_2 . To simplify the algebra, we set $\mu = 1/2$. Thus, the firm can be in one of three states of nature, G (“good”), U (“unlucky”) and B (“bad”), (Figure 1).

Figure 1. States of Nature

ω	$\Pr(\omega)$	$y_1(\omega)$	$y_2(\omega)$
G	π	y_1	\bar{y}_2
U	$(1 - \pi)/2$	0	\bar{y}_2
B	$(1 - \pi)/2$	0	\underline{y}_2

At the end of period 1 and before period 2, the physical asset can be liquidated, yielding L . One can think of L as representing the value of the firm’s physical asset in a piecemeal liquidation,

as opposed to the value $y_2(\omega)$ generated by a reorganization. In state U , the reorganization value of the firm $y_2(U) = \bar{y}_2$ can be interpreted both as the value under E , and as the value under an alternative management team generating $y_{ALT} = \bar{y}_2$.⁴

Both investment and liquidation are zero-one decisions (Section 4 allows for partial liquidation). We assume:

A.1: $y_1 > \bar{y}_2 > L > \underline{y}_2 > 0$.

Besides imposing $y_1 > \bar{y}_2$ (which only simplifies the exposition and does not entail a loss in generality), A.1 implies that in the first best the project should be liquidated if and only if reorganization profits are low; in G the project is both liquid and profitable, in U the project is illiquid but eventually profitable. Only in B is the project both illiquid and unprofitable so that it should be liquidated. We also assume:

A.2: $\pi(y_1 + \bar{y}_2) + (1 - \pi)L > K$.

A.2 implies that the net present value of the firm is positive even if its assets are liquidated in U , when continuation is efficient. This assumption only simplifies the exposition of our findings on contract choice; its implications will become clear after Proposition 1. To finance the firm, E tries to borrow from a wealthy investor I under a contract ensuring that I breaks even. To describe the set of feasible contracts, we must specify the contracting frictions in our model.

2.2 Investor Protection

The key contracting friction in our model captures the extent of legal protection of investors against managerial tunneling and is measured by the share $\alpha \in [0, 1]$ of the firm's (first and second period) cash flows that can be pledged to I . The remaining share $(1 - \alpha)$ goes to E . Legal protection against tunneling increases in α . Our model nests the Hart and Moore (1998) case of unverifiable cash flows as a special case when $\alpha = 0$. We thus allow for non-dissipative private benefits (Aghion and Bolton 1992), but the size of such private benefits depends on the extent of investor protection α , using a formulation introduced in a different context by Shleifer and Wolfenzon (2002).

In line with much of the financial contracting literature [e.g. Hart and Moore (1998), Bolton and Scharfstein (1996)], we assume that it is easier to pledge to investors physical collateral rather than cash flows. For simplicity, we assume that the full liquidation value L of physical collateral can

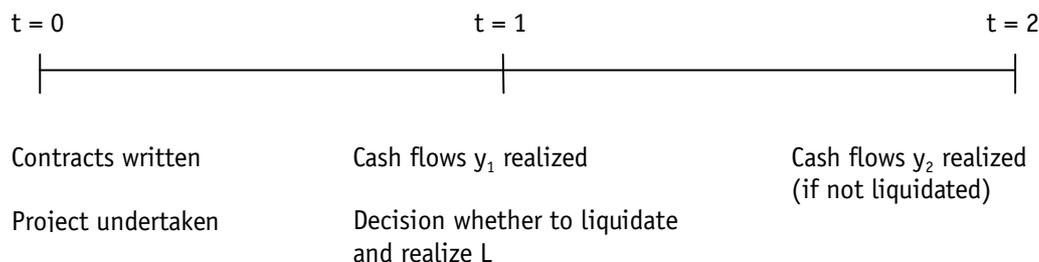
⁴This setup helps us to illustrate our findings in the most intuitive manner, but Appendix A2.1 shows that our basic results generalize in a straightforward way to a general setting where first and second period profits as well as liquidation values are stochastic and take on a continuum of values.

be pledged to I , even though allowing investor protection to increase the pledgeability of physical collateral would not change our results, as long as physical collateral remains easier to pledge than cash flows. As a result of these assumptions, the first period liquidation proceeds pledgeable to I are equal to $L + \alpha y_1(\omega)$, that is to the value of the firm's physical assets L plus the amount $\alpha y_1(\omega)$ of first period cash flows that E was unable to divert. More important, there is a potential incentive for I to reorganize: by doing so, I obtains $\alpha y_2(\omega)$ in period 2, as opposed to 0 in models of unverifiable cash flows. Thus, not only can E fully pledge physical collateral L as in Hart and Moore (1998), but also other less tangible assets up to the extent of investor protection α .

As an additional contracting friction, we assume that the firm's reorganization value is unverifiable by courts. If courts could perfectly verify the firm's reorganization value, then the parties would resolve financial distress by writing a forcing contract where reorganization is implemented if and only if the firm's reorganization value is high. To highlight the role of incentive mechanisms, we assume this possibility away.⁵

What about the parties' information structure? To simplify the exposition here we assume that E and I are perfectly informed about the firm's reorganization value, but Appendix A2.2 shows that our results easily extend to the case where E is privately informed about the firm's reorganization value. Figure 2 shows the timing of the model.

Figure 2. Timeline



We consider contracts where I lends $D \geq K$ to E in exchange for a repayment schedule. In line with Aghion and Bolton (1992), we allow contracts to allocate to E or I the decision of whether to liquidate or reorganize the firm after first period profits and repayment. Crucially, we

⁵In a previous version of the paper we formally proved that our main results (especially those under multiple creditors) are unchanged if we allowed the parties to contract on a noisy signal of $y_2(\omega)$. We interpreted the precision of the signal as an index of courts' ability to verify the firm's reorganization value. These results are available upon request. See Gennaioli (2008) for a formal model of court state verification and contracting.

allow repayments to depend on whether the party in control reorganized or liquidated the firm in financial distress. This assumption allows contracts to provide the party in control with incentives to take an efficient decision. As we shall see, the parties' ability to provide such incentives (and the resulting efficiency of contracts) depends on investor protection α .⁶

3 The Case with One Creditor

We now study the case where E borrows from one creditor. While the spirit of this Section is reminiscent of such papers as Aghion and Bolton (1992) and Hart and Moore (1998), it is useful to build up intuition for the more interesting case where the firm borrows from multiple creditors, and to stress the role of investor protection in shaping the parties' ability to resolve financial distress by contract. For brevity, we focus on the case without ex post renegotiation but we formally study renegotiation in the Appendix.

Suppose that the state is U or B , namely first period repayment is zero and the firm is in financial distress.⁷ In those states, it must be decided whether to liquidate the firm, which is efficient in B , or to reorganize it, which is efficient in U . Bankruptcy scholars stress that in this case the debtor typically prefers reorganization because it allows him to extract private benefits of control, while secured creditors prefer liquidation because they do not see the upside of reorganization (e.g. Hart 1995). In our setup, this conflict may be solved by collateralizing to I the reorganization proceeds $\alpha\bar{y}_2$, and not just certain physical assets as in standard debt contracts. If I is given a claim on the firm's reorganization proceeds and control over the liquidation v. reorganization decision then, provided $\alpha\bar{y}_2 \geq L$, he finds it optimal to liquidate if and only if the state is B , consistent with ex post efficiency. But even if $\alpha\bar{y}_2 < L$ and thus I has a bias for liquidation, an ex ante contract can induce I to make an efficient decision by stipulating a debt write-down S such that:

$$\alpha\bar{y}_2 \geq L - S. \tag{1}$$

⁶Aghion and Bolton (1992) also consider the case where actions are verifiable and note that in this case the allocation of cash flows can serve incentive purposes. However, rather than explicitly solving for optimal contracts, they establish that even in this case similar agency problems to the case of unverifiable actions arise.

⁷Disregarding state G is not important, because contract terms for G are set in isolation. The independence of G from U and B arises because in our model courts perfectly determine if the state is G or not (i.e. if the first period cash flow is 0 or y_1). As a result, G only affects the optimal resolution of financial distress in states U and B by affecting the ex ante break even constraint. The alternative assumption that courts cannot perfectly tell apart strategic and liquidity defaults would only complicate the analysis without changing our main results. Note that, as in Hart and Moore (1998), although strategic default in state G is a theoretical possibility, it will never arise in equilibrium under optimal contract terms.

Thus, by contracting ex ante on the firm's reorganization value, I can be made to internalize the social benefit of liquidation, triggering an ex post efficient outcome. Clearly, this contract can only be used if it is ex ante feasible, which is indeed the case provided:

$$\pi(\alpha y_1 + \bar{y}_2) + \frac{1-\pi}{2}[\alpha \bar{y}_2 + (L-S)] \geq K, \quad (2)$$

where, as shown in the Appendix, $\alpha y_1 + \bar{y}_2$ is the maximal repayment I can obtain in G . When investor protection is strong, contracts can give I the incentive to resolve financial distress efficiently and condition (2) is met (if $\alpha = 1$ then $S = 0$ and E can pledge all cash flows to I). When instead α is low break even is hard to attain because low α reduces repayment in G and U [i.e., $\alpha y_t(\omega)$ is low] and increases S . This last effect is key: when investor protection is low providing I with incentives may be so costly that it undermines ex ante break even (if $\alpha = 0$, I efficiently reorganizes if and only if $S = L$, which yields break even only under the very restrictive condition $\pi \bar{y}_2 \geq K$).

If inducing I to efficiently reorganize is infeasible, the parties may let E control the reorganization decision upon default. I is still pledged both reorganization cash flows $\alpha y_2(\omega)$ and physical collateral $L - S$, but now the debt write-down S must induce E to efficiently liquidate the firm in B . This requires:

$$(1 - \alpha)\bar{y}_2 \geq S = (1 - \alpha)\underline{y}_2. \quad (3)$$

E efficiently liquidates the firm when the contract compensates him for the control rents he loses in liquidation. To simplify the analysis, we call E -control this arrangement and I -control the previous one to stress the key difference between them, namely the identity of the party controlling the reorganization decision. Also, E -control is ex ante feasible when condition (2) is met (and thus when α is large), although now S equals $(1 - \alpha)\underline{y}_2$ and not the level implied by expression (1).

If neither E - nor I -control are feasible, ex ante break even requires E to sacrifice ex post efficiency. A simple way to go is for I to commit to terminating the firm upon default by writing a contract whereby foreclosure automatically follows non-repayment. We call this arrangement, akin to the Hart and Moore (1998) debt contract, *straight debt* to stress its similarities with the standard notion of debt. Because in financial distress *straight debt* yields L to I , it facilitates break even relative to both I - and E -control when $\alpha \bar{y}_2 < L$. Unfortunately, this ex ante benefit comes at the cost $(\bar{y}_2 - L)/2$ of over liquidating the firm in U . The proposition below illustrates the impact of α on contracts and welfare:⁸

⁸To preserve our focus on contracts, Proposition 1 only reports which of the above defined contractual typologies

Proposition 1 *There exist α_I, α_E and α_S with $\min(\alpha_I, \alpha_E) \geq \alpha_S$ such that for $\alpha \geq \alpha_I$ the parties can attain the first best under I -control. Provided $\alpha_E \leq \alpha_I$, E -control allows the parties to attain the first best also in $\alpha \in [\alpha_E, \alpha_I)$. For $\alpha \in [\alpha_S, \min(\alpha_I, \alpha_E))$, the parties attain the second best under straight debt. For $\alpha < \alpha_S$ the firm is not financed.*

The proof is in the Appendix. *Straight debt*, E -control and I -control are the most efficient contracts for the parties to resolve financial distress.⁹ As in Aghion and Bolton (1992) the choice between entrepreneur and investor control is a key dimension in financial contract design. The novel message of Proposition 1 is that investor protection α shapes the optimality of different contracts by shaping the trade-off between ex ante and ex post efficiency. If α is high ($\alpha \geq \alpha_I$), the parties reach the first best with I -control. If α is so low that I -control is infeasible, the parties may attain the first best with E -control. Provided investor protection is sufficiently good (i.e. $\alpha \geq \alpha_E$) this latter contract could still be feasible because at low α it is cheaper to incentivize E rather than I . If α is very low, tunneling of the firm by E is a major problem for I , creating pressure for a quick piecemeal sale. To attain break even, I commits to always liquidate ex post by using *straight debt*. Over-liquidation is thus the price to pay to ensure break even at low α . Thus, in our model the contractual inclusion of automatic foreclosure on the debtor's physical assets depends endogenously on α .¹⁰ Finally, when α is lowest (i.e. $\alpha < \alpha_S$) the firm is not financed.

The key lesson of this one creditor model is that higher investor protection increases the efficiency of contractual resolutions of financial distress by allowing contracts to collateralize the firm's reorganization value, not just specific physical assets, thereby providing investors with incentives for efficient reorganization. In practice, the ability of I -control to attain the first best rationalizes

is used as a function of α . Detailed Proofs, including the expression for total debt capacity at different levels of α , can be found in Appendix 1.

⁹In principle, since parties are symmetrically informed about the firm's reorganization value, the parties might include in their contract a revelation game (Maskin 1999) of the following sort. The parties separately report the state of nature. The contract specifies that if both reports are U the firm is reorganized, if both reports are B the firm is liquidated. If reports disagree, the firm is liquidated and the proceeds are paid to charity. This contract induces a truth telling Nash equilibrium implementing the first best with the appropriate assignment of payouts. Unfortunately, however, the players may also coordinate on two other Nash equilibria (always say B or always say U , where the latter equilibrium could be eliminated by fining the investor ex post for having lied). As a result, whenever feasible, E -control and I -control dominate this revelation game. When instead both E and I -control are infeasible, the revelation game may improve upon straight debt, although the revelation game itself is infeasible for low α because in financial distress it repays at most $(1/2)(\alpha\bar{y}_2 + L)$ to I . Crucially, in Section 4 we shall see that when E borrows from multiple creditors I -control is always preferable to the revelation game.

¹⁰Two clarifications are worthwhile at this point. First, Assumption A.2 implies that if *straight debt* guarantees financing, E prefers to sign it rather than doing nothing, but the main features of contract choice remain valid even if A.2 is relaxed. Second, the Proof of Proposition 1 shows that allowing for ex post renegotiation does not affect our main results. Introducing renegotiation only reduces investor repayment in G , thereby uniformly increasing $\alpha_I, \alpha_E, \alpha_S$, but it neither affects the comparison of different contracts nor the role of investor protection.

the use of the *floating charge*, a security used in many common law countries (Djankov et al., 2006). Unlike the fixed charge, which corresponds to collateral over certain specific physical assets, the floating charge can be extended to cover the whole pool of the company's assets, including intangibles and working capital (i.e. cash, receivables and future cash flows). In the context of our model, a floating charge corresponds to pledging to I the reorganization proceeds $\alpha\bar{y}_2$. In line with the above analysis, one way to implement our I -control contract is to give an investor: 1) a floating charge, 2) a fixed charge on some of the firm's physical assets (i.e. on $L - S$), and 3) the right to reorganize v. liquidate the firm upon default. Remarkably, these features coexist in the observed use of floating charge financing (e.g. Franks and Sussman 2005), which can thus be viewed as inducing I to internalize the social benefits of reorganization and liquidation by giving him both physical and non-physical collateral.

The incentive mechanisms built into our I - and E -control contracts are also related to the use of a convertible security where I 's debt is converted into equity upon default. Aghion, Hart and Moore (1992) advocate conversion of all debt into equity upon default.¹¹ Like the floating charge, such conversion allows contracts to pledge not only liquidation but also reorganization proceeds. However, there is an important difference between the two mechanisms. By giving both an equity stake in the reorganized firm and physical collateral, the floating charge allows the investor to internalize the benefit of efficient continuation also when $\alpha\bar{y}_2 < L$. By contrast, under conversion of debt into equity the investor would obtain the same share of liquidation and reorganization proceeds, thereby inefficiently liquidating the firm whenever $\alpha\bar{y}_2 < L$. In the context of the traditional ex post approach to bankruptcy, the optimality of implementing a debt write-down S to controlling creditors upon default might in turn be viewed as providing an efficiency justification to violations of priority.

This analysis already rationalizes some features of floating charge financing, but two questions remain open. First, in the real world floating charge financing consists of different debt classes with different concentration. Thus, to assess the potential of floating charge financing it is key to study the multiple creditors case. Second, with one creditor the first best is sometimes easier to attain under E -control as opposed to I -control. In Section 4 below we address both of these issues.

¹¹In contrast to our approach, Aghion, Hart and Moore (1992) do not derive their proposal in a formal ex ante model of optimal contracting, nor do they stress the role of investor protection. Most important, as we shall discuss in the Conclusions, the AHM proposal is similar to our E -control contract in the single creditor case and it is significantly different from our optimal debt structure in a multiple creditors setting.

4 Multiple Creditors and Floating Charge Financing

We introduce multiple creditors by assuming that the firm's physical assets feature constant returns to scale and can be partially liquidated. That is, after liquidating a share $f < 1$ of the firm's assets, total output is fL plus the continuation value $(1 - f)y_2(\omega)$. This assumption of constant returns to scale only helps simplify the algebra and we will relax it immediately after deriving Lemma 1.

Before studying the properties of the optimal debt structure, it is important to stress that in our model upon default all of the three leading inter-creditor conflicts stressed by bankruptcy scholars can arise: the conflict among multiple secured creditors leading to inefficient runs on the firm's assets (e.g. Bulow and Shoven 1978, Jackson 1986), the conflict between secured and unsecured creditors (e.g. Hart 1995, Manove, Padilla and Pagano 2001), and the conflict between old and new creditors leading to over- or under-investment in financial distress (e.g. Gertner and Scharfstein 1991). Section 4.2 allows for the arrival of new creditors and studies the optimal debt structure in that case. For now, we focus on the first two conflicts, which occur among existing creditors. The following numerical examples show that under certain debt structures both the conflict among secured creditors and the conflict between secured and unsecured creditors can arise in our model and lead to over-liquidation.

Example. Suppose that $L = 10$, $y_1 = 100$, $\bar{y}_2 = 32$, $\underline{y}_2 = 6$, $\alpha = 1/2$. The ex post efficient resolution of distress is also ex ante optimal because it maximizes repayment to the creditors. The maximum (first and second period) payout to creditors in state G is $(1/2) * 100 + 32 = 82$. Suppose that creditors as a group are owed 88 and the debt structure does not take financial distress into account. Furthermore, suppose that the multiplicity of creditors prevents them from bargaining ex post.¹² The following two outcomes may then arise in financial distress.

A (inefficient run). There are two senior secured creditors. Each of them is entitled to a first period repayment of 10. Each creditor can liquidate the firm's physical assets and obtain 10 in case of default. If both creditors exercise their liquidation rights, each of them gets 5. All other creditors are unsecured. Clearly, this debt structure leads to efficient liquidation in state B . Consider now state U . If both secured creditors wait until the second period, they share $(1/2) * 32$, each getting 8. If they both liquidate, each obtains 5. As a result, efficient continuation is socially profitable for them. Unfortunately, it is not in the creditors' individual interest: if one creditor liquidates and the other does not, the former obtains 10 and the second obtains nothing. This is an example of

¹²This assumption of no ex post bargaining is commonly invoked to justify state intervention in financial distress.

a *prisoner's dilemma*. As a result, in state U there will be a run on the firm's assets, leading to inefficient liquidation. This inefficiency arises because both creditors have control rights on the same pool of assets.

B (*lazy secured creditor*). There is only one secured creditor, who has all the liquidation rights and is entitled to a first period repayment of 10. All other creditors are unsecured. This debt structure leads to efficient liquidation in B . Consider now state U . Irrespective of the outcome, the secured creditor obtains 10. As a result, he has no particular incentive to reorganize the firm, in spite of the fact that reorganization would benefit creditors as a whole. The intuition is best seen by assuming that the creditor is uninformed about the firm's reorganization value but can acquire information at a positive cost. Clearly, the secured creditor sees no benefit to acquiring information, although creditors as a whole would be willing to spend up to 3 to gather information about the reorganization value. This inefficiency arises because the secured creditor's payoff is the same under liquidation and efficient reorganization.

These examples illustrate two problems that may arise with many creditors. In both cases the debt structure plays an important role. In the first case, there were too many liquidation rights. In the second case, the repayment schedule of secured debt was too flat across states.

4.1 The Optimal Debt Structure

We now study how the optimal debt structure can deal with those problems and to what extent it depends on investor protection. To simplify the exposition, we first illustrate two key properties of the optimal debt structure under no ex post renegotiation in Lemmata 1 and 2. Proposition 2 then describes the optimal debt structure when ex post renegotiation is allowed.

From the above examples it is easy to see that, absent ex ante feasibility problems, the I -control contract derived in Section 3 can help resolve conflicts among existing creditors. Indeed:

Lemma 1 *In the case of borrowing from $n > 1$ creditors, E can replicate the one-creditor outcome attained under I -control by giving each creditor an I -control contract, that is by giving each creditor the right to liquidate and cash a share l^*/n of the firm's physical assets and pledging each creditor a share $1/n$ of reorganization proceeds, where $l^* \in [\alpha(\underline{y}_2/L), \alpha(\bar{y}_2/L)]$.*

By pledging both reorganization proceeds and physical collateral, the entrepreneur can provide each creditor with the incentive to efficiently reorganize or liquidate his share of the firm. By using

these incentives, the entrepreneur can replicate the one creditor outcome of I -control under multiple creditors.¹³ This scheme creates unanimity among creditors over the efficient reorganization decision, thereby avoiding both inefficient runs and lazy creditor problems. These properties can be illustrated clearly within the previous numerical examples A and B :

There are two secured creditors, 1 and 2, each has physical collateral of 5. In financial distress, each of them can unilaterally liquidate its own physical collateral. In reorganization, each creditor is entitled to receive $1/2$ of equity. If a creditor liquidates, he gets 5. If instead a creditor reorganizes, he gets $(1/2) * (1/2) * 6 = 1.5$ in state B and $(1/2) * (1/2) * 32 = 8$ in state U . As a result, if creditors know the state, they implement the efficient reorganization policy. There are neither inefficient runs nor lazy creditors. Moreover, even if creditors are uninformed and on average lose from reorganization (they get less than 5), *each of them* is willing to spend up to 1.5 to obtain information about the firm's reorganization value – thus, contracts can yield an optimal resolution of financial even if, as stressed by Kahl (2002), something new is learned in financial distress.

This result suggests that creditor runs and lazy creditors are more likely the by-product of a sub-optimal debt structure than intrinsic problems of financial distress. One way to avoid these conflicts is to pledge to each creditor holding liquidation rights both a share of reorganization proceeds and physical collateral under the same I -control contract so as to induce them to internalize the social value of reorganization. Whenever I -control contract is feasible, Lemma 1 shows that this arrangement resolves inter-creditor conflicts and yields an efficient resolution of financial distress.

Remarkably, it turns out that in our model under multiple creditors E can do even better: by borrowing from (at least) two classes of secured creditors E can improve upon the one-creditor outcome and also avoid using E -control altogether. The optimal debt classes are the following:

Lemma 2 *The debt structure maximizing investor repayment and attaining an ex post efficient resolution of financial distress consists of two classes of secured debt. One class is given control rights under an I -control contract. The second class has no control rights but has cash flow rights over the remaining liquidation and reorganization proceeds. In this arrangement, total expected repayment to creditors equals $\pi(\alpha y_1 + \bar{y}_2) + (1 - \pi)(\alpha \bar{y}_2 + L) / 2$.*

¹³Obviously, since the possibility of splitting the firms into n equal parts heavily relies on constant returns and is most likely unrealistic, Lemma 1 should just be viewed as an illustration of the possibility to use incentives to make the preferences of all creditors congruent with ex post efficiency. As we shall see in Proposition 2, the optimal debt structure does not rely on splitting the firm and thus on the assumption of constant returns.

One class of creditors lends under an I -control contract, another class has no control rights. The separation of control and cash flow rights allows contracts to divorce the provision of incentives from total repayment, thereby reducing the incentive costs of I -control. To see this, suppose that $\alpha\bar{y}_2 < L$. Then, because liquidation proceeds are easier to pledge than reorganization cash flows, some liquidation proceeds must be redistributed away from the holder of control rights so as to give him the incentive to efficiently reorganize. With the single class of debt of Lemma 1, this is attained by redistributing to E an aggregate debt write-down $S = L - \alpha\bar{y}_2$, equally split across the individual creditors each of whom now bears a write-down of S/n . As shown by expression (2) this debt write-down reduces creditors' repayment under liquidation, thereby reducing debt capacity. If instead E borrows from two classes of secured creditors where only one of them holds liquidation rights under an I -control contract, the redistribution S can be made to the holders of the other class of debt, and not to E , thereby maximizing creditors' repayment. Thus, borrowing from two distinct debt classes allows E to reduce the ex ante cost of providing incentives to investors because it allows creditors to obtain $(1/2)(\alpha\bar{y}_2 + L)$ upon default, as opposed to $(1/2)(\alpha\bar{y}_2 + L - S)$ under a single debt class. One consequence of this fact is that now, provided:

$$\pi(\alpha y_1 + \bar{y}_2) + (1 - \pi)(\alpha\bar{y}_2 + L)/2 \geq K, \quad (4)$$

E can always attain the first best by giving control rights to a single debt class lending under an I -control contract. Notice that (4) is the maximum that can be possibly repaid to creditors under a first best optimal reorganization policy. Not only does the issuance of the two classes of debt above increase the feasibility of I -control, it also implies that – unlike in the single creditor case – with two classes of debt E -control is never used. Indeed, if E controls the reorganization decision, incentive provision implies that the debt write-down S must necessarily benefit E , thereby reducing investor repayment below (4). In other words, in our model it is never optimal to let E control the firm upon default and adjust his cash flow rights to provide him with efficient incentives because those incentives would be too costly ex ante. When the debtor borrows from multiple creditors there is a natural tendency for the optimal debt structure to allocate control rights to some investor(s) upon default.

One objection to Lemma 2 is that ex post collusion among creditors can undermine the separation of liquidation and repayment rights attained by issuing two classes of debt. If creditors as a group are entitled to the full liquidation proceeds then, whenever creditors as a group lose

from reorganization (i.e. $\alpha \bar{y}_2 < L$), they may collude against E and liquidate the firm in state U . Put differently, the creditor(s) without control rights could bribe the creditor(s) holding control rights into inefficient liquidation. To address this and other possible concerns we now study the optimal debt structure under ex post renegotiation among creditors that, as we shall see, allows us to analyse the optimal concentration of creditors (i.e. the number of creditors in each class), so far an irrelevant dimension.

4.1.1 Exogenous Coalition Formation

In the bankruptcy literature it is often assumed that renegotiation among two or more creditors is impossible (e.g. Berglöf et al. 2003). Since such a stark assumption would immediately prevent any bargaining between the holders of the two classes of debt, we assume more realistically that even with multiple creditors bargaining can take place within a coalition of creditors, as long as such a coalition forms. Thus, to study such bargaining process we need to specify a process of coalition formation among $n > 1$ creditors. We assume:

A.3: With a total of N creditors, a coalition of $n \leq N$ of them forms with probability $P(n|N) = [N!/(N-n)!n!]/2^N$.

Under A.3 coalitions form by random assignment and, intuitively, if N is larger it becomes harder to form an encompassing coalition of creditors. While our results do not depend on it, assumption A.3 allows us to show in the most intuitive way the determinants of the optimal concentration of creditors, abstracting from the possibility of creditors' holdouts. In Section 4.1.2 we relax assumption A.3 and allow for endogenous consolidation of claims by any ("vulture") investors, to find that considering creditors' holdouts strengthens our results.

Given a debt structure consisting of a number N_c of secured claims holding control rights under an I -control contract and N_{nc} secured claims without control rights, renegotiation works as follows: after a coalition between $n_c \leq N_c$ holders and $n_{nc} \leq N_{nc}$ non-holders of liquidation rights is formed, the members of the coalitions bargain over the liquidation decision and all bargaining power is held by the group of creditors holding liquidation rights (this assumption only simplifies the analysis; what matters for our results is that it is more difficult to form a coalition as n increases). Under A.3, we find:

Proposition 2 *There exists $\hat{\alpha}_I$ such that, for $\alpha \geq \hat{\alpha}_I$, the first best can be implemented by giving all control rights to one large secured creditor (i.e. $N_c = 1$) who is pledged all reorganization proceeds*

and must distribute an amount $S = L - \alpha \underline{y}_2$ of liquidation proceeds to an infinite number of creditors without control rights (i.e. $N_{nc} = \infty$). If $\alpha_S \leq \alpha < \hat{\alpha}_I$, E cannot do better than committing to always liquidate the firm upon default by issuing straight debt contracts with standard foreclosure rights to (any) number of secured creditors. If $\alpha < \alpha_S$, the project is not financed.

When ex post renegotiation is allowed then, provided investor protection is sufficiently large, the first best is attained by fully concentrating liquidation rights on a large investor lending under an I -control contract, and by fully dispersing the creditor class without liquidation rights. As a result, in the optimal debt structure many creditors have the right to collect some liquidation proceeds but only one creditor can unilaterally decide whether to totally or partially liquidate the firm irrespective of the other creditors' ex post preferences. As previously seen, I -control gives the investor holding control rights the incentive to implement the first best liquidation policy while the issuance of two classes of debt reduces the ex ante cost of giving such incentives. In addition, the concentration of control rights on a single, large creditor and the dispersion of the other claims is optimal because it prevents the formation of a coalition of creditors that is sufficiently large and affluent to bribe the holder of control rights into inefficient liquidation.¹⁴ This result that different debt classes should optimally have different control rights and different degrees of concentration to prevent collusion among them is novel to the financial contracting literature, which has thus far studied only the optimal concentration of a single class of creditors (e.g. Bolton and Scharfstein 1996, Diamond 2004), and helps rationalize the coexistence of bank and public debt, as opposed to the choice between them (e.g. Diamond 1991, 1993; Rajan 1992; von Thadden 1995).

If instead investor protection is low (i.e. $\alpha_S \leq \alpha < \hat{\alpha}_I$), the first best cannot be attained and the optimal debt structure induces liquidation also in U to foster creditors' break even. The debtor can implement this outcome by issuing only *straight debt* contracts to multiple secured creditors.¹⁵

¹⁴Notice that the optimal debt structure is also immune to other potential problems created by renegotiation. For example, the incentive properties of I -control prevent the creditor holding control rights from threatening other creditors that he will inefficiently reorganize or liquidate the firm, so as to force them to accept an opportunistic distressed exchange. The intuition is that, because the holder of control rights has the incentive to put a financially distressed firm to its most efficient use, his threats of doing the opposite are not credible. In principle, the creditor holding control rights may also threaten the debtor to precipitate financial distress and take over the firm. In our model, if E chooses to repay his debt, there is no way in which the creditors can precipitate financial distress. However, even if such a threat were available, it would be easy to avoid it in our model. Indeed, it is always possible to set the size of the equity stake and the repayment under liquidation low enough that the creditor loses from financial distress. As a result, the creditor does not want to precipitate it.

¹⁵Under multiple creditors, we have allowed for partial liquidation. Thus, for $\alpha_S \leq \alpha < \alpha_C$, break even is also attained by a *straight debt* contract that in U and B liquidates a fraction $f < 1$ of the project. Intuitively, partial liquidation improves upon full liquidation if and only if over-liquidation is more costly than under-liquidation, i.e. if $L < (\bar{y}_2 + \underline{y}_2)/2$. See the Appendix for details.

Although this debt structure paves the way for creditors' runs in financial distress, these runs are not suboptimal in a constrained sense because – given low investor protection – the firm's physical assets should be always liquidated upon default.¹⁶ In this sense, Proposition 2 indicates that creditor runs and other ex post conflicts among creditors may be the by-product of a low level of investor protection, which prevents the possibility for the debtor to issue debt structures triggering an efficient resolution of financial distress. The benefit of investor protection in fostering the use of more flexible debt structures exploiting multiple classes of debt characterized by different degrees of control and concentration is novel to the literature on financial contracting with multiple investors (e.g. Dewatripont and Tirole 1994, Berglöf and von Thadden 1994, Winton 1995, Park 2000), which has abstracted from the role of investor protection.¹⁷

These results on the impact of investor protection on the optimal debt structure and welfare rationalize the empirical findings that more developed countries have a comparative advantage at writing more flexible financial contracts (Lerner and Schoar 2005, Qian and Strahan 2007) and at more flexible resolutions of financial distress (Djankov et al. 2006).

Remarkably, our optimal debt structure closely resembles the resolution of financial distress as carried out in the U.K. with the extensive use of floating charge financing. Upon deciding for reorganization, the floating charge holder leaves the management in control. Upon deciding for liquidation, the floating charge holder usually appoints a professional agent, e.g. a receiver. In turn, the receiver assumes all the powers of the company's board of directors on behalf of the

¹⁶In principle, the same debt structure used at $\alpha \geq \hat{\alpha}_I$ could be made consistent with the outcome of always liquidating the firm just by giving the creditor with control rights insufficient incentives to reorganize. We prefer to underscore the possibility to implement this outcome under debt structure dispersing straight debt among several creditors to highlight the idea that at low α phenomena such as creditors' run may be constrained efficient. In a similar vein but in a setting with unverifiable cash flows (akin to $\alpha = 0$) Bolton and Scharfstein (1996) argue that dispersion of control rights deters strategic default and increases debt capacity. We do not explicitly model this effect but we note that, consistent with our model, it would imply that for low α dispersion of liquidation rights is likely to be optimal. For high α instead, deterring strategic default is less important and concentration of liquidation rights on one creditor is likely to be optimal, again consistent with our model.

¹⁷There are also other differences between our model and these papers. In Dewatripont and Tirole (1994), the coexistence of debt and equity allows the debt structure to give incentives to the manager to exert effort and to an investor to liquidate the firm after bad performance. In their model, in the absence of a managerial effort choice, a single security would be optimal.

Berglöf and von Thadden (1994) also stress the role of managerial moral hazard by showing that issuing short and long term debt might maximize the debtor's incentive to repay. In our model instead, the issue is not to incentivize the manager but the investor and the presence of a second security allows to do so at zero ex ante cost.

In a costly-state-verification model Winton (1995) derives the optimal mix of secured and unsecured claims as a function of exogenous verification costs. In our model instead the ex ante and ex post costs of different claims are determined endogenously as a function of imperfect enforcement.

In a model where different investors have access to different monitoring technologies, Park (2000) studies the optimal debt structure when the moral hazard problem is particularly severe and finds that it is optimal for the entrepreneur to borrow from two classes of debt. In contrast, we derive the optimal debt structure in a model without monitoring and in our model investors do not differ ex ante.

floating charge holder (e.g. Davies 1997, p. 385). Because fixed charges are usually senior to the floating charge, large lenders such as banks often take both a fixed and floating charge. The floating charge gives the bank control rights over the reorganization decision and the fixed charge gives it seniority in liquidation, ahead of any preferential claims and unsecured creditors. The other claims are then dispersed. Franks and Sussman (2005) document that floating charge financing constitutes an effective mechanism to resolve financial distress in the U.K. In particular, there is no litigation in court, there are no inefficient runs, and the floating charge holder's typical response to financial distress is an attempt to rescue the firm rather than to liquidate it automatically. In a large cross section of countries, Djankov et al. (2006) document that when it is legally allowed, the floating charge is widely used and performs well.

4.1.2 Endogenous Coalition Formation

We now show that the optimal debt structure of Proposition 2 remains optimal even if coalitions of creditors without control rights can form endogenously via the consolidation of claims in secondary markets. The intuition is that the dispersion of those claims in the optimal debt structure gives rise to a typical holdout problem (Gertner and Scharfstein 1991), thereby preventing any such consolidation.

Suppose the firm is in state U and that $\alpha\bar{y}_2 < L$, namely reorganization is socially efficient but creditors as a whole lose from it. Furthermore, suppose that $\alpha \geq \hat{\alpha}_I$ so that the first best can be implemented with the debt structure of Proposition 2. The question then arises, is the previous debt structure robust to the consolidation of dispersed claims? To see that, notice that in U the large secured creditor is owed $\alpha\bar{y}_2$ in reorganization and $\alpha\underline{y}_2$ in liquidation. Suppose that there are N_{nc} creditors holding no liquidation rights in the optimal debt structure. Each of them is owed 0 in reorganization and $(L - \alpha\underline{y}_2)/N_{nc}$ in liquidation. By assumption, dispersed creditors are owed more under liquidation than under efficient reorganization. Suppose now that a party (e.g. one of the creditors) considers launching a tender offer for dispersed claims in the attempt to bribe the holder of liquidation rights and induce (inefficient) liquidation. Will that party be able to consolidate a sufficient number of dispersed claims so as to be able to bribe the holder of control rights? The answer is yes if the bidder can buy a number M of dispersed claims at a price p such that

$$\alpha\bar{y}_2 \leq \alpha\underline{y}_2 + (M/N_{nc})(L - \alpha\underline{y}_2), \quad (5)$$

namely if the bidder can buy enough claims to induce the holder of liquidation rights to internalize the loss suffered by other creditors in reorganization. Condition (5) is equivalent to condition $M \geq M^* \equiv N_{nc}\alpha(\bar{y}_2 - \underline{y}_2)/(L - \alpha\underline{y}_2)$. As a result, the tender offer succeeds if and only if at least M^* dispersed debtholders sell their claim.

Does there exist an equilibrium where this happens? The answer is no. To see that, suppose that there is a negligible but strictly positive cost of bidding. Then, if the bidder expects $M < M^*$, his demand for claims $M^d(p)$ in the secondary market is N_{nc} for $p < 0$, and 0 otherwise. If instead the bidder expects $M \geq M^*$, his demand for claims $M^d(p)$ in the secondary market is N_{nc} for $p < (L - \alpha\underline{y}_2)/N_{nc}$ and 0 otherwise. When N_{nc} is large and each creditor does not expect to be pivotal, the supply of claims depends on the creditors' (rational) expectation about M . Thus, if creditors think that $M < M^*$, then the supply is 0 for $p < 0$, any number in $[0, N_{nc}]$ for $p = 0$ and N_{nc} otherwise. If creditors think that $M \geq M^*$, then supply is 0 for $p < (L - \alpha\underline{y}_2)/N_{nc}$, any number in $[0, N_{nc}]$ for $p = (L - \alpha\underline{y}_2)/N_{nc}$ and N_{nc} otherwise. It is immediate to see that demand and supply can never be equal at $M \geq M^*$. Indeed, at price $p = (L - \alpha\underline{y}_2)/N_{nc}$ the bidder has no incentive to buy any claim. The only equilibrium is thus one where $p = 0$ and $M = 0$.

Indeed, since for the bidder to have appropriate incentives to buy p must be less than the fundamental value of the claim, each creditor prefers not to sell, hoping that the others will sell. Since in the optimal debt structure $N_{nc} = \infty$, it seems reasonable to assume that no creditor expects to be pivotal. As a result, no consolidation of claims can occur in equilibrium. The intuition is that the dispersion of the claims without control rights gives rise to a typical holdout problem, preventing their consolidation and allowing the debt structure of Proposition 2 to attain the first best. Thus, when allowing debt structures to reflect the possibility of financial distress, the holdouts of dispersed creditors are not necessarily harmful as commonly assumed (e.g. Gertner and Scharfstein 1991), as they can allow the debtor to beneficially separate control and cash flow rights among different classes of investors.¹⁸

4.2 Optimal Debt Structure with Arrival of New Creditors

Another argument often advanced to justify government intervention in bankruptcy pertains to the possibility that the firm acquires new creditors as time passes (e.g. Hart 2000), because in

¹⁸So far we have abstracted from the potential costs arising from creditors' dispersion. For example, Bris and Welch (2005) note that creditors' dispersion may make them vulnerable to the debtor, eventually undermining break even. In Appendix A2.3 we formally model this possibility and show that in that case the debtor faces a tradeoff between the ex post benefit of dispersing claims and its ex ante cost, reducing repayment.

the presence of conflicts between old and new creditors the initial debt structure may become suboptimal. We now study whether the optimal debt structure can deal with the problem of the arrival of new creditors, and to what extent the optimal debt structure in such a case depends on investor protection.

Sequential arrival of creditors naturally arises when the firm faces new investment opportunities¹⁹, as the conflict between existing and new claimholders may result in under- as well as over-investment (e.g. Myers 1977, Jensen and Meckling 1976, Gertner and Scharfstein 1991). For concreteness, suppose that in financial distress, before observing whether liquidation or reorganization is efficient (i.e. before deciding whether to reorganize or liquidate), the firm has the opportunity to improve an existing line of business by investing $F > 0$.²⁰ The cash flow from such investment is $r \geq 0$. If the investment is undertaken, continuation cash flows increase to $y_2(\omega) + r$, while liquidation cash flows are instead constant at L . The return r is perfectly observed at the time of re-investment $t = 1$, but is uncertain ex ante, i.e. at $t = 0$, and distributed in the interval $[0, r_{\max}]$ according to the c.d.f. $R(r)$. The return r is also unverifiable by courts. As a result, E cannot issue claims specifying the re-investment policy as a function of r . The debt structure must instead specify a mechanism for taking the investment decision. We assume:

$$\mathbf{A.4:} \quad r_{\max} < \min \left[L - \underline{y}_2, 2F/\alpha \right].$$

In words, the cash flow r generated by the new investment is sufficiently small that it does not affect the efficiency of reorganization versus liquidation [even if investment takes place, in state B liquidation is better than reorganization, that is $\underline{y}_2 + r_{\max} < L$], and is never so large that existing creditors would gain for sure by undertaking it (i.e. $\alpha r_{\max}/2 < F$). The first condition is imposed for simplicity, the second to keep the analysis interesting. If the investment opportunity increases the resources available to existing creditors, there would be no conflict at all.

Because the investment only pays off in U , it is socially optimal to invest if and only if $r/2 \geq F$. Clearly, under a suboptimal debt structure one could either obtain an under-investment problem if existing creditors oppose refinancing because they do not see the upside of a positive NPV, or an over-investment problem if E always raises new (supra-priority) financing because he does not bear the downside of a negative NPV. Thus, to induce efficient re-investment an optimal debt structure

¹⁹In our model, absent new investment opportunities new creditors need not arrive and the analysis of Sections 4.1 and 4.2 still applies, because borrowing does not serve insurance purposes. See Bisin and Rampini (2006) for a model where borrowing from new creditors serves insurance purposes.

²⁰We focus on investment opportunities arising in financial distress because in such state the conflict between existing and new creditors is likely to be more intense, but our analysis easily extends to all states of nature.

must solve two problems. First, it must prevent E from always diluting existing claims by raising additional funds with higher priority. Second, it must induce existing creditors to internalize the upside of efficient re-investment. Of course, the optimal debt structure should combine these new goals with the previous ones of efficient reorganization and ex ante break even. We establish:

Proposition 3 *There exists a threshold $\alpha_I^* \geq \hat{\alpha}_I$ such that, for $\alpha \geq \alpha_I^*$ the first best can be implemented by giving all liquidation and refinancing rights to one large secured creditor. If such creditor allows refinancing for an amount D his claim falls by αD . Such creditor is also pledged all reorganization proceeds and must distribute an amount $S = L - \alpha (\underline{y}_2 + r_{\max} - F)$ of liquidation proceeds to an infinite number of creditors without liquidation or refinancing rights. If $\alpha \in [\hat{\alpha}_I, \alpha_I^*)$, only a second best can be implemented whereby some (or all) positive re-investment opportunities are passed. This outcome can be attained by increasing the debt write-down to the large creditor to $\alpha g(\alpha) D$, where $g(\alpha) \geq 1$ is a decreasing function. For $\alpha < \hat{\alpha}_I$ the optimal debt structure is identical to the one of Proposition 2.*

Even if the firm needs to acquire new creditors to finance investment opportunities, provided investor protection is sufficiently large (i.e. for $\alpha \geq \alpha_I^*$), the first best is attained under a simple debt structure consisting of two classes of secured creditors, of which one is fully concentrated on one large lender who has all control rights, and the other is fully dispersed without control rights. Now the optimal debt structure gives the large secured creditor also the right to allow supra-priority financing, on top of the control rights over the liquidation decision.

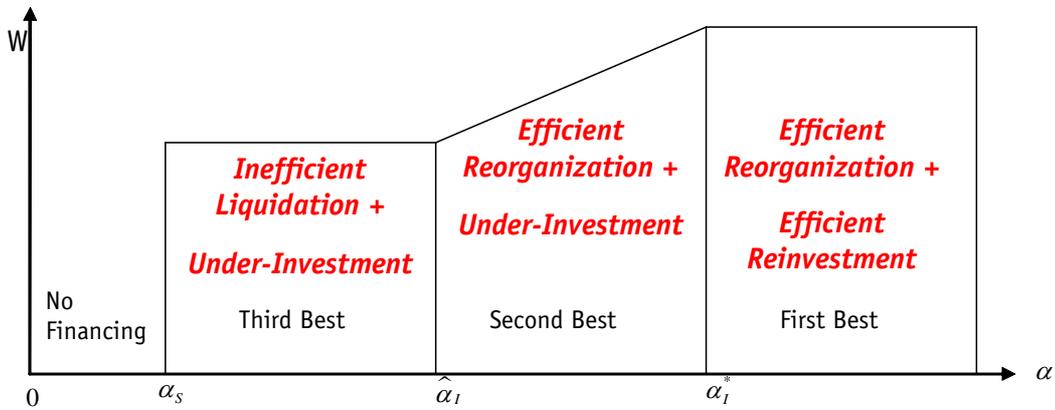
Such an optimal debt structure avoids both under- and over-investment by making the large secured creditor residual claimant to the NPV of the new investment, thereby fostering an efficient re-financing decision. The equity stake in the reorganized firm induces such creditor to see the upside of any positive NPV project, and the debt write-down induces him to bear the downside of any negative NPV project, too, by suitably reducing the claim of such creditor relative to those of other creditors upon refinancing.

Importantly, just like poor investor protection against fraud creates a tension between efficient reorganization and ex ante break even, so it does with respect to new investment opportunities. If investor protection is intermediate (i.e. $\hat{\alpha}_I \leq \alpha < \alpha_I^*$) large re-investment undermines ex ante break even and the first best cannot be attained. In this case the firm, while implementing an efficient reorganization policy, must pass up some positive NPV investment opportunities ex post, the more so the lower is α . The debtor can implement this outcome by increasing the extent to

which new financing reduces the large creditor's repayment to the level $\alpha g(\alpha) D$, which increases as investor protection falls. This feature makes sure that for low levels of α the large creditor finds it profitable to allow new financing if and only if the return on reinvestment is sufficiently large.

If instead investor protection is low (i.e. $\alpha_S \leq \alpha < \hat{\alpha}_I$) to preserve break even E must commit to always liquidate and never refinance upon default. This outcome can be achieved by issuing standard *straight debt* contracts to a number of secured creditors. Figure 3 plots contract choice and welfare as a function of investor protection as in Proposition 3.

Figure 3. Optimal Contracts with Arrival of New Creditors



The figure above confirms our finding that more developed countries (i.e. countries where α is higher) have a comparative advantage at using more flexible debt structures, thereby attaining a more efficient resolution of financial distress. When α is low ($\alpha < \alpha_I^*$), arrival of new creditors seriously undermines the ability of existing ones to obtain repayment. In such cases, the optimal debt structure optimally induces a bias towards under-investment so as to preserve ex ante break even. As a result, our model yields the novel prediction that the under-investment problem in financial distress should be more severe in countries with poor investor protection.

Interestingly, floating charge financing in the U.K. is often held responsible for under-investment in financial distress (e.g. Franks, Nyborg and Torous 1996). Our model suggests two interpretations of these remarks. At one level it could be that, for floating charge financing to work perfectly in practice, investor protection has to be so implausibly high that not even the U.K. level is large enough to allow the refinancing of all profitable firms in financial distress. If this were the case, our results would suggest that under-investment is the necessary cost of attaining ex ante break

even. More subtly but perhaps more realistically, the U.K. courts' ambiguous stance towards supra-priority financing has raised questions regarding its viability (e.g. Davies 1997), and our model suggests that this uncertainty and other limitations to supra-priority financing may directly trigger under-investment. In this respect, our analysis indicates that one simple reform strategy in the U.K. might be to just allow debt structures to combine floating charge with supra-priority financing. Along the lines of our Proposition 3, this reform would unleash the possibility for contracts to induce the floating charge holder to internalize the social benefit of re-investment.²¹ Of course, these are only specific examples of the normative implications of our analysis. The next section develops more general implications for bankruptcy reform.

5 Conclusions

We study the economics of the optimal resolution of financial distress in an ex ante model of contracting. We find that if investor protection is strong the first best can be implemented under a debt structure consisting of two debt classes: one fully concentrated class of secured debt where a large creditor is given the exclusive control right to reorganize or liquidate the firm upon default and the contractual incentives to do so efficiently, and a second, fully dispersed class of secured debt without control rights. If instead investor protection is low, the second best can be implemented with a debt structure dispersing control rights among creditors lending under standard "straight debt" contracts. Our results rationalize in an optimal contracting setup the optimality of floating charge financing and its efficiency at high levels of investor protection.

From the standpoint of bankruptcy reform, one immediate implication of our analysis is that it may be desirable to include a mechanism similar to the floating charge in the bankruptcy code and freely allow the parties to opt for it. Indeed, our analysis, as well as a cursory look at the two leading academic proposals for bankruptcy reform – the use of cash auctions (Baird 1986, Jensen 1989) and the use of options (Bebchuk 1988; AHM 1992) – suggests that floating charge financing may have advantages relative to both proposals. With respect to cash auctions, which rely on financial markets' ability to price a bankrupt firm, floating charge financing gives insiders such as large investors (or even entrepreneurs) the right incentives to reveal their own information truthfully, which may

²¹Of course, to solve these problem one might use a more top down approach, legally reducing the power of the floating charge holder to block reinvestment and restructuring (thereby hurting junior creditors and shareholders) in financial distress. The U.K. Enterprise Act of 2002 is an example of this second type of approach, whose consequences are yet to be fully evaluated.

allow a better estimation of firms' reorganization values than the information possessed by market participants.²² With respect to the use of options, which actually resembles our E -control contract, floating charge financing appears to be less biased towards inefficient liquidation. The reason is that, unlike the AHM proposal that does not focus on two debt classes with different degrees of control and on the potential collusion among them, the two debt classes that characterize floating charge financing facilitate the provision of incentives for efficient reorganization.²³ Of course, we would expect floating charge financing (but also, and for the same reasons, the other proposals) to provide an efficient resolution of financial distress only when investor protection is sufficiently strong. Indeed, our model shows that these flexible debt structures and bankruptcy procedures that focus on rescuing profitable enterprises are only likely to be feasible in more developed countries where investor protection is strong. In emerging economies instead, the resolution of financial distress may need to focus on creditor repayment, even if that means the liquidation of potentially profitable firms. In this sense, our analysis formally illustrates how attempts to export the flexible bankruptcy procedures of developed economies to countries plagued by poor legal infrastructure may result in both ex ante and ex post inefficiencies, consistent with the evidence in Franks and Lóránth (2006) and Lambert-Mogilianski et al. (2006).

A more fundamental implication of our results is that the problems usually associated with creditors' multiplicity, rather than being intrinsic problems of financial distress, are more likely the by-products of the firms' debt structure. Within the traditional, ex post approach to bankruptcy, our analysis thus raises the question, why don't firms around the world always borrow under debt structures such as floating charge financing that can cope with problems of creditors' multiplicity?

To the extent that they don't, our model indicates two possibilities, which have radically dif-

²²The formal intuition is that financial markets, being uninformed, will lend an amount that reflects only the expected not the actual value of the reorganized firm. Thus, insiders will decide to raise money from financial markets and bid if and only if the expected value of the reorganized firm to outsiders exceeds its liquidation value, i.e. iff $\frac{1}{2}\alpha(\bar{y}_2 + \underline{y}_2) \geq L$. If insiders successfully post the bid, then the firm is reorganized even if liquidation is efficient (unless there is ex post renegotiation with creditors). If instead creditor protection is low and insiders cannot post the bid, then the firm is over-liquidated.

²³In particular, the AHM (1992) proposal distributes equity in the bankrupt firm to senior creditors and an option to buy equity to junior creditors or shareholders. After the options have expired, the new shareholders vote on whether to select one of the cash bids or maintain the company as a going concern, either under existing management or under some alternative management team. In the context of our model, this scheme amounts to: 1) giving secured creditors all the equity in the firm and 2) giving unsecured creditors as well as shareholders (or the entrepreneur) the option to post a non-cash bid for the firm. In the aggregate, secured creditors will never accept an offer that is less than L , the liquidation value of the firm. As a result, the firm would be inefficiently liquidated when $\alpha\bar{y}_2 < L$. Our model suggests that one way to avoid this problem is to reduce the value of collateral of secured creditor by the debt write down S . Then, the amount S should be distributed to a new class of creditors (holding neither equity nor options) in such a way as not to affect the reorganization v. liquidation decision.

ferent policy implications. On the one hand, the use of inflexible debt structures may just be due to legal restrictions to floating charge financing. In such a case, the best policy prescription would simply be to lift those restrictions, thereby increasing freedom of contract. On the other hand, the use of inflexible debt structures may be due to low investor protection. In such a case, there could be ways for bankruptcy law to improve upon the pure private contracting outcome, for instance by strengthening investor protection in fraudulent conveyance law. Similarly, if other un-modelled frictions make floating charge costly, bankruptcy law may improve efficiency by selectively curing the failures of floating charge financing.²⁴

Either way, and well beyond our specific model, the most general message of our analysis is perhaps that the benchmark against which bankruptcy procedures should be evaluated is not the ‘war of all against all’ depicted by the traditional approach to bankruptcy, but the much more orderly process implemented by floating charge financing.

²⁴Un-modelled frictions that may potentially create problems to floating charge financing could be, for example, the possibility for the debtor to wastefully delay default, or to enter non-exclusive contracts that the floating charge holder cannot directly monitor, along the lines of Bisin and Rampini (2006). However, since both of these frictions rely on an informational advantage for the borrower, the floating charge has the potential to solve them. Indeed, Appendix A2.2 shows that even if the borrower privately knows the value of the firm, still floating charge financing is well-suited to resolve financial distress efficiently because it can induce E to truthfully reveal his private information to the controlling investor. It is thus a priori unclear why such contract could not be used to give E the incentive to avoid costly delays and to report the evolution of the debt structure to existing investors. A more fruitful way to go is perhaps to consider externalities on third parties, along the lines of Bolton and Rosenthal (2002), such as for example tort creditors. The explicit modelling of these (and other) potential failures of floating charge financing is clearly beyond the scope of our paper, and we leave it to future research.

Appendix 1: Proofs

Proof of Proposition 1. I advances $D \geq K$ to E under a contract specifying a liquidation policy $\lambda(G; p)$ in G , first and second period repayments $d_1(\omega; p)$, $d_2(\omega; p, \lambda)$ and the party $c \in \{E, I\}$ that is in control of the reorganization decision when first period cash flows are equal to zero. Under a given contract, E 's expected profits are equal to:

$$\begin{aligned} & \pi \{y_1 + \lambda(G; 1)L - d_1(G, 1) + [1 - \lambda(G; 1)] [\bar{y}_2 - d_2(G, 1, 0)]\} + \\ & + \frac{(1 - \pi)}{2} \left\{ \begin{aligned} & \lambda(U; 1)L - d_1(U, 1) + [1 - \lambda(U; 1)] [\bar{y}_2 - d_2(U, 1, 0)] + \\ & + \lambda(B; 1)L - d_1(B, 1) + [1 - \lambda(B; 1)] [\underline{y}_2 - d_2(B, 1, 0)] \end{aligned} \right\} \end{aligned}$$

The optimal contract maximizes the above objective function subject to the following constraints. First, feasibility requires $d_1(\omega) \leq \alpha y_1(\omega) + \lambda(\omega)L$, $d_2(\omega) \leq \alpha y_2(\omega)$, $\lambda(\omega) \in \{0, 1\}$. Second, in state G , E must prefer to repay ($p = 1$) than to strategically default ($p = 0$). Because to avoid ex post inefficiencies it must be that $\lambda(G; 1) = 0$, then $d_1(G, 1)$ and $d_2(G, 1, 0)$ must satisfy:

$$y_1 - d_1(G, 1) + \bar{y}_2 - d_2(G, 1, 0) \geq y_1 + \lambda(G; 0)L - d_1(G, 0) + [1 - \lambda(G; 0)] [\bar{y}_2 - d_2(G; 0, 0)].$$

To maximize repayment, E 's payoff following default must be minimized, which requires setting $\lambda(G; 0) = 1$, $d_1(G; 0) = L + \alpha y_1$. This yields $d_1(G, 1) + d_2(G, 1, 0) \leq \alpha y_1 + \bar{y}_2$. Thus, in G no strategic default occurs and I can extract at most $d_1(G) = \alpha y_1 + (1 - \alpha)\bar{y}_2$, $d_2(G) = \alpha \bar{y}_2$. Notice that the contract terms for the state G can be set irrespective of those for U and B .

The third set of constraints of the problem is that for $\omega = U, B$, the equilibrium liquidation policy is chosen by the party in control to maximize his own utility, that is $\lambda(\omega) = \arg \max_{\lambda} \lambda u_c(t = 1, \omega) + (1 - \lambda)u_c(t = 2, \omega)$ where $c = E, I$ is the party in control. Finally, I must break even.

Consider what the last two sets of constraints imply for the optimal contract terms in B and U , starting from the case where I controls liquidation/reorganization. I implements ex post efficiency provided $d_L \equiv d_1(B) \geq d_2(B)$, $d_2(U) \geq d_L$. The repayment-maximizing, feasible schedule satisfying the last two constraints is $d_2(B) = \alpha \underline{y}_2$, $d_2(U) = \alpha \bar{y}_2$, $d_L = L - \max[L - \alpha \bar{y}_2, 0]$. This contract is ex ante feasible and thus implements the first best provided:

$$\pi(\alpha y_1 + \bar{y}_2) + \frac{1 - \pi}{2} \{\alpha \bar{y}_2 + L - \max[L - \alpha \bar{y}_2, 0]\} \geq K. \quad (6)$$

The above condition is certainly satisfied at $\alpha = 1$, but the left-hand side falls in α . Inequality (6) is satisfied also at $\alpha = 0$ provided $\pi\bar{y}_2 \geq K$, otherwise is only satisfied for α sufficiently large. As a result, there exists a threshold $\alpha_I \geq 0$ such that I -control is feasible and yields the first best if and only if $\alpha \geq \alpha_I$.

Consider now the contract where E controls liquidation/reorganization. E implements ex post efficiency provided $L - d_L \geq \underline{y}_2 - d_2(B)$ and $\bar{y}_2 - d_2(U) \geq L - d_L$. This implies that I 's payoff is maximized at $d_2(B) = \alpha\underline{y}_2$, $d_2(U) = \alpha\bar{y}_2$ and $d_L = L - (1 - \alpha)\underline{y}_2$. This contract is ex ante feasible and thus implements the first best provided:

$$\pi(\alpha y_1 + \bar{y}_2) + \frac{1 - \pi}{2} \left\{ \alpha\bar{y}_2 + L - (1 - \alpha)\underline{y}_2 \right\} \geq K. \quad (7)$$

The above condition is certainly satisfied at $\alpha = 1$, but the left-hand side falls in α . Inequality (7) is satisfied also at $\alpha = 0$ provided $\pi\bar{y}_2 + \frac{1 - \pi}{2}(L - \underline{y}_2) \geq K$, otherwise is only satisfied for α sufficiently large. As a result, there exists a threshold $\alpha_E \geq 0$ such that E -control is feasible and yields the first best if and only if $\alpha \geq \alpha_E$.

It is easy to see that, depending on parameter values it can either be $\alpha_E \geq \alpha_I$ or $\alpha_E < \alpha_I$. If $\alpha_E \geq \alpha_I$, then for $\alpha \geq \alpha_I$ the first best can be implemented under I -control and cannot be implemented otherwise. If $\alpha_E < \alpha_I$, then for $\alpha \geq \alpha_I$ the first best can be implemented under I -control, it can be implemented under E -control for $\alpha \in [\alpha_E, \alpha_I)$, and cannot be implemented otherwise.

For $\alpha < \min(\alpha_E, \alpha_I)$, the investor can only break even by sacrificing ex post efficiency and thus by liquidating both in U and B . One way to implement this outcome is to write a contract $\lambda(B) = \lambda(U) = 1$ where I automatically forecloses on E 's assets upon default. In this case, ex ante break even is attained provided

$$\pi(\alpha y_1 + \bar{y}_2) + \frac{1 - \pi}{2} L \geq K. \quad (8)$$

There exists an $\alpha_S \geq 0$ such that the above condition is satisfied for $\alpha \geq \alpha_S$.

Consider now the case with ex post renegotiation. Renegotiation can occur in G after E 's strategic default because at that point the contract stipulates liquidation but liquidation is not ex post efficient. Suppose that E 's has all the bargaining power. Then, if $y_1 + \alpha\bar{y}_2 < L + \alpha y_1$ then E entrepreneur cannot convince I to renegotiate, which implies that E can commit to repay to repay up to $\alpha y_1 + \bar{y}_2$ in G . If instead $y_1 + \alpha\bar{y}_2 \geq L + \alpha y_1$ the entrepreneur cannot commit

to repay more than $L + \alpha y_1$ in G . As a result, when $y_1 + \alpha \bar{y}_2 \geq L + \alpha y_1$ renegotiation reduces repayment to I . Notice that the possibility of renegotiation does not affect repayment in U and B . For $\alpha \geq \min(\alpha_E, \alpha_I)$ renegotiation does not occur because under I -control and E -control ex post efficiency is attained. For $\alpha < \min(\alpha_E, \alpha_I)$ renegotiation could only occur in U when the firm is inefficiently liquidated. However, since in this region $\alpha \bar{y}_2 < L$ the entrepreneur cannot bribe I and thus the contract is not renegotiated. ■

Proof of Lemmata 1 and 2. If the debtor borrows from $N > 1$ creditors under I -control contracts giving each creditor a share $1/N$ of reorganization proceeds and a share $l^*/N = \alpha(\bar{y}_2/L)$ of liquidation proceeds, then an ex post resolution of financial distress is attained, in line with Proposition 1. Lemma 2 immediately follows by noting that the debt write down S needs not be distributed to E but to a second class of creditors holding no liquidation rights. ■

Proof of Proposition 2. For $\alpha < \alpha_S$, the project is not financed. The reason is that creditors' multiplicity cannot increase total repayment above $\alpha y_1 + \bar{y}_2$ in state G and above L in states U and B , and such repayments are the same as those under *straight debt* (in the case with one creditor), which is not feasible if $\alpha < \alpha_S$. Define $\hat{\alpha}_I$ as the level of investor protection at which:

$$\pi(\hat{\alpha}_I y_1 + \bar{y}_2) + (1 - \pi)(\hat{\alpha}_I \bar{y}_2 + L)/2 = K.$$

Thus, $\hat{\alpha}_I$ is the smallest α at which implementing the first best with I -control ensures break even. Then, if $\alpha_S \leq \alpha \leq \hat{\alpha}_I$, only *straight debt* is feasible and break even requires liquidation in both U and B , which in the case of multiple creditors E can accomplish through a variety of debt structures (for example even by fully dispersing control rights). Given that fractional liquidation is allowed, the optimal debt structure might even allow for liquidation of only a fraction $f < 1$, where $\pi(\bar{y}_2 + \alpha y_1) + \frac{1}{2}(1 - \pi)[fL + (1 - f)\alpha(\underline{y}_2 + \bar{y}_2)] = K$. Yet, setting $f < 1$ is only efficient for E if $L < (\bar{y}_2 + \underline{y}_2)/2$, otherwise the welfare gain in U is more than compensated by the loss in B . If $L \geq (\bar{y}_2 + \underline{y}_2)/2$, then $f = 1$ is optimal.

For $\alpha \geq \hat{\alpha}_I$, the first best can be attained by giving control rights to a number N_c of creditors under a contract where each of those creditors is pledged a fraction x_c of reorganization proceeds and a fraction l_c of liquidation proceeds; $l_c \in [x_c \alpha(\underline{y}_2/L), x_c \alpha(\bar{y}_2/L)]$. The remaining cash flows is distributed among a number N_n of debtholders without control rights but entitled to obtain a share x_n of reorganization proceeds and a fraction l_n of liquidation proceeds, where $N_c x_c + N_n x_n = 1$ and $N_c l_c + N_n l_n = 1$. If in equilibrium renegotiation does not occur, this arrangement triggers an ex post

efficient outcome and ensures repayment (4) to creditors, guaranteeing break even. Furthermore, the creditors with control rights cannot credibly threaten E or other creditors to perform some inefficient action so as to extract resources from them.

Given the process of coalition formation, the debt structure N_c, N_n is chosen to minimize the probability that a coalition of creditors (some with and others without control rights over the liquidation decision) forms and triggers an inefficient liquidation in U . For $\alpha\bar{y}_2 \geq L$ all creditors, not only those holding liquidation rights, can be made to benefit from efficient reorganization. As a result, the interesting case arises for $\alpha\bar{y}_2 < L$ as creditors without control rights will necessarily lose from reorganization. Suppose now that a coalition of $(n_c + n_n)$ creditors forms, with $n_c \leq N_c$ and $n_n \leq N_n$. Within such coalition, the creditors without control rights can successfully bribe those with control rights into inefficient liquidation provided:

$$n_n \geq n_c \frac{x_c \alpha (\bar{y}_2 / L) - l_c}{l_n - x_n \alpha (\bar{y}_2 / L)} = n_c v.$$

A.3 implies that, for given (N_c, N_n) , the probability that a coalition of n_n creditors without control rights and of n_c creditors with control rights is a certain function $\Pr(n_n, n_c)$. Thus, the probability that some liquidation occurs equals:

$$\sum_{n_c=1}^{N_c} \sum_{n_n=n_c v}^{N_n} \Pr(n_c, n_n | N_c, N_n)$$

From the above formula and from assumption A.3 it is immediate to see that E minimizes the probability of inefficient liquidation by setting $N_c = 1$, namely by fully concentrating the control rights over the liquidation decision on one creditor. The intuition is that reducing the number of creditors with control rights reduces the probability that any of them is included into a coalition. As a result, the probability of implementing some inefficient liquidation equals:

$$\sum_{n_n=v}^{N_n} \Pr(1, n_n | N_c, N_n)$$

For given n_n , the above expression is minimized by maximizing parameter v via a suitable choice of x_c and l_c . In particular, it is optimal to set $x_c = 1$ and $l_c = \alpha(\underline{y}_2/L)$. Thus, the creditor with control rights must be "large". At the implied level of v , the probability of liquidation equals $\sum_{n_n=N_n k}^{N_n} [N_n! / (N_n - n_n)! n_n!] / 2^{N_n - 1}$, where $k = \frac{\alpha(\bar{y}_2 - \underline{y}_2)}{L - \alpha \underline{y}_2} < 1$ is a positive constant. For

$N_n \rightarrow +\infty$, this tends to $\lim_{N_n \rightarrow \infty} [N_n! / (N_n - N_n k)! N_n k!] / 2^{N_n - 1}$ which, by Stirling's approximation ($\ln n! \approx n \ln n - n$), equals $\lim_{N_n \rightarrow \infty} \exp \{-N_n \ln(1 - k)^{1-k} k^k\} / 2^{N_n - 1} = 0$. As a result, for $N_n \rightarrow +\infty$ the first best is attained. ■

Proof of Proposition 3. Consider first a debt structure implementing the first best allocation for every (r, ω) . By previous arguments, such debt structure still relies on an incentive mechanism and on two classes of debt, except that now also the re-investment decision needs to be allocated among claimholders. Because the large creditor with control rights of Proposition 2 is given a significant equity stake in the firm, he is the natural recipient also of the right to issue supra-priority financing because such equity stake allows him to benefit from re-investment. Call such creditor C and suppose that his lending contract specifies that if he allows supra-priority financing for an amount D , his repayment (both in reorganization and in liquidation) falls by θD . θ thus represents the extent to which the new creditor's claim compete with C 's claim.

At the optimal reorganization policy, C raises new financing (and invests) provided $x\alpha r/2 - \theta D \geq 0$. New financing is raised if and only if investment takes place. At the same time, C finds it profitable to set $D \in \{0, F\}$, where $D = 0$ stands for the case where new financing is not raised. Setting $\theta = x\alpha$ induces C to choose an ex post efficient refinancing (and investment) policy, namely it induces C to raise new financing if and only if $r/2 > F$. We later check whether a debt write-down of $x\alpha F$ is feasible under the optimal debt structure. What about the reorganization decision? C efficiently reorganizes if and only if in liquidation C obtains an amount $L - S$ satisfying, for every r , the conditions:

$$x\alpha \left[\underline{y}_2 + r - FZ(D = F) \right] \leq L - S \leq x\alpha \left[\bar{y}_2 + r - FZ(D = F) \right] \quad (9)$$

where $Z(D = F)$ is an indicator taking value 1 if $D = F$ and 0 otherwise. Because $\underline{y}_2 + r_{\max} < L$, it is always possible to find $L - S$ such that both conditions hold, for example $x\alpha(\underline{y}_2 + r_{\max} - F) = L - S$. Thus, C can be given the incentive to efficiently resolve financial distress. Notice that the debt write-down $x\alpha F$ to C is feasible both in state B and in state U because $r_{\max} > 2F$.

Consider now the optimal debt dispersion. As in Proposition 2, all creditors other than C must be fully dispersed so as to prevent the formation of coalitions against re-investment, and C must be large, which implies $x = 1$, and must have the incentive to efficiently reorganize, i.e. $S = L - \alpha \left(\underline{y}_2 + r_{\max} - F \right)$. Then, both the firm and the re-investment are financed and thus the

first best is attained provided:

$$\pi(\alpha y_1 + \bar{y}_2) + (1 - \pi) \{L/2 + \alpha(\bar{y}_2 + r^*)/2 - [1 - R(2F)]F\} = K. \quad (10)$$

where $r^* = \int_{2F}^{r_{\max}} r dR(r)$ and $[1 - R(2F)]$ is the ex ante probability that supra priority financing is raised in the first best. From condition (10) one can immediately see that there is a threshold α_I^* such that the first best can only be attained if $\alpha < \alpha_I^*$. Because A.4 implies that $\alpha r^*/2 < [1 - R(2F)]F$, the left-hand side of (10) is smaller than the left-hand side of (4). As a result, $\alpha_I^* \geq \hat{\alpha}_I$. For $\alpha \in [\hat{\alpha}_I, \alpha_I^*]$ new supra-priority financing is not allowed (or θ is set sufficiently large) so that the second best is attained with no re-investment but an efficient reorganization decision. In principle, for $\alpha \in [\hat{\alpha}_I, \alpha_I^*]$ some (but not all) profitable investment opportunities can still be undertaken by setting $\theta = g\alpha$ where $g > 1$ and $g \leq r_{\max}/2F$ (for $g \leq r_{\max}/2F$, C never finds it profitable to refinance). In this case, C reinvests whenever $r \geq \hat{r} \equiv gF$ and some profitable investment opportunities are passed – and hence the first best is not attained, – but for sufficiently high r investment takes place. The value of g is set to satisfy:

$$\pi(\alpha y_1 + \bar{y}_2) + (1 - \pi) \{L/2 + \alpha[\bar{y}_2 + r^*(g)]/2 - [1 - R(gF)]F\} = K$$

where $r^*(g) = \int_{gF}^{r_{\max}} r dR(r)$. It is immediate to see that, due to assumption A.4., the optimal g falls in α . As in Proposition 2, if $\alpha_S \leq \alpha \leq \hat{\alpha}_I$ the third best is implemented under *straight debt*.

For $\alpha < \alpha_S$, the project is not financed. ■

Appendix 2: Extensions

A2.1: Uncertain Cash Flows and Liquidation Values. We now show that floating charge financing is an optimal debt structure also when first and second period profits as well as liquidation values are all stochastic and take on a continuum of values. The timing is the same as before. We focus on the case of multiple creditors. As a normative benchmark, consider first the optimal contracting problem faced by the parties if courts have perfect information but still subject to the constraint that a fraction $(1 - \alpha)$ of profits can be seized by managers. In such a case, the debt structure includes a variable $\lambda(y_1, y_2, L)$ stipulating – for each state of nature (y_1, y_2, L) – whether the firm should be liquidated, in which case $\lambda(y_1, y_2, L) = 1$, or continued, in which case $\lambda(y_1, y_2, L) = 0$. With respect to creditor repayment, if in state (y_1, y_2, L) the project is liquidated then creditors are given L in the second period and cannot earn more than αy_1 in the first period. This is because under liquidation E does not earn rents in the second period and thus has no

incentive to repay in the first period as well. If instead in state (y_1, y_2, L) the project is continued, in line with the analysis of state G in Proposition 1, in the two periods creditors either obtain $\alpha y_1 + y_2$ provided $y_1 > y_2$ or $\alpha y_2 + y_1$ provided $y_2 > y_1$. As a result, if courts perfectly observe (y_1, y_2, L) , the optimal contract solves:

$$\begin{aligned} \max_{\lambda(y_1, y_2, L)} & E \{y_1 + \lambda(y_1, y_2, L) L + [1 - \lambda(y_1, y_2, L)] y_2\} \\ \text{s.t.} & E \{\lambda(y_1, y_2, L) (L + \alpha y_1) + [1 - \lambda(y_1, y_2, L)] [(\alpha y_1 + y_2) I(y_1 > y_2) + (\alpha y_2 + y_1) I(y_1 \leq y_2)]\} \geq K \end{aligned} \quad (11)$$

Then, the first order conditions imply that the optimal contract stipulates liquidation in a given state if and only if:

$$\begin{aligned} (L - y_2) + \omega [L - \alpha y_2 - (1 - \alpha) y_1] &> 0 \quad \text{for } y_1 < y_2 \\ (L - y_2) (1 + \omega) &> 0 \quad \text{for } y_1 > y_2 \end{aligned}$$

where ω is the multiplier associated with the investors' break even constraint. If the break even constraint is not binding (i.e. $\omega = 0$), liquidation occurs iff $L > y_2$. If instead the break even constraint is binding and the first period cash flows are low (i.e. $y_1 < y_2$) some ex post inefficient liquidation must occur for investors to break even. For $y_1 < y_2$ the above condition implies that the project must be liquidated iff $L > L^* \equiv \{y_2 + \omega [\alpha y_2 + (1 - \alpha) y_1]\} / (1 + \omega)$. If $\omega > 0$ then $L^* > y_2$, implying that liquidation is sometimes socially inefficient. Although for brevity we do not report a full comparative static analysis, it is straightforward to see that under the optimal contract inefficient liquidation (i.e. liquidation in states where $y_1 < y_2$) is more likely the lower is investor protection α . Once more, the intuition is that if α is lower then the break even constraint becomes more binding, increasing the ex ante benefit of inefficient liquidation.

We now show that the first best efficient outcome can be attained under a debt structure akin to the one we found to be optimal in Section 4. Suppose that all liquidation rights are given to one creditor whose credit is collateralized by a fraction $l(y_1, L)$ of physical assets. The physical collateral of this creditor is allowed to vary with y_1 to allow for debt write-downs, as found optimal in Section 4. Courts can enforce $l(y_1, L)$ because they perfectly observe y_1 and also observe L after liquidation proceeds are collected. The creditor holding liquidation rights is also given a claim to a share $x(y_1, y_2) \leq \alpha$ of reorganization cash flows (thus, a floating charge). The rest of the second period proceeds are paid to the other creditors. Courts can perfectly enforce $x(y_1, y_2)$ because

they can observe reorganization profits once they are realized. Finally, first period repayment can be arbitrarily divided among the floating charge holder and the infinitely many creditors not holding liquidation rights. First period repayment does not directly enter our analysis because, for a given liquidation policy, it is equal to the one prevailing in the previous model where the state of nature is perfectly observed by courts. The only aspect that matters in this new context is the possibility for the debt structure just discussed to implement, under a court that does not observe the reorganization value y_2 ex ante, the perfect information outcome attained in (11) above. It is easy to find that the the creditor holding control rights implements the optimal reorganization policy provided:

$$\begin{aligned} & \text{for any } y_1 > y_2 \text{ it must be that } x(y_1, y_2) \alpha y_2 \geq l(y_1, L) L \text{ iff } L \leq y_2 \\ & \text{for any } y_1 < y_2 \text{ it must be that } x(y_1, y_2) \alpha y_2 \geq l(y_1, L) L \text{ iff } L \leq L^* \end{aligned}$$

The creditor holding control rights can be given the incentive to follow the liquidation rule above by specifying the following contract. The creditor initially claims (y_1, y_2) and then the above liquidation rule is followed. It turns out that the creditor has the incentive to truthfully announce (y_1, y_2) provided his reorganization and liquidation proceeds follow the rule:

$$\begin{aligned} l(y_1, L) &= \underline{l} && \text{for every } y_1, L \\ x(y_1, y_2) &= x = \underline{l}/\alpha && \text{for every } y_1 > y_2 \\ x(y_1, y_2) &= xL^*/y_2 && \text{for every } y_1 < y_2 \end{aligned}$$

The contract then specifies that if the firm is reorganized and y_2 turns out to be different from the value announced by the creditor, the creditor is punished and obtains 0. In that respect, the creditor may only benefit from misreporting the reorganization value if by doing so he obtains more liquidation proceeds. However, liquidation proceeds are constant across possible realizations of y_2 and equal to $l(y_1, L) = \underline{l}$. Finally, it must be the case that $\underline{l} \leq \alpha y_2/L^*$ for every (y_1, y_2) , which ensures that $x(y_1, y_2) \leq 1$. Thus, the optimal liquidation policy can be attained under a floating charge type of contract (complemented by perjury laws on misreporting) provided the creditor has a fixed physical collateral and provided repayment in reorganization to the other creditors make sure that the above sharing rule is implemented. ■

A2.2: E has superior information on y_2 . If only E is informed on y_2 , then the debt structure must induce him to truthfully report it. From the proof of Proposition 1 it is easy to see that

in this case E must obtain an amount $(1 - \alpha)y_2$ of liquidation proceeds. As a result, the initial debt structure provides E with incentives to disclose his superior information by compensating him for the private benefits of control he foresakes. From now on, the analysis is identical to the case where information is perfect, except that now the total amount of resources that can be pledged to creditors under floating charge financing are equal to:

$$\pi(\bar{y}_2 + \alpha y_1) + (1 - \pi) \left[L - (1 - \alpha)y_2 + \alpha\bar{y}_2 \right] / 2.$$

In other words, the ability of an ex ante debt structure to implement the first best is reduced because if E obtains some information rent then total repayment to the other creditors is lower. If α is large enough that the above expression is greater than K , then the debt structure of Proposition 2 yields the first best. Otherwise, *straight debt* must be used and the second best is attained. ■

A2.3: The Cost of Debt Dispersion. Creditors' dispersion may be costly as it may hinder their individual incentives to gather evidence, hire lawyers, etc. so as to void or rescind managerial divertive activities, thereby reducing α , i.e. the share of cash flows that creditors can seize. Assume that if creditor i engages in (unverifiable) legal effort x_i , he prevents E from diverting a share x_i/n of each creditor's repayment. Thus, litigation is a public good: a creditor's successful attempt to monitor the debtor also benefits the other creditors. To exert x_i , creditor i spends a share $(1/2)\delta x_i^2$ of his own repayment. Thus, creditors' expenditures are perfect substitutes in increasing the total share of pledgeable cash flows. This assumption is only made for simplicity and ensures that creditors' incentives do not depend on the value of their claims. Parameter $\delta \geq 0$ characterizes investor protection in this Section. Then, each creditor individually invests $x_i = 1/(\delta n)$, and all creditors obtain the same share $\alpha(n, \delta) = (2n - 1)/2\delta n^2$ of their claim, which also corresponds to the overall share of cash flows the debtor must disgorge. Intuitively, $\alpha(n, \delta)$ falls in n because the moral-hazard-in-team among creditors gets worse. Expression $\alpha(n, \delta)$ can be integrated into the analysis of Section 4. Now enforcement is described by (δ, θ) and the earlier predictions obtained in the (α, θ) space can be formulated in the (δ, θ) space, with the main difference that our model also yields predictions on the number of creditors n . Thus, one can define $n(\delta, \alpha)$ as the maximum number of creditors E can borrow from as a function of repayment share α and creditor protection δ . The larger δ , the larger is the cost of creditors' uncoordination as reflected in a smaller α and, in turn, the smaller is the maximum number of creditors consistent with financing. Thus, higher δ reduces the cost of the multiplicity of creditors and affects the optimal debt structure. ■

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