Predation due to Adverse Selection in Financial Markets*

(July 2003)

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Abstract

An entrant can alleviate adverse selection problems in financial contracting by conditioning its own survival on future assessments made by financial markets. However, an incumbent may then engage in predatory behavior to try to adversely affect these markets' assessments and make exit more likely. We examine optimal financial contracting in the presence of this predatory threat, both when renegotiation is feasible, and when it is not. In contrast to previous literature, a contract that would be suboptimal in the absence of a predatory threat may optimally deter predation, even under competitive capital markets and renegotiation.

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JEL: G32, L12

Keywords: Predation, Long- Purse, Signal-Jamming

1. INTRODUCTION

In a well-known theory of predation (the "long-purse" theory), firms with ample financial resources drive financially constrained entrants out of the market by preying on them until these constraints are violated. In early versions (McGee (1958), Telser (1966)), this theory lacked an explanation for a simple, yet fundamental question: Why do rational investors fail to do something in light of the predatory threat? Why do they not -for instance- simply lift the financial restrictions that render the entrant a vulnerable prey -and the incumbent a willing predator?

Some imperfection in the capital market is needed as a basis for answering these questions. In a seminal paper, Bolton and Scharfstein (1990) considered one such imperfection: they showed that the assumption that a firm's *ex-post* returns are imperfectly observable by outsiders can provide a rigorous rationale for the long-purse theory of predation. Yet, this assumption is sometimes difficult to justify in practice. Alternative assumptions on capital market imperfections exist, which are widely used in the finance literature and which have yielded predictions supported by numerous empirical studies. A careful examination of the implications of such alternatives is needed, particularly when the importance of predation as a policy issue is considered. This paper is a contribution in this direction.

We examine the consequences on predation of outsiders having difficulty in assessing the *ex-ante* prospects of a project, rather than in monitoring its *ex-post* results. Models in which investors are *ex-ante* less informed about a firm than the firm itself have a long tradition in financial economics and have been used to explain a wide variety of corporate behavior, including capital-structure decisions (Ross, 1977; Myers and Majluf, 1984) and dividend policy (Bhattacharya, 1979; Miller and Rock, 1985). In our paper, this capital-market imperfection is at the core of predatory behavior: to mitigate the *ex-ante* informational asymmetry, an entrant may optimally condition its own survival -through the design of its financial liabilities- on future assessments by financial markets. A rival's predatory action aimed at adversely affecting these financial markets' assessments -and making exit more likely- may follow.

Bolton and Scharfstein (1990) showed -in a framework with *ex-post* hidden information- that investors may rationally commit to stop financing a firm if it performs poorly, and that this commitment may induce established rivals to engage in predatory behavior. They showed that when this predatory threat is taken into account, the equilibrium financial contract may, or may not, induce predation. Further work on this model (Faure-Grimaud, 1997; Snyder, 1996) analyzed the consequences of the potential renegotiation of financial contracts. Renegotiation weakens the ability of financial contracts to deter predation, which is then more likely to occur. Snyder (1996) showed that, with competitive capital markets, predation is not deterred in equilibrium unless it is trivial to do so (i.e., the optimal financial contract in the absence of predation trivially deters predation).[1] In this class of models, therefore, financial contracts are strategically distorted to deter predation only if renegotiation is not feasible (Bolton and Scharfstein, 1990) or capital markets are imperfectly competitive (Snyder, 1996).

In this paper we consider *ex-ante* asymmetric information as an alternative imperfection causing the firm's survival to depend on its performance. Assuming competitive capital markets, we examine both cases: with renegotiation and without it.

[1] To gain some insight on why this is so, notice that the benefits of predation for the incumbent firm depend on the sensitivity of the entrant's refinancing decision to the entrant's performance. To dissuade the incumbent from preying, this sensitivity needs to be reduced. But, even in the absence of a predatory threat, this sensitivity is already as small as it can credibly be. Since the project has a positive NPV –and under competitive capital markets the entrepreneur receives this value- the optimal date-zero contract maximizes the probability of refinancing. This probability is 1 if performance is good, and as high as is compatible with the provision of proper incentives, if the performance is bad. One cannot credibly contract a less likely refinancing decision after a good performance because such a contract would not be renegotiation-proof. One cannot raise the likelihood of refinancing after a bad performance either: it is already as high as the incentive problem allows.

Our main results both complement, and show important contrasts with, the *ex-post* hidden information model. It continues to hold that predation may or may not happen: the commonly used assumption that a firm is better informed than investors about its *ex-ante* prospects can also rationalize predation. But, in contrast with existing models, it can also result in the strategic distortion of financial contracts to deter predation even when renegotiation is possible and there are competitive capital markets.

To make the point that adverse selection in capital markets can render an entrant a vulnerable prey, we present in Section 2 a modified version of Diamond (1991, 1993). This model studies optimal financial contracting in a context in which i) the firm has initial private information about its creditworthiness, and ii) future information about this creditworthiness will arrive prior to the maturity of the project, when it can still be shut down. The optimal financial contract makes use of this information to reduce adverse selection. One crucial feature of this contract is that the firm is liquidated after bad news if the information is accurate enough. Good firms prefer this contract because the gains from reduced financing costs -which arise because a bad project yields higher returns to investors being liquidated than being completed- more than outweigh the losses due to (inefficient) liquidation.

In Section 3 we introduce the possibility of predation: the incumbent firm may interfere in the acquisition of information by the investors in the entrant firm. Indeed, as Fudenberg and Tirole (1986) emphasize, predation can take the form of devoting resources to "jam" information, if this encourages a rival's exit. To discourage predation, the sensitivity of the entrant's survival to future news needs to be lower. We show that the entrant typically reduces this sensitivity by raising the likelihood of survival after bad news (a "deep-pocket" contract). This contrasts with Bolton and Scharfstein (1990), in which the predation-deterring contract reduces the likelihood of survival when performance is good (a "shallow -pocket" contract). We examine the trade-offs leading to the decision whether to deter, or to acquiesce to predation, and show that both results are possible.

The analysis in Section 3 is first carried out under the assumption that the parties can commit to the terms of the contract signed at the outset. Yet, as Tirole (1988) and Snyder (1996) have stressed, a contract will not succeed in deterring predation if the incumbent believes that this contract will, in fact, be destroyed later on. We show that this is not the case here, because the predation-deterring contracts derived earlier do survive renegotiation. Furthermore, keeping these contracts in place is, in fact, the only equilibrium of the renegotiation game.

In Section 4 we go back to the setup in Section 2 and address the problem of equilibrium selection for the game as a whole. We show that there is a continuum of pooling equilibria, which includes our previous selection. Yet, within this continuum none survives the Cho-Kreps refinement. We then restrict our focus to contracts that are not allowed to randomize between liquidation and completion of the project. Under this restriction, implicit in Diamond (1991), we show that, in the absence of a predatory threat, the Cho-Kreps refinement selects contracts that liquidate the firm after bad news and let it survive after good news. Moreover, for some parameter values, the presence of this threat causes contracts to be strategically distorted to deter predation.

Our paper is closely related to Bolton and Scharfstein (1990) and Snyder (1996), but they focus on *ex-post* hidden information, while we consider *ex-ante* hidden information. Related literature also includes Fudenberg and Tirole (1986), in which a firm garbles the information received by a rival to encourage its exit. However, in their model there is no asymmetry of information between the firm and its investors, and they do not analyze the optimal response in financial contracting to the threat of predation, as in our paper. In Poitevin (1989), informational asymmetries in financial markets are also at the root of predatory behavior. His model differs from ours in two respects: first, the predatory action does not influence financial markets' beliefs, while it is its sole purpose in our model; second, we consider contracting that is either with renegotiation, or without it, while he looks only at contracting without renegotiation. Also related is Jain, Jeitschko and Mirman (1999), who look at entry deterrence in an adverse selection model. Their focus, however, is on the incumbent's financial contract, while ours is on the entrant's.

2. CONTRACTS IGNORING THE PRODUCT MARKET

This section presents a modified version of Diamond (1991, 1993) to show that adverse selection in financial markets can lead to contracts that condition a firm's survival on its performance. In this model future news will reduce the initial asymmetry of information between a firm and its outside investors at a time when the project can still be shut down. Future news refers to any signal that might be useful in assessing the future profitability of the firm, such as a financial report, the preliminary outcome of a research project, or the existence of large orders. Although this signal may involve actual cash-flows, we abstract from them to focus solely on informational issues. We discuss the effect of including a cash-flow component as part of the information in our conclusions.

A firm, which we identify with the entrant, has access to a project needing an outlay of I. The project's life extends over three periods, t = 0, 1, 2. At t = 0, the firm offers a contract –described below- to raise the amount I in a competitive credit market. This contract, which can be made contingent on future information, is accepted if it provides nonnegative expected returns to investors. At t = 1, information arrives and the project can be liquidated, yielding L

$\leq$ I. At t = 2, if the project has not been liquidated, it will generate cash flows that can be assigned to investors as well as a "control rent"[2] of C that cannot be transferred to them.

There are two types of projects, good and bad. The type of project carried out by a firm is the firm's private information. Good projects return a cash flow of X > I. Bad projects return X with probability π, and 0 otherwise, with $\pi X < L \leq I$. Thus, under symmetric information, bad projects would not obtain financing. On the other hand, even bad projects are worth undertaking if the control rent is taken into account: $\pi X + C > I \geq L$. Outside investors assign the firm a probability f to having a good project. Thus, as of t = 0, there is a probability $q = [f + (1 - f)\pi]$ that the date-two cash flow will be X. News arriving in t = 1 can be good (an upgrade takes place) or bad (a downgrade). Good borrowers receive bad news with probability e and bad borrowers with probability r, e < r. Let f^d (f^u) be the updated probability –according to Bayes' rule- that the firm is good given bad (good) news:

$$f^d = \frac{ef}{fe + (1-f)r}, \qquad f^u = \frac{(1-e)f}{f(1-e) + (1-f)(1-r)}$$

Likewise, denote by q^d (q^u) the conditional probability that date-2 cash flow will be X given bad (good) news.

A contract specifies the repayment schedule –the repayments due under completion and liquidation of the project- and the probability of liquidation, both as a function of the realization of date-one news. Thus, a contract specifies ϕ^s, L^s, and R^s, for s = d, u, where ϕ^s denotes the probability of liquidation, L^s (R^s) the repayment due to investors under liquidation (completion) of the project, and the superscripts indicate whether good (s =u) or bad (s = d) news arrives at t = 1.

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[2] We can think of the control rent as non-pecuniary benefits enjoyed by management if there is no liquidation, such as reputation or the use of the previously acquired human capital. Another example could be, as in Aghion and Bolton (1992), that of a business run by a family whose members attach value to the survival of the business with its initial status. In their model, however, unlike ours, the control rent is random.

We will assume that both interim news and cash flows are verifiable by outsiders, so that our results do not depend on the existence of *ex-post* hidden information.

We concentrate, as Flannery (1986) and Diamond (1991, 1993) do, on the contract preferred by good quality firms among the pooling equilibrium contracts: i. e., we study a situation in which all firms offer the same contract - the one preferred by good quality firms among those able to attract financing[3]. This contract, thus, solves Program A:

Maximize $H(\phi^d, L^d, R^d, \phi^u, L^u, R^u) = e\{(1-\phi^d)(C+X-R^d)+\phi^d(L-L^d)\}+$

$(1-e)\{(1-\phi^u)(C+X-R^u)+\phi^u(L-L^u)\}$

subject to

$[f(1-e)+(1-f)(1-r)]\,[q^u(1-\phi^u)R^u+\phi^u L^u]+$

$[fe+(1-f)r]\,[(1-\phi^d)q^d R^d+\phi^d L^d] \geq I$ (1),

$0 \leq \phi^d \leq 1,\ 0 \leq \phi^u \leq 1$ (2),

$0 \leq R^d \leq X,\ 0 \leq R^u \leq X,$ (3),

$0 \leq L^d \leq L,\ 0 \leq L^u \leq L,$ (4)

Condition (1) is the investor's individual rationality constraint, Condition (2) must hold for ϕ^s to be a probability, and Conditions (3) and (4) are limited-liability constraints.

Notice that, since there is limited liability, the entrant will enter whenever it is able to attract financing -which amounts to the fulfillment of the constraints in Program A. It is easy to see that this will be the case if and only if

$$\mathrm{Max}\,\{qX,\ [f(1-e)+(1-f)(1-r)]\,q^u X+[fe+(1-f)r]\,L\} \geq I \qquad (5)$$

[3] Notice that, since a firm known to be bad does not attract financing, off-equilibrium beliefs establishing that any deviating firm is bad can sustain this equilibrium. The existence of other equilibria is addressed in Section 4.

By solving Program A, we obtain the following proposition -a slight modification of Diamond (1991, 1993)-, which characterizes the optimal contract. (All the proofs are in the Appendix).

Proposition 1. If there is entry, the optimal contract specifies that

i)After good news, the firm survives ($\phi^u = 0$) and repays less than its cash flow ($R^u < X$)

ii) After bad news:

ii.i) The firm retains nothing ($R^d = X$, $L^d = L$), and either

ii.ii) survives ($\phi^d = 0$) if $e > e^*$, or

ii.iii)is liquidated ($\phi^d = 1$) if $e < e^*$,

where $0 < e^* \leq r$.

Furthermore, the expected profits for a good quality entrant decrease in e.

There are two benefits provided by date-one news: i) it reduces expected repayments from good firms by increasing those from bad firms, and ii) it increases the quality of the projects that are allowed to survive to their full completion by liquidating projects that most likely are bad. To take advantage of date-one news, the optimal contract thus exhibits two important features. First, investors' claims are maximum if there is bad news. Good firms accept this burden in exchange for reduced repayments following good news, because they are less likely than bad firms to obtain bad news. Second, if the date-one signal is accurate enough ($e < e^*$), the firm is liquidated after bad news because the gains from reduced financing costs – which arise because a bad project yields higher returns to investors being liquidated than completed- more than outweigh the losses due to (inefficient) liquidation.

3. PREDATORY BEHAVIOR.

3.1 The Threat of Predation.

By making the entrant's liquidation depend on future news, the contract in Proposition 1 may encourage an incumbent firm to devote resources to "jam" such news. We now examine this possibility. Let $e = e^D$ and $r = r^D$ without product-market competition. A measure of the uninformativeness of date-one news is given by[4]

$$d((e^D, r^D), (0, 1)) = |0 - e^D| + |1 - r^D|$$

Thus, $d = 0$ when $e^D = 0$ and $r^D = 1$, in which case the interim information fully reveals the firm's type; while $d = 1$ if $e^D = r^D$: the interim signal is completely uninformative. Suppose that, by incurring a cost $c > 0$, the incumbent can take an action that changes the distribution of the interim signal to (e^A, r^A), so that the signal is less informative[5]:

$$d((e^A, r^A), (0, 1)) \;>\; d((e^D, r^D), (0, 1)) \qquad (6)$$

This predatory action may take a variety of forms, from (secret) price discounts or better purchase conditions, to leakages of misleading information about advances or drawbacks in research and product development.

Two remarks are in order. First, to isolate the informational effects of the predatory action, we abstract from any impact it may have on the entrant's earnings. We examine these additional cash-flow effects in the conclusions. Second, we do not consider situations in which, contrary to assumption (6), the good project's interim signal is more robust to "garbling" than that of the bad type and predation increases the information about the entrant's type. Although assumption (6) is not a general characteristic of predation, it is one that we find convenient to show that certain types of predation may occur as a result of

[4] See Aghion and Bolton (1992)

[5] In a polar case, the predatory firm makes sure -by increasing the appeal of its own product- that its rival's early signal, -say early orders- does not have any chance of being good. Then the signal becomes useless.

adverse selection in financial markets, and that financial contracts may be strategically distorted to prevent predation.

Suppose that the incumbent obtains profits π^m if the entrant exits the market and π^d ($< \pi^m$) otherwise. Then, the incumbent will prey on the entrant if

$$(\phi^d - \phi^u)\,[f\,(e^A - e^D) + (1 - f)(r^A - r^D)][\pi^m - \pi^d] > c \tag{7}$$

We know from Proposition 1 that when $e^D > e^*$, the optimal financial contract that ignores the predatory threat never calls for liquidation: $\phi^d = \phi^u = 0$. Thus, a necessary condition for predation to occur is $e^D < e^*$, in which case $\phi^d = 1$, $\phi^u = 0$ would be set, were predation not an issue. It is then clear from (7) that the contract that bests manages capital-market imperfections maximizes the appeal of predation, just as in Bolton and Scharfstein (1990). Notice also that conditions $(\phi^d - \phi^u) = 1$, (6) and (7) imply that $e^A > e^D$. If an action that reduces the informational content of the interim signal is attractive to the incumbent firm, it necessarily increases e. To simplify the exposition, we will consider that $r^A = r^D$. Thus, we will assume that the sole effect of the incumbent's predatory action is an increase of e, from $e^D < e^*$ to e^A, such that (7) is satisfied when $\phi^d = 1$, $\phi^u = 0$. Therefore, the assumptions concerning the predatory action amount to:

$$\Delta \equiv \frac{c}{f(e^A - e^D)(\pi^m - \pi^d)} < 1 \qquad \text{with} \qquad e^D < e^* \tag{8}$$

When the sensitivity of the liquidation decision to date-one news is above the threshold level Δ, the incumbent firm has incentives to prey. This level depends on the costs for the incumbent to prey (c), the difference in the profits with and without the entrant ($\pi^m - \pi^d$), and the distortion created by the predatory action ($e^A - e^D$). Under condition (8), the optimal sensitivity of the liquidation decision when the predatory threat is ignored ($\phi^d - \phi^u = 1$) is above this threshold level, and thus gives incentives for the incumbent to prey ($\Delta < 1$).

3.2 Optimal Response to the Predatory Threat.

We now analyze the optimal contracting problem when the threat of predation has to be dealt with. Assume contracts are not renegotiable[6]. The optimal financial contract signed at t = 0 chooses $e \in \{e^D, e^A\}$, ϕ^d, L^d, R^d, ϕ^u, L^u and R^u so as to solve Program B:

Max $H(\phi^d, L^d, R^d, \phi^u, L^u, R^u, e)$

s.t. (1), (2), (3), (4), and

$$\begin{aligned} &\phi^d - \phi^u \le \Delta \text{ if } e = e^D \\ &\phi^d - \phi^u \ge \Delta \text{ if } e = e^A \end{aligned} \tag{9}$$

This program is equal to program (A) except for the extra decision variable e and the constraint (9). This constraint specifies that the value chosen for e must be compatible with the incumbent's incentives. To deter predation ($e = e^D$), the entrant must reduce the sensitivity of the liquidation decision to future news ($\phi^d - \phi^u$) to a level no higher than Δ.

Proposition 2. If the entrant chooses to deter predation, the optimal financial contract sets

i) Maximum repayment after bad news ($L^d = L$, $R^d = X$),

ii) a "deep-pocket" contract: $\phi^u = 0$, $\phi^d = \Delta$ if $C + (1-e)\{\dfrac{qX - L}{f(1-e) + (1-f)(1-r)\pi} \geq 0$,

iii) a "shallow-pocket" contract: $\phi^u = 1 - \Delta$, $\phi^d = 1$ otherwise

There are two ways to deter predation, as in Bolton and Scharfstein (1990): liquidate more often after good news (shallow-pocket strategy), or liquidate less often after bad news (deep-pocket strategy). To gain some intuition as to why "deep-pocket" contracts are usually optimal, start from a "shallow-pocket" contract and depart from it by marginally reducing both probabilities of liquidation in exactly the same amount. By doing this, we i)increase the

[6] We will show later that relaxing this assumption does not alter our results.

control rents, ii)leave the incentives to prey unaltered, and iii)increase the *ex-ante* expected revenues from the project if $q X > L$ –if the firm's expected cash-flows as of date zero (and assuming that there is never liquidation) are worth more than the liquidation value of its assets. Since $q X > L$ is the most common situation and a "deep-pocket" strategy has the additional advantage of increasing control rents, it is the usual choice for deterring predation. Yet, there are projects able to attract financing for which the opposite strategy is optimal. These projects have a small chance of being ultimately successful. But, they attract financing because it is known that valuable information will become available at a time when they can still be shut down and a substantial amount of the investment can still be recovered.

As an alternative to deterring predation, the entrant may simply decide to acquiesce to it. According to the following proposition, both results are possible:

Proposition 3 Assume that renegotiation of the contract signed at the outset is not feasible. Then the threat of predation reduces entry. When entry does occur, it may or may not be followed by predation. For each pair (e^D, e^A), $e^D < e^*$, there exists $\Delta^* < 1$ such that the optimal financial contract:

i) deters predation when $\Delta > \Delta^*$, and

ii) induces predation when $\Delta < \Delta^*$

Δ^* satisfies:

$\Delta^* = 0$ if $e^A > e^*$

$\Delta^* > 0$ for $(e^A - e^D)$ sufficiently close to zero.

To gain some insight on this proposition, let us consider two polar cases illustrating that the optimal contract may, or may not, deter predation. Consider first the case in which the predatory action renders the intermediate signal completely uninformative, $e^A = r$. By acquiescing to predation, the entrant would actually have no intermediate information at all. By deterring predation, it, instead, preserves the informational content of the signal. This will be its optimal choice because, even if the contract made liquidation completely insensitive to this signal –which ensures that predation is indeed deterred- the entrant could at least use the signal to reduce cross-subsidization. Optimal contracts take advantage of this possibility to its full extent: they provide nothing to the firm after a bad realization of the signal. Consider now the case in which the predatory action has such a mild impact on the intermediate signal, that it is optimal to acquiesce to predation –notice that, for any $\Delta > 0$, if $(e^A - e^D)$ is small enough, this will be the case. The entrant rationally conjectures that the incumbent will prey. Nevertheless, the signal remains accurate enough to use it in exactly the same manner as when the incumbent does not prey. After good news, the firm survives. After bad news, the firm is entitled to nothing and is liquidated. More generally, there is a trade-off between the effect of predation on the informativeness of date-one news, against the loss of sensitivity in the liquidation decision needed to deter predation, which, in turn, depends on the costs and benefits of predation for the incumbent firm.

3.3 Renegotiation of Financial Contracts

We will now show that the contracts which we found to be optimal without renegotiation do, indeed, survive renegotiation. Moreover, we will show that only they can emerge in equilibrium. We model renegotiation by introducing a take-it-or-leave-it offer by the firm after the release of date-one news, but before the liquidation decision. If the investor accepts, the new contract replaces the old one. Otherwise, the original contract remains in place. We assume that the firm and the investor renegotiate the original contract based on a (rational) conjecture about the predatory behavior of the incumbent firm, but without having observed whether predation actually occurred.

We will concentrate on the case in which $q X > L$, which implies that the optimal way to deter predation –should the firm wish to do this- is via a "deep-pocket" contract. Under this assumption, the contract in place when renegotiation starts shows $\phi^u = 0$ and $R^u < X$ after good news, and either $\phi^d = 1$ and $L^d = L$ (if predation is accepted), or $\phi^d = \Delta$ $L^d = L$ and $R^d = X$ (if predation is deterred) after bad news.

Proposition 4. If there is bad news and the contract $\phi^d = \Delta$, $L^d = L$, $R^d = X$ is in place, it is an equilibrium outcome of the renegotiation game that both firms propose to maintain this contract and the investor accepts. Moreover, if $e \leq e^*$, no other contract is accepted in any pooling or separating equilibrium.

Since the contract with $\phi^d = 1$ and $L^d = L$ is a special case of the contract $\phi^d = \Delta$, $L^d = L$, $R^d = X$ (when $\Delta = 1$), the previous proposition implies that the contract in place after bad news ($s = d$) is renegotiation-proof, irrespective of whether it triggers or deters predation. Moreover, no other contract can emerge as equilibrium, for we will have $e = e^D \leq e^*$ if predation is deterred (by assumption), and $e = e^A \leq e^*$ (from Proposition 3) if it is accepted.

The following proposition establishes the analogous properties for the contracts in place after good news ($s = u$).

Proposition 5. If there is good news and the contract $\phi^u = 0$, $R^u < X$ is in place, it is an equilibrium outcome of the renegotiation game that both firms propose to keep this contract and the investor accepts. No other contract is accepted in any pooling or separating equilibrium.

Let us try to gain some intuition on the results of the renegotiation game. In doing so, keep in mind that liquidation destroys value, since even bad firms are worthy of survival when the control rent is taken into account.

Consider first the contracts in place after good news. The part of the contract dealing with liquidation calls for no liquidation at all ($\phi^d = 0$). Modifying this part of the contract has, therefore, no chance of being mutually advantageous. Given that there is no liquidation, the only unresolved issue is how to divide the cash flow from a surviving project. But, any change in the division initially agreed on would hurt one of the parties.

Consider now the contracts in place after bad news. They do call for some liquidation ($\phi^d > 0$), which implies that there are potential gains from settling on alternative contracts with less liquidation. Indeed, even though, by reducing liquidation, the monetary payoff from a project believed to be bad decreases, its control rent increases, and this gain more than offsets that reduction. Yet, the initial contract assigns none of the monetary payoff from the project to the firm, leaving it unable to compensate the investor for the loss in cash when liquidation is reduced. By rendering the firm illiquid after bad news, the contract ensures that the investor will not be able to benefit from a reduction in liquidation and will, therefore, veto any potentially improving proposal.

4. EQUILIBRIUM SELECTION

We have shown in the previous section that only the contract initially in place can emerge as part of an equilibrium of the renegotiation game. We now go back to the setup in Section 2 and address the issue of equilibrium selection for the game as a whole. Our previous selection was –following Diamond (1991)- the pooling equilibrium preferred by good quality firms. One may wonder whether there are other equilibria, in particular, separating equilibria that might be preferable for these firms. The following proposition answers this question. It refers to the game without predatory threat that corresponds to the setup in Section 2: first, each firm proposes a contract (ϕ^d, L^d, R^d, ϕ^u, L^u, R^u) and, second, the investor accepts or rejects this contract without the presence of an incumbent deciding whether or not to prey.

Proposition 6. In the game without predatory threat there are no separating equilibria, but there is a continuum of pooling equilibria. In one of these equilibria, both firms propose the contract described in Proposition 1 and investors accept the proposal.

It turns out that none of the above equilibria survives the Cho-Kreps refinement. To see why, consider, first, a pooling equilibrium contract in which, after good news, there is some liquidation and not all liquidation proceeds go to investors ($\phi^u > 0$, $L^u < L$)[7]. It can be shown that the good firm is willing to accept a higher increase in L^u than the bad firm (keeping ϕ^u constant) to achieve a marginal reduction in R^u. This means that there exists a defection that differs from the equilibrium contract in that it sets $R^{u'}$, $L^{u'}$ with $R^{u'} < R^u$, $L^{u'} > L^u$ such that the good firm prefers the contract showing $R^{u'}$and $L^{u'}$, if it is accepted, to the equilibrium contract, but the bad firm does not. According to the Cho-Kreps intuitive criterion, we should set at one the probability that the defector is good, which implies that the defection should be accepted if it is close enough to the equilibrium proposal. Thus the good firm, indeed, defects from the equilibrium, which, therefore, does not survive the Cho-Kreps refinement.

Consider now a pooling equilibrium contract in which, after good news, there is either some liquidation with all liquidation proceeds going to investors ($\phi^u > 0$ and $L^u = L$), or there is no liquidation at all ($\phi^u = 0$). It can be shown that the good firm is willing to accept a

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[7] Note that the contract must also exhibit $\phi^u < 1$, for otherwise it would be rejected by the investor.

higher increase in ϕ^u (assuming that all liquidation proceeds go to investors) to achieve a given reduction in R^u. This implies that there exists a defection that differs from the equilibrium contract in that it sets $R^{u'}$ and $\phi^{u'}$ with $\phi^{u'} > \phi^u$, $R^{u'} < R^u$ (and $L^{u'} = L$) that, if accepted, increases the good firm's welfare –and decreases that of the bad firm- relative to the proposed equilibrium. According to the Cho-Kreps criterion, this defection should be viewed as coming from good projects. Given this belief, and given that the equilibrium proposal is accepted, the alternative proposal should also be accepted if ($R^{u'}$, $\phi^{u'}$) is close enough to (R^u, ϕ^u). The good firm does, indeed, deviate to this proposal, which implies, again, that the equilibrium does not survive the Cho-Kreps refinement.

Given that the Cho-Kreps refinement yields such a drastic result when contracts are allowed to set random liquidation schemes, we examine the case in which the financial contract is restricted (as is implicit in Diamond (1991)) to specifying either pure survival, or pure liquidation of the project, after the release of the interim news. It can be easily shown that, again, there are no separating equilibria. But now there are pooling equilibria that do survive the Cho-Kreps refinement.

Consider first the model without predatory threat (the setup in Section 2). The following proposition tells us that only (pooling) equilibria in which the project is liquidated after bad news and completed after good news can survive the Cho-Kreps refinement. One equilibrium that does survive such refinement is the one in which all liquidation proceeds go to investors and the investor breaks even.

Proposition 7. If in the game without predatory threat the liquidation decision ϕ^s is restricted to be in the set {0, 1} and the intermediate signal without predation is accurate enough (e is small enough), then: i) there exists an equilibrium that satisfies the intuitive criterion of Cho and Kreps, and ii) all equilibria that satisfy such a criterion exhibit both firms proposing $\phi^d = 1$ and $\phi^u = 0$.

The following proposition deals with the case in which there is predatory threat (the setup in Section 3). It tells us that, under such threat and for some parameter values, the Cho-Kreps refinement chooses pooling equilibria in which the firm is never liquidated.

Proposition 8. If in the game with predatory threat the liquidation decision ϕ^s is restricted to be in the set {0, 1} and the intermediate signal is accurate enough in the absence of predation (e^D is small enough), there are parameter values such that i) there exists an equilibrium that satisfies the intuitive criterion of Cho and Kreps, and ii) all equilibria that satisfy such a criterion exhibit both firms proposing $\phi^d = \phi^u = 0$.

Propositions 7 and 8 taken together show the possibility that the threat of predation changes the financial contract selected by the Cho-Kreps criterion from one exhibiting vulnerability to predation, namely, liquidation after bad news and survival after good news, to one showing survival no matter the nature of the interim news. Thus, the financial contract is strategically distorted to deter predation. This time, however, the set of equilibria is (meaningfully) reduced by requiring the financial contract to specify either pure survival or pure liquidation of the project after the release of the interim news.

CONCLUDING REMARKS.

In this paper we have examined optimal financial contracting in a model in which adverse selection in financial markets causes an entrant's survival to depend on future information, and an incumbent firm may prey on the entrant to adversely affect this information. We now look at: i) the assumption concerning the relationship between the interim signal (which we identify with future information), cash flows, and the predatory action, and ii) the implementation of the optimal contract through a mixture of short-term and long-term debt.

We have assumed that the interim signal involves no cash flows, and that the predatory action has no consequences on the entrant's earnings. Suppose, instead, that the interim signal takes the form of a date-one cash flow, which, for simplicity, can be either positive (good news) or zero (bad news). Provided that the date-one cash flow is low relative to the initial investment and to the final cash flow, the results are extended as follows: the date-one cash flow should be completely repaid to investors, for this reduces cross-subsidization. On the other hand, it becomes more likely that a financial contract that deters predation is optimal since, by deterring predation, a firm not only preserves the accuracy of the interim signal, but it also prevents the reduction of the returns from the project.

There is a variety of ways to implement the optimal contract in each situation. Consider, for instance, a framework where the firm can issue short-term debt that matures after news is released, but before the project is finished, and long-term debt that comes due at the completion of the project (as in Diamond (1991, 1993)). Since short-term debt matures before the project yields cash flows, it has to be refinanced. Failure to do so results in liquidation of the project. It can be easily shown that, under some simplifying assumptions, the optimal contract can be implemented by pure short-term debt in the absence of a predatory threat and by a mixture of short-term and long-term debt in its presence. Thus, in this context, the strategic distortion of the firm's financial liabilities takes the form of a replacement of (some) short-term debt by long-term debt.

APPENDIX

Proof of Proposition 1

At an optimum, (1) holds with equality. Otherwise, we could decrease either R^d or L^d, still satisfy this constraint, and improve the objective function. Solve then for R^u in (1), when it holds with equality, as a function of R^d, L^d, L^u, ϕ^d and ϕ^u. Let $\underline{R}^u$ be the resulting function.

Define $V(\phi^d, L^d, R^d, \phi^u, L^u, e) = H(\phi^d, L^d, R^d, \phi^u, L^u, \underline{R}^u, e)$

To solve program A, we can then ignore (1) and maximize V instead of H. $R^d = X$ is part of an optimal contract, since

$$\frac{\partial V}{\partial R^d} = (1-\phi^d)\{\frac{\pi(1-f)(r-e)}{(1-e)f+\pi(1-f)(1-r)}\}$$

has the same sign as $(r - e) > 0$. Also, $L^d = L$, since

$$\frac{\partial V}{\partial L^d} = \phi^d\{\frac{(1-f)(r(1-e)-e(1-r)\pi)}{(1-e)f+\pi(1-f)(1-r)}\}$$

and $r > e$ implies that the term in brackets is positive. ϕ^u is optimally set equal to zero (and thus L^u is irrelevant), as

$$\frac{\partial V}{\partial \phi^u} = \frac{(1-e)\{-q^u(X+C)+(1-q^u)L^u+q^uL\}}{q^u} < \frac{(1-e)(L-q^u(X+C))}{q^u} < 0,$$

for $q^u X > L$ is a necessary condition for the project to attract financing.

The derivative with respect to ϕ^d is

$$\frac{\partial V(\phi^d, L, X, 0, L, e)}{\partial \phi^d} = \frac{(1-e)\{fe+(1-f)r\}}{f(1-e)+(1-f)(1-r)\pi}\{L-q^dX-f^d\frac{f^u+(1-f^u)\pi}{f^u}C\}$$

Notice that this derivative has the same sign as the last bracketed term. This term decreases in e, has a maximum of $L - \pi X > 0$ at $e = 0$ and a minimum of $L - q(X + C)$ at $e = r$. Let e^* be such that the term in brackets is zero if $L - q(X + C) < 0$ and $e^* = r$ otherwise.

Finally, expected rents for good quality firms decrease in e, since

$$\frac{\partial V(\phi^d, L, X, 0, L, e)}{\partial e} = \frac{f(1-e)\phi^d (L - X - C) + (1-f)(1-r)\pi(R^u - X - \phi^d C)}{f(1-e) + (1-f)(1-r)\pi} < 0$$

Proof of Proposition 2.

Given that the good quality firm chooses $e = e^D$, it faces the problem

Max $V(\phi^d, L^d, R^d, \phi^u, L^u, e^D)$ s.t. (1), (2), (3), (4), and

$$\phi^d - \phi^u \leq \Delta \tag{A1}$$

Note that $R^d = X$, $L^d = L^u = L$ continue to be part of an optimal contract, as in Proposition 1, because these variables do no enter into the no-predation constraint (A1). This constraint is binding because, from Proposition 1, ignoring it leads to $\phi^d = 1$ and $\phi^u = 0$, thus violating it. Since a marginal increase in ϕ^d (ϕ^u) raises the left hand-side of NP by one (minus one), the optimal contract will exhibit $\phi^d = \Delta$, $\phi^u = 0$ iff

$$-\frac{\partial V(\phi^d L, X, \phi^u, L, e^D)}{\partial \phi^u} \geq \frac{\partial V(\phi^d L, X, \phi^u, L, e^D)}{\partial \phi^d}$$

which, after some algebra, amounts to $C + (1-e)\{\frac{qX - L}{f(1-e) + (1-f)(1-r)\pi} \geq 0$.

Proof of Proposition 3.

The value of the objective function when predation is deterred is:

$V(\phi^d, L^d, R^d, \phi^u, L^u, e) = V(\Delta, L, X, 0, L, e^D)$ if a "deep-pocket" contract is used , and

$V(\phi^d, L^d, R^d, \phi^u, L^u, e) = V(1, L, X, 1\text{-}\Delta, L, e^D)$ if a "shallow-pocket" contract is used.

The entrant can also structure its financing so as to accommodate predation ($e = e^A$) and obtain

Max $V(\phi^d, L^d, R^d, \phi^u, L^u, e^A)$ s.t. (1), (2), (3), (4), and

$$\phi^d - \phi^u \geq \Delta \tag{A2}$$

Again, $R^d = X$, $L^d = L^u = L$ are optimal because they do not enter into (A2). $\phi^u = 0$ also continues to be optimal because the objective function decreases in ϕ^u and a reduction in it relaxes the constraint.

Now, if $\frac{\partial V(\phi^d L, X, 0, L, e^A)}{\partial \phi^d} < 0$, which is equivalent to $e^A > e^*$, the restriction $\phi^d - \phi^u \geq \Delta$ is binding, $\phi^d = \Delta$ is optimal, and all the variables in the objective function, except for e, take the same values as when predation is deterred with a "deep-pocket" contract. Since $e^A > e^D$ replaces e^D and V decreases in e, predation is deterred: $\Delta^* = 0$ when $e^A > e^*$.

If, on the other hand, the entrant wants to accommodate predation when $e^A < e^*$, it will optimally do so by setting $\phi^d = 1$. The restriction $\phi^d - \phi^u \geq \Delta$ will not bind and the value of the objective function will be

$$V(1, L, X, 0, L, e^A) = (1 - e^A)\{X - \frac{I - (fe^A + (1-f)r)L}{f(1-e^A) + (1-f)(1-r)\pi}\}$$

We compare acceptance with deterrance of predation when $e^A < e^*$ by means of the following three steps

*i)*For $\Delta < 1$ and e^A sufficiently close to e^D, the entrant acquiesces to predation. To see that the entrant does not deter predation using a "deep-pocket" contract, notice that, if $e < e^*$, then $V(\phi^d, L, X, 0, L, e)$ increases in ϕ^d and, thus, $V(\phi^d, L, X, 0, L, e) < V(1, L, X, 0, L, e)$ for all $\phi^d < 1$. This implies that $V(\Delta, L, X, 0, L, e^D) < V(1, L, X, 0, L, e^A)$ as e^A converges to e^D (which, given a fixed value $\Delta = \frac{c}{f(e^A - e^D)(\pi^m - \pi^d)}$, implies that $c/f\,(\pi^m - \pi^d)$ converges to zero). Thus, the entrant prefers accommodation over deterrence with a "deep pocket" contract. By a similar argument, the entrant does not deter predation using a "shallow-pocket" contract either: $V(1, L, X, \phi^u, L, e) < V(1, L, X, 0, L, e)$ for all $\phi^u > 0$.

ii) As Δ approaches 1, predation is deterred, for then both $V(\Delta, L, X, 0, L, e^D)$ and $V(1, L, X, 1\text{-}\Delta, L, e^D)$ converge to $V(1, L, X, 0, L, e^D) > V(1, L, X, 0, L, e^A)$, where the inequality holds because $V(1, L, X, 0, L, e)$ is decreasing in e and $e^D < e^A$.

iii) Both $V(\Delta, L, X, 0, L, e^D)$ and $V(1, L, X, 1\text{-}\Delta, L, e^D)$ increase in Δ, while $V(1, L, X, 0, L, e^A)$ does not depend on Δ.

Notice finally that (i-iii) imply the existence of the threshold level Δ^* above which predation is deterred.

Proof of Proposition 4.

Suppose that the contract $\phi^d = \Delta$, $L^d = L$, $R^d = X$ is in place. We now prove that it is a (pooling) equilibrium for each firm to propose to keep this contract and for the investor to accept this proposal and to reject any other proposal under the off-equilibrium belief that a deviating firm proposing $\phi^{de} < \Delta$ ($\phi^{de} > \Delta$) is bad (good).

a)Conditional on the belief that a deviating firm proposing $\phi^{de} < \Delta$ is bad, the investor optimally rejects such proposal, since it would otherwise get

$$\phi^{de} L^{de} + (1 - \phi^{de}) \pi R^{de} \leq \phi^{de} L + (1 - \phi^{de}) \pi X < \Delta L + (1 - \Delta) \pi X$$

where the last inequality follows from $\phi^{de} < \Delta$ and $\pi X < L$.

b)Conditional on the belief that a deviating firm proposing $\phi^{de} > \Delta$ is good, the optimal investor response it to reject this proposal because, by accepting, the investor would get

$$\phi^{de} L^{de} + (1 - \phi^{de}) R^{de} \leq \phi^{de} L + (1 - \phi^{de}) X < \Delta L + (1 - \Delta) X$$

where the last inequality follows from $\phi^{de} > \Delta$ and $L < X$.

c) It is transparent that under any beliefs a deviating firm proposing $\phi^{de} = \Delta$ with $(L^{de}, R^{de}) \neq (L, X)$ will have its proposal rejected.

Let us now see that no other contract is accepted in any pooling or separating equilibrium when $e \leq e^*$ and there is bad news.

Suppose that there is a pooling equilibrium in which each firm proposes (ϕ^p, L^p, R^p) and the investor accepts. From Bayes' rule, the investor should set at f^d (the prior belief following bad news) the probability that a firm proposing (ϕ^p, L^p, R^p) is good.

Consider first the case $\phi^p < \Delta$. Then the investor's acceptance decision is not optimal, since

$$\phi^p L^p + (1 - \phi^p) q^d R^p \leq \phi^p L + (1 - \phi^p) q^d X < \Delta L + (1 - \Delta) q^d X$$

where the last inequality follows from $\phi^p < \Delta$ and $L > q^d X$.

Consider now the case $\phi^p > \Delta$. Then the bad firm defects from equilibrium to choose the initial contract (Δ, L, X) and get $(1 - \Delta) C$ instead of its equilibrium utility

$$\phi^p L + (1 - \phi^p) [C + \pi X] - [\phi^p L^p + (1 - \phi^p) \pi R^p] \leq$$

$$\phi^p L + (1 - \phi^p) [C + \pi X] - [\Delta L + (1 - \Delta) \pi X] <$$

$$\Delta L + (1 - \Delta) [C + \pi X] - [\Delta L + (1 - \Delta) \pi X] = (1 - \Delta) C$$

where the first inequality follows (after some algebra) from the fact that the investor accepts the pooling equilibrium contract and the second one from $\phi^p > \Delta$ and $L < C + \pi X$.

Suppose now that there is a separating equilibrium where the bad firm proposes the contract (ϕ^b, L^b, R^b), the good firm the contract $(\phi^g, L^g, R^g) \neq (\phi^b, L^b, R^b)$ and the investor accepts. Since each firm chooses a different contract, the investor will be able to distinguish among them in equilibrium.

We now show that the contract proposed by the bad firm must be $(\phi^b, L^b, R^b) = (\Delta, L, X)$. To see this, notice first that $\phi^b \geq \Delta$, for otherwise the investor's expected profits under the initial contract, $\Delta L + (1 - \Delta) \pi X$, would be greater than under the bad firm's proposal, $[\phi^b L^b + (1 - \phi^b) \pi R^b]$, since $L > \pi X$. Next, notice that $\phi^b \leq \Delta$. Otherwise –as simple algebra shows- either the investor or the bad firm would be worse-off under the bad firm's proposal than under the initial contract, because $L < C + \pi X$. Given that $\phi^b = \Delta$, any contract not exhibiting $R^b = X$, $L^b = L$ would be rejected by the investor.

Similarly, the good firm must also propose the initial contract, $(\phi^g, L^g, R^g) = (\Delta, L, X)$, contradicting the fact that we have a separating equilibrium. This follows from three facts. First, $\phi^g \leq \Delta$, for otherwise the investor's expected profits under the initial contract, $\Delta L + (1 - \Delta) X$, would be greater than under the bad firm's proposal, $[\phi^g L^g + (1 - \phi^g) R^g]$, since $L < X$. Second, $\phi^g \geq \Delta$, for otherwise the bad firm's expected profits under the good firm's proposal –which are at least $(1 - \phi^g) C$ – would be greater than under its own proposal $(1 - \Delta) C$. Third, given that $\phi^g = \Delta$, any contract not exhibiting $R^g = X$, $L^g = L$ would be rejected by the investor.

Proof of Proposition 5.

Suppose that a contract $\phi^u = 0$, $R^u < X$ is in place. It is a (pooling) equilibrium for each firm to propose to keep this contact and for the investor to accept this proposal under the off-equilibrium belief that any deviating firm is good. Conditional on this belief, a bad firm will not defect from equilibrium because it would obtain

$$\phi^{de}(L - L^{de}) + (1 - \phi^{de}) [C + \pi(X - R^{de})] = \phi^{de}L + (1 - \phi^{de})(C + \pi X) – \{\phi^{de} L^{de} + (1 - \phi^{de}) \pi R^{de}\}$$
$$\leq \phi^{de}L + (1 - \phi^{de}) (C + \pi X) - \pi R^u < C + \pi X - \pi R^u$$

where the first inequality follows from the equilibrium contract being accepted and the second one from $L < C + \pi X$.

A good firm will not defect either because it would obtain

$$\phi^{de}L + (1 - \phi^{de}) (C + X) – \{\phi^{de} L^{de} + (1 - \phi^{de}) R^{de}\} \leq \phi^{de}L + (1 - \phi^{de}) (C + X) - R^s < C + X - R^s$$

where the first inequality follows from the equilibrium contract being accepted and the second one from $L < C + X$.

We now show uniqueness. First, we show that there cannot be a (pooling) equilibrium in which each firm proposes the same contract (ϕ^p, L^p, R^p) with $\phi^p > 0$ and the investor accepts. To see this, suppose the contrary. Note that the investor should set at f^u (the prior belief after good news) the probability that a firm proposing (ϕ^p, L^p, R^p) is good.

The bad firm defects from equilibrium to choose the initial contract $\phi^u = 0$, R^u, since

$$\phi^p L + (1 - \phi^p)(C + \pi X) - \{ \phi^p L^p + (1 - \phi^p) \pi R^p \} \leq$$

$$\phi^p L + (1 - \phi^p)(C + \pi X) - \pi R^u < C + \pi (X - R^u)$$

where the first inequality follows (after some algebra) from the equilibrium contract being accepted by the investor and the second one from $\phi^p > 0$ and $L < C + \pi X$. Notice also that any contract with $\phi^p = 0$ different from the original contract will either be rejected by the investor or not attractive to the firm.

Next, we show that there cannot be a separating equilibrium. To see this suppose, contrary to our claim, that there is a separating equilibrium in which the good firm proposes (ϕ^g, L^g, R^g) and the bad firm proposes $(\phi^b, L^b, R^b) \neq (\phi^g, L^g, R^g)$. Since each firm chooses a different contract, the investor will be able to distinguish among them in equilibrium. Notice now that the bad firm must propose the initial contract, $\phi^b = 0$, $R^b = R^u$. Indeed, it must be $\phi^b = 0$, for otherwise –as simple algebra shows- either the investor or the bad firm would be worse-off under the bad firm's proposal than under the initial contract, since $L < C + \pi X$. Given $\phi^b = 0$, it must be $R^b = R^u$, for otherwise either the bad firm or the investor would prefer the original contract. A similar argument leads us to conclude that $\phi^g = 0$, $R^g = R^u$, contradicting that there is a separating equilibrium.

Proof of Proposition 6.

We first show that it is a (pooling) equilibrium for each firm to propose a contract that provides the investor with expected profits of at least I, and for the investor to accept this proposal and to reject any other proposal, under the off-equilibrium beliefs that any deviating firm is bad. Given these beliefs, the investor's expected profits from accepting any proposal different from the equilibrium proposal are no higher than $\pi X < L$ if the project is completed and no higher than $L \leq I$ otherwise. Thus, the proposal is rejected. Since both types of firm get positive expected utility from the equilibrium contract, no one has incentives to shift to the alternative proposal.

We now show that there are no separating equilibria. Suppose the contrary. Consider first the bad firm's equilibrium contract. Associated to this contract is the belief that the project is bad for sure, and it is thus rejected. Consider now the good firm's contract. Given the belief that attached to this contract is a good project, some positive probability of completion must be specified. By switching to the good firm's proposal, however, the bad firm gets at least the control rent C with some positive probability. A contradiction.

Proof of Proposition 7

i)We first prove that a pooling equilibrium with $\phi^d = \phi^u = 0$ does not survive the Cho-Kreps refinement if e is small enough.

Consider first the case in which the equilibrium shows $R^d < X$. Since the good firm is less likely than the bad firm to get a downgrade ($e < r$), it is also willing to accept a higher increase in R^d to achieve a given reduction in R^u. Thus, there exists a defection that differs from the equilibrium proposal in that it sets $R^{d'}$, $R^{u'}$, with $R^{d'} > R^d$, $R^{u'} < R^u$ that, if accepted, reduces (increases) the bad (good) firm's welfare, relative to the equilibrium level. (A rejection of the proposal reduces the firm's expected utility, whatever its type). According to the Cho-Kreps intuitive criterion, we should set at one the probability that the defector is good, which implies that the defection should be accepted provided it is close to the equilibrium proposal. Therefore, a pooling equilibrium with $\phi^d = \phi^u = 0$ and $R^d < X$ does not survive the Cho-Kreps refinement.

Consider now the case in which the pooling equilibrium shows $R^d = X$. Consider a defection showing $\phi^{d'}=1$, $L^{d'} = L$, $\phi^{u'} = 0$ and $R^{u'} = R^u - \frac{eC}{(1-e)}$ - ε. It is easily checked that this defection, if accepted, will reduce (increase) the bad (good) firm's welfare, relative to the equilibrium contract, for ε positive and small. According to the Cho-Kreps intuitive criterion, we should set at one the probability that the defector is good. Conditional on this belief, simple algebra shows that the investor's optimal response is to accept the proposal if e is small enough. Under this condition, the equilibrium does not survive the Cho-Kreps refinement.

ii) Notice now that there cannot be a pooling equilibrium with $\phi^u=1$ if $e < e^*$, since it would provide the investor with expected revenues lower than I.

iii) Consider now a pooling equilibrium in which each firm proposes the contract $\phi^u=0$, $\phi^d=1$, $L^d = L$ and R^u such that the investor breaks even, and the investor accepts this proposal and rejects any other proposal under the off-equilibrium beliefs that any deviating firm is bad. We now show that this equilibrium satisfies the Cho-Kreps intuitive criterion. There are two types of defections. Consider first a defection that, if accepted, increases the bad firm's welfare. For this type of defection, the Cho-Kreps criterion allows us to set at one the probability that the defector is bad. Conditional on this belief, the proposal is rejected. Consider now a defection that, even if accepted by the investor, reduces the bad firm's welfare, relative to the equilibrium level. It is easily checked that this defection will also reduce the good firm's expected utility and will, therefore, never take place (provided that e is small enough if the defection shows $\phi^{u'} = 1$ and $\phi^{d'} = 0$).

Proof of Proposition 8

We now have that the value of $e \in \{ e^D , e^A \}$ is determined according to the following:

If $\phi^d - \phi^u < \Delta$, the incumbent does not prey: $e = e^D < e^A \leq r$

If $\phi^d - \phi^u > \Delta$, the incumbent preys, $e = e^A \leq r$

i) We will first show that a pooling equilibrium showing $\phi^d = 1$, $\phi^u = 0$ (and thus $e = e^A$) is ruled out by the Cho-Kreps criterion for the particular case in which $e^A = r$, e^D is small enough, and $(1 - r)\,\pi$ is above a threshold level smaller than one.

i.i)If $L^d < L$, consider the defection showing $\phi^{d'} = 1$, $\phi^{u'} = 0$, $L^{d'} = L$ and

$R^{u'} = R^u - \frac{r[L - L^d]}{(1-r)}$ - ε. As is easily checked, this defection, if accepted, will increase (reduce) the good (bad) firm's welfare, relative to the equilibrium contract, for ε positive and small. Thus, according to the Cho-Kreps criterion, the investor should set at one the probability that the defecting firm is good. Simple algebra shows that this implies that the proposal is accepted and, therefore, the equilibrium does not survive the Cho-Kreps refinement.

i.ii) If $L^d = L$, take the defection showing $\phi^{d'} = \phi^{u'} = 0$, $R^{d'} = X$ and

$R^{u'} = \frac{(C+X)(r-e^D) + R^u(1-r) + e^D C}{(1-e^D)}$ - ε. It is easy to see that (for ε positive and small) this defection, if accepted, will increase the good firm's welfare and, provided that e^D is small enough and $(1-r)\pi > \frac{C}{C+X-R^u}$, reduce that of the bad firm. Then, the investor should believe, according to the Cho-Kreps criterion, that the defection comes from a good type of firm and –as simple algebra shows –should therefore accept it.

ii)We now show that a pooling equilibrium with $\phi^d = \phi^u = 0$ and $R^d = X$ does satisfy the Cho-Kreps criterion if $e^A = r$, e^D is small enough and π is high enough. Consider first a defection that does not reduce the bad firm's expected utility, relative to the equilibrium contract. According to the Cho-Kreps criterion, we can set at one the probability that the defector is bad, which implies that the proposal is rejected. Consider now a defection that reduces the bad firm's expected utility. It is easy to check that, if $e^A = r$, e^D is small enough and π is sufficiently close to one, this defection will also reduce the good firm's expected utility and will, therefore, never take place.

ACKNOWLEDGEMENTS

I am grateful to Bruno Biais, Terry Bohn, Eneas Caldiño, Miguel A. García-Cestona, Javier Suárez, and Jean Tirole for valuable insights. I also acknowledge useful comments from seminar audiences at Madrid, Barcelona and Toulousse and, especially, the support and hospitality of the Departmament d'Economia de la Empresa, Universitat Autonoma de Barcelona, where I was visiting while part of this research was done. Suggestions by Tore Ellingsen (the editor) and an anonymous referee helped to improve the paper substantially. Any remaining errors are, of course, my own.

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